Indigenous food of Uttarakhand: A bridge between health and heritage

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Abstract

Uttarakhand, a Himalayan state of India, is endowed with unique agro-climatic conditions that support exceptional crop diversity. The region is a natural repository of traditional cereals, millets, coarse grains, green leafy vegetables, pulses, and a wide range of seasonal fruits and vegetables. These locally available agri-products form the foundation of Uttarakhand's traditional cuisine, which is rich not only in macronutrients and micronutrients but also in bioactive compounds with significant medicinal and therapeutic properties. Such indigenous foods plays vital role in preventing lifestyle diseases, boost immunity, supporting overall well-being. According to NFHS-5 (2019–21), Uttarakhand has shown a positive decline in child stunting by more than six percentage points compared to NFHS-4, suggesting that sustained reliance on traditional, nutrient-dense foods may have contributed to improved nutrition outcomes. However, rapid modernisation, urbanisation, and exposure to global food trends have caused a shift away from culinary heritage. Inclination towards western culture and ultra-processed food habits, often due to inadequate awareness regarding nutritional, ecological, and cultural value of their traditional foods. This transition poses a risk to both nutritional security and the preservation of cultural heritage. The present review aims to explore the rich traditional cuisine of Uttarakhand and highlight its health benefits, with special emphasis on millets, coarse grains, uncommon seeds, indigenous fruits and vegetables, and native pulses, which act as powerhouses of essential nutrients and are critical for achieving long-term food and nutritional security in the present study. The review also focus on the of traditional food knowledge systems such as eating according to season and time, the choice of foods suitable for the cold Himalayan climate, culinary practices followed during festivals, rituals, and agricultural cycles. These food traditions not only support physiological health but also strengthen social cohesion, as traditional dishes often serve as a medium for community bonding, celebrations, and intergenerational knowledge transfer.

Keywords: Cuisine, Uttarakhand, Millets, Therapeutic value, Traditional food knowledge, Food and nutritional security, Indigenous foods, Functional foods, Himalayan biodiversity

1. Introduction

Uttarakhand is the 27th state of India, carved out of Uttar Pradesh on 9 November 2000. Situated in the western Himalayan region, it is often called the 'Land of Gods' (Devbhoomi)" due to its rich spiritual heritage, as well as its extraordinary natural beauty. The state is divided into two principal administrative and cultural regions: the Garhwal region (comprising the seven districts of Haridwar, Dehradun, Tehri Garhwal, Rudraprayag, Chamoli, Uttarkashi' Pauri Garhwal) and the Kumaon region (comprising the six districts of Nainital, Bageshwar, Pithoragarh Champawat, Almora, and Udham Singh Nagar) (Kala & Nautiyal, 2023) [13].

Agriculture is the backbone of Uttarakhand's rural economy. According to Ministry of Agriculture and Farmers Welfare data (2023), Uttarakhand had over 181,000 hectares under fruit cultivation and approximately 99,000 hectares under vegetable cultivation in FY 2022–23. The hilly terrain and diverse agro-climatic zones make the state one of India's most biologically rich regions in terms of crop diversity, supporting the cultivation of wheat, rice, maize, multiple millet species (finger millet, foxtail millet barnyard millet, and amaranth), pulses (soybean, black soybean, horse gram, peas, urad, and various rajma varieties), vegetables, wild herbs, flowers such as rhododendron, and fruits including amla, apple, and citrus varieties (Kala & Nautiyal, 2023) [13].

Both the Garhwal and Kumaon regions share a rich cultural and culinary heritage, though several dishes are known by different names in each region. Traditional cuisine in Uttarakhand has evolved in harmony with the local ecology, climate, and cultural traditions. Dishes are prepared and consumed in accordance with the season, weather, and occasion, reflecting a sophisticated traditional knowledge system. For example, horse gram (gahat), being heat-producing in nature, is consumed predominantly during the winter months (Malik *et al*., 2025) [16]. Similarly, dishes prepared from finger millet (mandua) such as roti, badi, and kafuli are integral to winter diets to keep the body warm, while special foods such as cholai laddu, til ke laddu, arshe, rottana, rot, urad dal pakode, and gulgule are reserved for festivals and ceremonies such as marriages, births, and religious recitations (Gupta & Harti, 2025) [11].

Dwivedi *et al*., (2024) [6] documented that the northwestern Himalayan region, spanning Uttarakhand and Himachal Pradesh, is home to ethnically diverse communities including

the Garhwali, Kumaoni, Bhotiya, and Jaunsari whose centuries-old indigenous food knowledge, grounded in an intimate understanding of local flora, is central to meeting their dietary and therapeutic needs. These local varieties of leafy vegetables, tubers, ferns, legumes, and millet, consumed fresh, sun-dried, pickled, or fermented constitute a unique functional food system rich in health-promoting bioactive molecules (Dwivedi *et al*., 2024) [6].

The traditional dietary pattern of the people of Uttarakhand reflects both cultural practices and local food availability (Kala & Nautiyal, 2023) [13]. Breakfast typically includes chapati accompanied by vegetables, curd, chutney, or stuffed roti. Lunch generally consists of boiled rice or jhangora (barnyard millet) served with traditional preparations such as kafuli, chainsoo, and phanu (Gupta & Harti, 2025) [11]. Dinner is usually a light meal of chapati with vegetables. It is also a widely held traditional belief that mattha (buttermilk) should not be consumed after sunset, reflecting an embedded understanding of digestive and circadian rhythms (Kala & Nautiyal, 2023) [13].

Despite the demonstrable nutritional and therapeutic value of these traditional foods, rapidly changing food habits driven by urbanisation, migration, and the influence of global fast-food culture are eroding these practices. This investigation was undertaken to document and highlight the nutritional potential of traditional food crops, millets, and indigenous cuisine of Uttarakhand, and to underscore their relevance to food and nutritional security in the region.

2. Review of literature

Kala and Nautiyal (2023) [13], in their comprehensive study, documented 38 traditional cuisines of Uttarakhand. They emphasised that with integration of cultural groups through globalisation and outside forces, abundant traditional foods developed by indigenous communities are either lost or on the verge of extinction. The study highlights the critical need to document and revive these traditional food knowledge systems for ensuring socio-cultural and ecological sustainability. Ojha *et al*., (2022) [20] conducted a study among 445 marginal hill community of central Himalayan to explore food medicine interface, through dietary recall and diversity scores showed that the community had rich indigenous food in their diet, they often used herbal medicinal plant found in the remote hilly location thus this concluded that the community has rich dietary and diversity which is indicator nutritional security. Dwivedi *et al*., (2024) [6], systematically documented Nutraceutical foods from the northwestern Himalayan region encompassing Uttarakhand and Himachal Pradesh. The study highlighted that the diversity of local flora leafy vegetables, millet varieties, tubers, legumes, and ferns forms the basis of a unique functional food tradition. They documented the use of locally produced fermented beverages by tribal groups, all of which possess probiotic properties beneficial to gut health. The paper also reviewed the importance of indigenous soy-based fermented products and their bioactive compounds against obesity, diabetes, and cardiovascular disease. Gupta and Harti (2025) [11], in an exploratory study published in the Journal of Ayurveda, documented the traditional foods and beverages of Uttarakhand, describing in detail preparations such as manduwa roti, jhangora bhat and kheer, bhatt ki chutkani (black soybean curry), chainsoo (black gram curry), phanu (horse gram curry), kandali saag (nettle leaf soup), moola thaichwani (mountain radish), butwa (goat organ meat), gulthiya, arshe, and traditional chutneys made from hemp seed (bhangeera), perilla seed (bhanjeer), sesame seed (til), rhododendron squash (buransh sarbat), and badi. Bhatt (2024) [1], documented lesser-known traditional cuisines of Uttarakhand including lal bhat (red rice), nettle soup, jholi, phanu, chainsoo, kafuli, thechwani, rot, badi, bhatt ki chatney, jhangora kheer, urad pakoda, and Kumaoni raita and explored their potential in promoting culinary tourism. The study highlighted that the documentation and promotion of these traditional cuisines can contribute to both nutritional security and regional economic development. Singh *et al*., (2025) [24] provided an overview of the traditional foods of Uttarakhand and their functional importance, emphasising the antioxidant potential, anti-inflammatory properties, and bioactive compound content of traditional cereals, millets, vegetables, and spices used in Uttarakhand's cuisine. The review underscored the importance of preserving traditional food systems for achieving long-term health and nutritional security.

3. Traditional cuisines of Uttarakhand

The traditional cuisine of Uttarakhand is characterised by its use of locally grown, minimally processed ingredients, traditional cooking techniques such as slow-cooking, roasting, and grinding, and an intuitive understanding of the therapeutic properties of food. The following section documents the key traditional preparations of the region.

3.1 Grain-Based Preparations

Manduwa Roti (Finger Millet Flatbread)

Manduwa roti is a flatbread prepared from finger millet (ragi, Eleusine coracana) flour. It is among the most commonly consumed traditional preparations in both Garhwal and Kumaon regions, particularly in winter. Ragi flour is kneaded with water and rolled into flat breads that are cooked on a hot griddle (tawa) and typically served with ghee, vegetable preparations, or pulses. It has calcium rich content (344 mg/100 g) properties and demonstrated its anti-diabetic and antioxidant properties, manduwa roti is regarded as a super food and it have important health value (Devi *et al*., 2014) [4].

Jhangora Bhat (Barnyard Millet Rice)

Jhangora bhat refers to cooked barnyard millet (Echinochloa frumentacea) and is a staple grain preparation in Uttarakhand. Jhangora is also used to prepare the traditional sweet dish jhangora kheer (millet pudding). It is an exceptionally rich source of dietary fibre (10.1 g/100 g), iron (15 mg/100 g), and protein (6.2 g/100 g), with a low carbohydrate content and a low glycaemic index, making it particularly beneficial for the person suffering from cardiovascular and diabetes health issues. (Dayakar Rao *et al*., 2017) [3].

Gahat ki Roti (Stuffed Horse Gram Bread)

Gahat ki roti is a stuffed flatbread (parantha) prepared by soaking horse gram (Macrotyloma uniflorum) later boiled and grinded into a paste and seasoning with basic spices. The prepared mixture is filled inside rolled dough, which is then shallow fried in oil or ghee. It is a highly nutritious preparation, given that horse gram contains 21.73 g/100 g of protein and is rich in minerals including calcium (287 mg/100 g), iron (7.02 mg/100 g), and potassium (1,065 mg/100 g) (Malik *et al*., 2025) [16].

Chholya Roti / Lagdi

Chholya roti (also known as lagdi) is a sweet flatbread prepared from wheat flour, jaggery, water, and ghee. It is prepared during festivals and auspicious occasions and reflects the traditional practice of using natural sweeteners rather than refined sugar.

3.2 Pulse-based preparations

Bhatt ki Chutkani (Black Soybean Curry)

Bhatt ki chutkani is a signature dish of the Kumaon region, prepared from black soybean (Glycine Max). The soybeans are soaked overnight and cooked in a gravy of onion, garlic, tomato, and spices. Black soybean is nutritionally exceptional, containing 41-44% protein, 27-30% dietary fibre, and significant quantities of bioactive compounds including isoflavones and anthocyanins. Research has demonstrated its anti-hyper glycaemic, anti-inflammatory, anti-cancer, anti-obesity,and neuroprotective effects (Li *et al*., 2024) [15].

Urad Chainsoo (Black Gram Curry)

Urad chainsoo is a traditional curry of the Garhwal region, prepared by dry-roasting black gram (Vigna Mungo), grinding it into a powder, and cooking it in hot oil with garlic, cumin seeds, black pepper, asafoetida, and spices for 30–40 minutes. The roasting process enhances bioavailability of nutrients and decrease anti-nutritional factors, making the preparation both highly digestible and nutritious.

Gahat Phanu (Horse Gram Curry)

Gahat phanu is prepared from horse gram soaked in water for 4-6 hours, ground into a paste, and cooked in a paste of hot oil and spices. Horse gram (gahat) has been documented to have exceptional Malik *et al*.,(2025) [16] found that Gahat is anti-hypertensive, anti-diabetic, antioxidant, anti-inflammatory, analgesic, anti-peptic ulcer, anti-cholelithiasis, antimicrobial, anti-obesity, and hepatoprotective properties. Its high resistant starch content also plays vital role as a prebiotic (Malik *et al*.,(2025)) [16].

Rasbhat

Rasbhat is a popular traditional dish of the Kumaon region. A mixed pulse preparation (ras) is made by cooking local legumes including black soybean, horse gram, and urad together. It is either served as a thick soup or with boiled rice (bhat). This multi-legume preparation provides a complementary amino acid profile and a rich array of minerals, making it a highly nutritious meal.

Rajma Dal

Uttarakhand is renowned for its cultivation of several locally distinct varieties of rajma (kidney beans, Phaseolus vulgaris), grown in its hilly terrain. Celebrated local varieties include those from Harshil, Joshimath, Chakrata, and Munsyari. Pahadi rajma varieties are smaller in size but are known for their rich flavour, high protein content, and dense nutritional profile compared to commercially cultivated varieties.

3.3 Vegetable and wild green preparations

Kandali Saag (Nettle Leaf Curry)

Kandali saag is a green curry prepared from fresh leaves of kandali or sisuan (stinging nettle, Urtica dioica). Fresh nettle leaves are washed, briefly roasted over a flame, boiled for 20 minutes, and the excess water drained. The boiled leaves are ground into a paste and cooked in hot oil with garlic and asafoetida, with rice flour optionally added as a thickening agent. Sahal *et al*.,(2025) [23]documented nettle as a novel food rich in magnesium, calcium, zinc, and iron; containing palmitic acid, linoleic acid, vitamins A, B, K, and C; and being an rich source of phenolic and bioactive compounds including chlorophyll, carotenoids, lutein, beta-carotene, and essential amino acids. In Ayurvedic tradition, it is used to improve gut health, treat arthritis, and manage rheumatism.

Moola Thaichwani (Ground Mountain Radish)

Moola thaichwani is prepared by crushing mountain radish on a grinding stone and cooking it with hot oil, ginger, garlic, and spices (Gupta *et al*., 2025) [11]. Rashakrishna M & Baskaran K (2026) postulated that Mountain radish is rich in glucosinolates and other phytochemicals that confer anti-inflammatory and anti-carcinogenic characteristics.

Linguda Sabzi and Achar (Fiddlehead Fern)

Linguda (fiddlehead fern) is a wild vegetable that grows in moist, cool areas of Uttarakhand. It is consumed as a vegetable preparation and also preserved as pickle (achar) to enable its consumption over extended periods. Due to the presence high antioxidant, omega 3 fatty acids and vitamin A and C content these ferns are regarded as a valuable wild food resource in traditional hill communities.

Kafuli

Kafuli is a thick green curry traditionally prepared from a combination of green leafy vegetables commonly fenugreek, spinach, and other locally available greens cooked with rice paste (as a thickener) and seasoned with spices and ghee. It is a quintessential winter dish, highly valued for its warming properties and rich micronutrient content.

3.4 Preserved and fermented foods

Badi (Sun-Dried Pulse Dumplings)

Different varieties of badi are prepared in Uttarakhand using moong dal, colocasia stem (pindalu), ash gourd (petha), mountain radish, and pahadi cucumber. After shaping into small dumplings, the badi are sun-dried and stored for up to a

year. Badi serves as a valuable preserved substitute for pulses and provides a concentrated source of protein and minerals throughout periods when fresh vegetables and pulses are unavailable. Fermentation and sun-drying enhance digestibility and nutrient bioavailability (Dwivedi *et al*., 2024) [6].

Manjholi / Chutkani-Butkwani

Manjholi (or chutkani-butkwani) is a traditional soup or thin curry prepared from a mixture of the water drained from boiled rice, combined with curd and spices such as cumin seeds, chilli powder, salt, and asafoetida. It is a simple, easily digestible preparation that aids gut health and digestion.

3.5 Ritual and festival foods

Rot

Rot is a sweet preparation made from wheat flour, jaggery, and ghee. It is traditionally prepared during puja (worship) and religious recitations dedicated to the deities of Uttarakhand. The use of jaggery as a natural sweetener rather than refined sugar reflects the health-conscious character of traditional cuisine.

Arshe (Arsey)

Arshe are sweet rice flour and jaggery cakes traditionally prepared for festivals and ceremonies in the Uttarakhand. They can preserve for a long time without any artificial preservatives earlier times this sweet dish was used for travelling.

3.6 Traditional chutneys and condiments

Bhangeera chutney (Hemp seed chutney)

Bhangeera chutney is prepared from roasted hemp seeds (Cannabis sativa) ground with spices and served as a condiment. The nutrient evaluation of Hemp seeds (28 g) proved that it contains 161 kcal, 9.2 g protein, 12.3 g fat, 2.8 g fibre, 300 mg magnesium, and 5 mg zinc, along with all essential fatty acids, including omega-6 fatty acids. Hemp seed is beneficial for maintaining hormonal balance, controlling inflammation, and improving digestive, skin, hair, and nail health (Chauhan, 2020) [2].

Bhanjeer chutney (Perilla seed chutney)

Bhanjeer chutney is prepared from roasted perilla seeds (Perilla frutescens, locally called bhangjeera or chiaunjeer) ground with tomato, onion, and spices. Perilla seed oil is remarkably rich in alpha-linolenic acid (ALA) which constitute 54-65% of total fatty acids, making it one of the highest plant-based omega-3 sources. Research published in Heliyon (2024) identifies perilla seeds as rich in omega-3 fatty acids, dietary fibre, amino acids, vitamins, and minerals, with demonstrated antioxidant, antidiabetic, anti-obesity, cardioprotective, neuroprotective, antimicrobial, anticancer, and anti-inflammatory effects (Kaur et.al., 2024) [14]. A further review in Molecules (2024) confirmed perilla seed oil's contribution to antioxidant, anti-inflammatory, lipid-lowering, hypoglycaemic, neuroprotective, and immunomodulatory activities (Guan *et al*., 2024) [10].

Til ki chutney (Sesame seed chutney)

Til ki chutney is prepared from roasted sesame seeds (Sesamum indicum) ground with spices. Til is excellent source of sesamin and sesamolin (lignans), calcium, magnesium, iron, and polyunsaturated fatty acids, with well-documented antioxidant and anti-inflammatory properties.

4. Nutritional properties and health potentials of indegenous food crop

The traditional cuisine of Uttarakhand are not merely local dietary staples; they are nutritional powerhouses whose health benefits are increasingly validated by modern science. The following section presents the nutritive composition and documented health potentials of key ingredients.

Table 1

Food Item	Key Nutrients (per 100 g)	Documented Health Benefits
Finger Millet (Ragi)	Protein 7.3 g, Fibre 3.6 g, Ca 344 mg, Fe 3.9 mg, Zn 2.8 mg, P 283 mg	Anti-diabetic, antioxidant, anti-cancer, cholesterol-lowering; prevents anaemia and osteoporosis
Barnyard Millet (*Jhangora*)	Protein 6.2 g, Fibre 10.1 g, Ca 20 mg, Fe 15 mg, P 293 mg, Zn 0.4 mg	Controls blood sugar and body fat; beneficial for diabetes and cardiovascular disease
Horse Gram *(Gahat)*	Protein 21.73 g, Ca 287 mg, Fe 7.02 mg, K 1065 mg, P 290 mg, Mg 152 mg	Anti-hypertensive, anti-inflammatory, anti-diabetic, hepatoprotective, diuretic, prebiotic
Black Soybean (*Bhatt*)	Protein 41–44%, Fibre 27–30%, Riboflavin 202.9 µg, Vit C 16–17.5 nmol, Vit E 66–100 µg	Anti-inflammatory, anti-cancer anti-obesity, anti-diabetic, neuroprotective; rich in isoflavones and anthocyanins
Nettle (*Kandali/Sisuan*)	Mg, Ca, Zn, Fe, Vit A, B, C, K; Chlorophyll, carotenoids, lutein, beta-carotene	Improves gut health, treats arthritis and rheumatism; manages eczema and uterine haemorrhage
Hemp Seed (*Bhangeera*)	Protein 9.2 g, Fat 12.3 g, Mg 300 mg, P 405 mg, Zn 5 mg, Fe 3.9 mg, Vit E 15.4 mg	Hormonal balance, anti-inflammatory, improves digestive/skin/hair health; reduces obesity and blood pressure
Perilla Seed (*Bhanjeer*)	ALA 54–65% of fatty acids, rich in fibre, amino acids, vitamins, minerals	Antioxidant, antidiabetic, anti-obesity, cardioprotective, anticancer, neuroprotective, immunomodulatory
Colocasia (*Pindalu/Gaderi*)	High carbohydrate, good source of K, Ca, Fe	Antioxidant, anti-inflammatory, antihyperglycaemic, anticancer
Red Rice (*Lal Bhat*)	Protein, minerals, fibre, vitamins; phenolic compounds and anthocyanins	Prevents diabetes, cancer, liver disorders; supports brain function and digestive health

***Source*:** Finger millet — Devi *et al*. (2014) [4], J Food Sci Technol; Barnyard millet — Dayakar Rao *et al*. (2017) [3], ICAR–IIMR; Horse gram — Malik *et al*. (2025) [16], Asian J Dairy Food Res; Black soybean — Li *et al*. (2024) [15], Food Frontiers; Nettle — Sahal *et al*. (2025) [23], Food Chem X; Hemp seed — Chauhan (2020) [2], Pharma Innov J; Perilla seed — Kaur *et al*. (2024) [14], Heliyon; Guan *et al*. (2024) [10], Molecules; Colocasia — Nigussie (2025) [18], Innovation; Red rice — Patel & Singh (2023) [21], Pharma Innov J.

4.1 Finger millet (*Eleusine coracana - Mandua / Ragi*)

Finger millet is a nutritious pseudocereal that has been valued for its health benefits for generations. It provides approximately 7.3 g of protein and 3.6 g of dietary fibre per 100 g, making it a substantial source of essential nutrients. One of its most notable features is its exceptionally high calcium content (344 mg/100 g) far exceeding that of rice or wheat making it particularly beneficial for bone health and the prevention of osteoporosis. In addition, ragi supplies important minerals such as iron (3.9 mg/100 g), zinc (2.8 mg/100 g), and phosphorus (283 mg/100 g), along with B-complex vitamins including thiamine, niacin, and riboflavin (Devi *et al*., 2014) [4]. Finger millet has a lower glycaemic response attributable to its high fibre content, which helps regulate blood sugar and maintain gut health. It is also rich in polyphenols, flavonoids, and dietary fibre and demonstrates antioxidant, anti-diabetic, anti-cancer, and cholesterol-lowering properties (Devi *et al*., 2014) [4].At the national level, recognition of the nutritional importance of millets has been growing. India was a primary proponent of the United Nations General Assembly's declaration in the year 2023 [12] and declared as the International Year of Millets (FAO. 2023) [12]. ICAR data indicate that Uttarakhand has a significant area under small millets, second only to Madhya Pradesh and Chhattisgarh (ICAR, 2023) [12]. The Government of India's declaration of 2018 as the National Year of Millets reflected a broader policy commitment to reviving millet cultivation and consumption to support nutritional security in rain-fed regions (Ministry of Agriculture and Family welfare2018).

4.2 Barnyard Millet (*Echinochloa frumentacea -Jhangora*)

Barnyard millet is among the most nutritionally rich of the small millets, containing protein (6.2 g/100 g), fibre (10.1 g/100 g), iron (15 mg/100 g), phosphorus (293 mg/100 g), thiamine (0.33 mg/100 g), and niacin (4.2 mg/100 g). It is a good source of linoleic, palmitic, and oleic fatty acids. The resistant starch content of barnyard millet helps to control blood sugar and lipid levels in the body, making it particularly beneficial for persons with diabetes and cardiovascular disease (Dayakar Rao *et al*., 2017) [3]. Barnyard mill*et al*so provides approximately 25% fewer calories than rice when consumed as a grain, making it an important food for weight management.

4.3 Nettle (Urtica dioica - *Kandali / Sisuan*)

Stinging nettle has been described by Sahal *et al*., (2025) [23] in Food Chemistry X as a novel food with exceptional nutritional and phytochemical potential. It contains high concentrations of magnesium, calcium, zinc, and iron, as well as dietary fibre. Its fatty acid profile includes palmitic acid and linoleic acid. Nettle is also rich in vitamins A, B, K, and C, along with chlorophyll, carotenoids, lutein, beta-carotene, and a full spectrum of essential amino acids (isoleucine, leucine, phenylalanine, valine, methionine, threonine, tryptophan, and lysine,). Nettle is an rich source of phenolic and bioactive compounds with antioxidant activity. As per Ayurvedic tradition, it is useful for improving gut health, arthritis, and rheumatism, and has been applied in the management of nosebleeds, eczema, uterine haemorrhage, and urinary retention (Sahal *et al*., 2025) [23].

4.4 Horse Gram (Macrotyloma uniflorum -*Gahat*)

Gahat is an indigenous legume of Uttarakhand that contains a high amount of non-digestible carbohydrates (45–54 g/100 g) that release glucose gradually, making it particularly effective in managing diabetes. It has high protein content (21.73 g/100 g) and resistant starch, which acts as a prebiotic. Horse gram provides substantial quantities of calcium (287 mg/100 g), iron (7.02 mg/100 g), magnesium (152 mg/100 g), phosphorus (290 mg/100 g), and potassium (1,065 mg/100 g) (Malik *et al*., 2025) [16]. It has documented anti-hypertensive, anti-diabetic, antioxidant, anti-inflammatory, anti-hyper-cholesterolaemic, anti-peptic ulcer, anti-histamine, anti-cholelithiasis, antimicrobial, anti-obesity, analgesic, diuretic, haemolytic, and hepatoprotective properties.

4.5 Black Soybean (Glycine max - *Bhatt*)

Black soybean is classified as a superfood by Li *et al*., (2024) [15] in a systematic review published in Food Frontiers. It contains an exceptional protein content of 41.38-44.32%, along with carbohydrates (32.80%), dietary fibre (27.61-30.47%), lipids (10.37-18.56%), riboflavin (202.9 µg/100 g), vitamin C (16.0-17.5 nmol/100 g), and vitamin E (66.13-100.76 µg/100 g). All essential amino acids are present in sufficient amounts, along with saturated and polyunsaturated fatty acids beneficial to cardiovascular health. The high complex carbohydrate content (polysaccharides and oligosaccharides) supports gut health, and its capacity to bind water and oil helps prevent cholesterol and lipid accumulation. Bioactive compounds including isoflavones, anthocyanins, and hypolipidemic agents boosts anti-inflammatory, anti-diabetic, anti-obesity, anti-cancer, and neuroprotective effects (Li *et al*., 2024) [15].

4.6 Hemp Seed (Cannabis sativa - *Bhangeera*)

Hemp seeds are among the most nutritionally complete plant foods available in the Himalayan region. A serving of 28 g provides 161 kcal, 3.3 g carbohydrate, 9.2 g protein, 12.3 g fat, 2.8 g fibre, 300 mg magnesium, 405 mg phosphorus, 5 mg zinc, 3.9 mg iron, and 15.4 mg vitamin E. Hemp seed contains all essential fatty acids and is naturally excellent in essential omega-6 fatty acids. It is used in traditional medicine and food to maintain hormonal balance, support smooth muscle function, regulate body temperature, control inflammation, prevent high blood pressure, and improve the health of hair, skin, and nails (Chauhan, 2020) [2].

4.7 Perilla Seed (Perilla frutescens - *Bhanjeer / Bhangjeera*)

Perilla seed (*bhanjeer or bhangjeera)* is one of the most nutritionally significant indigenous seed foods of the Uttarakhand hills. A comprehensive review published in Heliyon (2024) identifies it as an oilseed crop rich in omega-

3 fatty acids (particularly alpha-linolenic acid at 54–65% of total fatty acids), dietary fibre, amino acids, vitamins, and minerals. Perilla seed oil is among the richest plant-based sources of omega-3 ALA, and over 90% of its fatty acids are unsaturated. Documented biological activities include antioxidant, antimicrobial, antidiabetic, anti-obesity, cardioprotective, anti-inflammatory, neuroprotective, and anticancer effects (Kaur *et al*., 2024) [14]. A further review confirmed perilla seed oil's antioxidant, anti-inflammatory, lipid-lowering, hypoglycaemic, neuroprotective, and immunomodulatory activities, along with its ability to increase the abundance of beneficial gut microbiota (Guan *et al*., 2024) [10].

4.8 Colocasia (Colocasia esculenta - *Arbi / Gaderi / Pindalu*)

Colocasia is an important root vegetable in Uttarakhand, consumed as both a vegetable and in the preparation of *badi*. It contains high carbohydrate content as starch, but low fat and protein, and is a good source of potassium, calcium, and iron. Due to its bioactive compounds, colocasia has multiple documented health benefits including anticancer, antihyperglycaemic, anti-inflammatory, anticancer, antioxidant activities (Nigussie, 2025) [18].

4.9 Red rice (*Lal Bhat*)

Red rice varieties, traditionally cultivated in certain areas of Uttarakhand, have high nutritional and health value. They are plentiful in vitamins, minerals, protein, fibre, and powerful antioxidants including phenolic compounds and anthocyanins. These compositions have been demonstrated to help prevent urolithiasis, cancer, liver disorders, diabetes, and to support brain function and digestive health. Red rice also helps prevent vitamin A deficiency (Patel & Singh, 2023) [21].

5. Nutritional status of Uttarakhand and relevance of traditional foods

Government health surveillance data from the National Family Health Survey (NFHS-5, 2019-21), launched by the department of Ministry of Health & Family Welfare, Government of India, provide important context for understanding the nutritional relevance of traditional foods in Uttarakhand.

Uttarakhand is among the few states that recorded a substantial decline in child stunting between NFHS-4 (2015-16) and NFHS-5 (2019-21), with a reduction of more than six percentage points one of the largest improvements among all Indian states (Government of India, NFHS-5, 2021). In relation to severe acute malnutrition (SAM), districts such as Tehri Garhwal and Uttarkashi recorded significant reductions: Tehri Garhwal declined from 28.1% to 5.2%, and Uttarkashi from 23.6% in NFHS-4 to considerably lower levels in NFHS-5, two of the largest reductions observed across all Indian districts (PMC, 2022).

However, challenges persist. NFHS-5 data indicate that anaemia prevalence among women increased by 30.9% in Uttarakhand between NFHS-4 and NFHS-5 one of the highest increases nationally. Overweight and obesity among women in Uttarakhand have also risen sharply, from 20.4% in NFHS-4 to 29.7% in NFHS-5 (Dutta *et al*., 2024) [5]. Coverage of vitamin A supplementation in Uttarakhand was 53.7% in NFHS-5, indicating a need for improved delivery of micronutrient interventions (NFHS-5, 2021).

These trends underscore the dual nutritional challenge faced by the state persistent undernutrition in certain districts alongside rising overweight and lifestyle-related conditions in urban areas and highlight the critical relevance of reviving traditional, nutrient-dense dietary practices. Foods as Ragi (excellent source of iron and calcium), horse gram (protein and minerals), and black soybean (protein and bioactive compounds) are directly relevant to addressing anaemia, protein-energy malnutrition, and the rising burden of non-communicable diseases simultaneously (Ojha *et al*., 2022 [20]; Malik *et al*., 2025) [16].

6. Traditional food knowledge systems of Uttarakhand

The trad food practices of Uttarakhand embody a sophisticated indigenous knowledge system that integrates ecological, physiological, cultural, and spiritual dimensions of food. Kala and Nautiyal (2023) [13] highlight that the farmers of Uttarakhand have developed traditional subsistence farming systems that can support long-term social and ecological sustainability. Traditional dietary practices in Uttarakhand include:

- **Seasonal eating:** foods are chosen in accordance with their heating or cooling properties relative to the season. Hot-natured foods (*gahat*, ragi preparations) are consumed in winter, while lighter preparations are favoured in summer.
- **Festival foods:** specific preparations are associated with religious festivals and agricultural cycles, reinforcing the cultural and social dimensions of traditional food (*rot, arshe, cholai laddu, gulgule*).
- **Wild food foraging:** communities harvest wild plants including nettle *(kandali), linguda* (fiddlehead fern), kafal, kingoda, and various medicinal herbs as supplementary food sources a practice documented to support dietary diversity and provide micronutrients unavailable from cultivated crops (Ojha *et al*., 2022) [20].
- **Traditional preservation:** sun-drying (badi), fermentation, and pickling are employed to preserve seasonal foods for year-round consumption, ensuring nutritional security during winter months.
- **Culinary practices:** traditional soaking (*raat ko bheegona*) and grinding of pulses before cooking reduce anti-nutritional factors (tannins, phytates) and enhance the digestibility and bioavailability of nutrients.
- **Spice use:** spices and condiments as cumin, green chilli, ginger, garlic, faran, and turmeric used generously in traditional cooking carry documented anti-inflammatory, antimicrobial, carminative, immunomodulatory characteristics.

Ojha *et al*., (2022) [20] documented that central Himalayan communities rely on a diverse range of cultivated and wild food

plant species, which together provide both adequate dietary diversity and nutritional security. The food medicine interface observed in these communities means that traditional foods simultaneously serve nutritional and therapeutic purposes, contributing to a system of preventive healthcare rooted in cultural knowledge.

The *Bhotiya* community of Uttarakhand prepares traditional fermented preparations including *jann* (local beer) and *sez* using a traditional catalysing agent called *balam* (in Kumaon) or *balma* (in Garhwal) (Journal of Ethnic Foods, 2022). These fermented foods and beverages are rich source of lactic acid bacteria and yeasts, which enhance nutrient absorption and boost gut health, and their microbial composition has implications for physiological strength in high-altitude surround (Frontiers in Sustainable Food Systems, 2025).

7. Research methodology

The present study follows a mixed-approach design, combining descriptive and analytical methods. It is based on secondary data collected from peer-reviewed journals indexed in PubMed, Frontiers, Springer Nature, MDPI, and other reputable databases; official government publications including "NFHS-5 (Ministry of Health & Family Welfare, Government of India), agricultural statistics from the "Ministry of Agriculture & Farmers Welfare, and data from the Department of Agriculture, Uttarakhand; publications and reports by ICAR and NIN; and authenticated online academic repositories.

Literature was identified through systematic searches of PubMed, Google Scholar, ResearchGate, and government portals using keywords including 'indigenous food Uttarakhand', 'traditional cuisine Uttarakhand', 'finger millet health benefits', 'barnyard millet', 'horse gram nutrition', 'black soybean functional food', 'nettle Urtica dioica nutrition', 'perilla seed oil', 'hemp seed nutrition', and 'Himalayan traditional food knowledge system'. Publications from 2014 to 2025 were prioritised, with older seminal references included where relevant. All included studies are peer-reviewed and published in reputable academic journals or official government sources.

8. Conclusion

Traditional cuisine of Uttarakhand has sustained mountain communities for centuries, and its nutritional and therapeutic value is now being rigorously validated by modern food and nutrition science. This review demonstrates that Uttarakhand's indigenous foods including Ragi, black soybean, barnyard millet, horse gram, nettle, hemp seed, perilla seed, red rice, and Colocasia are rich in Nutrients and bioactive compounds which actively improve human health. Most of the pulses used in traditional preparations are soaked before cooking, and many are roasted or ground traditional processes that reduce anti-nutritional factors and enhance digestibility and nutrient bioavailability. The generous use of spices such as cumin, ginger, garlic, *faran*, and turmeric further enriches the therapeutic potential of traditional cuisine.

Government nutritional surveillance data (NFHS-5) indicate that while Uttarakhand has made commendable progress in reducing child stunting, persistent challenges in anaemia prevalence and rising obesity underline the urgency of reviving traditional nutrient-dense dietary patterns, which provide iron, calcium, protein, and protective bioactive compounds without the high caloric density of ultra-processed foods.

The erosion of traditional food knowledge under the influence of modernisation and globalisation poses a significant risk to both nutritional security and cultural heritage. Documentation, promotion, and revitalisation of traditional foods are therefore not merely cultural imperatives but essential public health priorities.

9. Recommendations

- Traditional foods should be promoted through health education programmes, school nutrition curricula, and community outreach initiatives in Uttarakhand, emphasising their nutritional and cultural value.
- With changing food habits and dietary patterns, traditional foods can be modified and incorporated into the formulation of functional foods, ready-to-eat products, and ready-to-cook convenience formats to enhance their acceptability among younger generations without compromising their nutritional integrity.
- Policy support is needed to incentivise the cultivation of traditional millet varieties, indigenous pulses, and wild food crops through government agricultural schemes, minimum support prices, and integration into public distribution and mid-day meal systems.
- Documentation of traditional food knowledge systems including recipes, preparation methods, seasonal dietary patterns, and the cultural contexts of festival foods should be undertaken as a matter of urgency, given the rapid pace of intergenerational knowledge loss.
- Research into the food–medicine interface of Uttarakhand's traditional ingredients, including clinical validation of their anti-diabetic, anti-inflammatory, and other therapeutic properties, should be promoted and supported.
- Culinary tourism, geographical indication (GI) tags for uniquely regional products (e.g., *Pahadi rajma*, red rice, *bhangjeera*), and the promotion of traditional foods in the hospitality and food processing industries can simultaneously support economic development and cultural preservation.

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