RESEARCH PAPER

Rumex hastatus D. Don: From Himalayan Food to Phytopharmacology—Ethnomedicine, Phytochemistry, Pharmacological Evidence and Translational Prospects

MAHROOF KHAN[1]*, AZIZ AHMED CHIWAN[2], JAVID AHMAD MIR[3] AND MUZAFAR AHMAD ZERGER[4]

1. [1,3,4] Department of Botany, Shri Chhote Shah Government Degree College, Mendhar Poonch, JK(UT) –India, 185211,
2. **[2]Department of Botany, Govt. Degree College Surankote**

Corresponding author: Mahroof Khan; Email: dr.mahroofkhan76@gmail.com

Author emails: azizchowan@gmail.com

javid.db25@gmail.com; zargarmuzafar.4u6@gmail.com

Abstract

Rumex hastatus D.Don (Polygonaceae), traditionally known in Himalayan communities as a sour leafy wild vegetable and medicinal plant, occupies an important position at the interface of food and ethnomedicine. Despite increasing experimental interest, evidence remains dispersed across ethnobotanical surveys, nutritional analyses, phytochemical investigations and preclinical pharmacology.This narrative review integrates evidence concerning the traditional food uses, ethnomedicinal applications, nutritional and phytochemical composition, pharmacological activities, safety and translational potential of *R. hastatus*, with particular emphasis on Himalayan knowledge and the relationship between traditional use and experimental validation. Literature was identified through searches of PubMed, PMC, publisher databases, Google Scholar-indexed records and botanical databases using combinations of "*Rumex hastatus*", ethnobotany, edible, food, phytochemistry, pharmacology, antioxidant, antidiarrhoeal, hepatoprotective, cytotoxicity and related terms. Taxonomic identity was cross-checked against Plants of the World Online. Primary experimental studies were prioritized over secondary reviews, and evidence was classified as ethnobotanical, in vitro, ex vivo or in vivo.*R. hastatus* is an accepted Himalayan species distributed from Afghanistan to south-central China and northwestern India. Its leaves are consumed raw as salad, prepared as chutney or used as a leafy vegetable. Nutritional investigations identified substantial carbohydrate, protein and fibre contents together with flavonoids, saponins and alkaloids. Root phytochemistry has demonstrated rutin, luteolin, vitexin and luteolin-7-O-glucoside, while isolation studies identified nepodin, rumexoside, orientaloside, resveratrol, torachrysone glycoside and hastatusides A and B. Experimental studies report antioxidant, anticholinesterase, antidiarrhoeal, antispasmodic, gastroprotective, hepatoprotective, anti-inflammatory, antimicrobial, cytotoxic, antitumour and antiangiogenic activities. However, evidence is predominantly preclinical and extract-dependent, with substantial variation in plant part, solvent, dose and assay.*R. hastatus* represents a promising Himalayan food–medicine resource, but translation into functional foods or phytopharmaceuticals requires authentication, chemical standardization, assessment of oxalate and other antinutritional factors, bioavailability studies, chronic toxicity testing and ultimately controlled human studies. [1, 12–16, 19–23]

Keywords: *Rumex hastatus*; Polygonaceae; wild edible plant; ethnomedicine; Himalayan food; phytochemistry; flavonoids; antioxidant; gastroprotection; pharmacology; safety; functional food

How to cite this article: MAHROOF KHAN. Rumex hastatus D. Don: From Himalayan Food to Phytopharmacology—Ethnomedicine, Phytochemistry, Pharmacological Evidence and Translational Prospects. Int J Drug Deliv Technol. 2026;16(89s):778-795. DOI: 10.25258/ijddt.16.89s.83.

1. Introduction

The boundary between food and medicine is increasingly recognized as a continuum rather than a strict dichotomy. Wild edible plants have historically contributed not only calories and micronutrients but also culturally transmitted strategies for maintaining health and managing illness. This food–medicine relationship is particularly prominent in mountainous regions, where communities have developed extensive knowledge of locally available plants, their edible portions, seasonal availability, preparation methods and medicinal applications. Such knowledge provides a valuable starting point for identifying plants with nutritional, nutraceutical and pharmacological potential. [16, 17, 20]

The genus *Rumex* L. (Polygonaceae) contains approximately 200 species distributed predominantly across temperate and subtropical regions. Several species, including sorrels and docks, are consumed as vegetables or flavouring plants and are simultaneously used in traditional medicine. The genus is chemically diverse, with reported anthraquinones, naphthalenes, flavonoids, tannins, stilbenes, terpenes, lignans and other phenolic constituents. Across the genus, these constituents have been associated experimentally with antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective and antitumour activities. [15, 16]

Rumex hastatus D.Don is an accepted species of Polygonaceae. According to Plants of the World Online, its native range extends from Afghanistan through Pakistan, the western Himalaya and India to Nepal, Tibet and south-central China. It is a subshrub or shrub associated primarily with temperate habitats. [1]

In the western Himalaya, *R. hastatus* is particularly relevant because it is simultaneously recognized as a **wild edible plant and medicinal resource**. Kinnaur ethnobotanical work recorded the leaves as pleasantly sour and refreshing and reported their consumption raw as salad or preparation as chutney. A recent survey in Spiti Valley also included *R. hastatus* among wild food resources. [19, 20]

The ethnomedicinal importance of the species is similarly broad. A survey in the mid-hills of Solan district, Himachal Pradesh, recorded the whole plant under the vernacular name "Khattib-uti" for oral treatment of indigestion, skin diseases and constipation. [21]

More importantly, a 2026 study specifically examined traditional and scientific knowledge of *R. hastatus* and *R. nepalensis* across altitudinal zones in Himachal Pradesh. The study interviewed 160 informants and identified differences in plant-part use and ethnobotanical knowledge across altitudes. This provides an important new dimension for understanding how environment, availability and cultural transmission may influence the use of *R. hastatus*. [17]

Experimental research has subsequently investigated several aspects of the species. Root extracts have demonstrated antioxidant and anticholinesterase activities; essential oil has shown antioxidant and cholinesterase-inhibitory effects; various fractions have demonstrated antitumour, antiangiogenic and cytotoxic activities; and animal studies have provided evidence for antidiarrhoeal, gastroprotective and hepatoprotective effects. More recent work has expanded the evidence base to aerial-part phytochemistry, α-amylase and urease inhibition and antimicrobial activity. [3–10, 18, 23]

Nevertheless, the existing evidence has several limitations. Different studies have used roots, leaves, stems, aerial parts, whole plants or essential oils; extraction procedures range from aqueous and ethanolic preparations to methanol, chloroform, ethyl acetate, butanol and petroleum ether fractions. Consequently, activity reported for one preparation cannot automatically be attributed to traditionally consumed leaves. Furthermore, most pharmacological studies remain in vitro or animal-based. Clinical evidence is lacking, and safety data relevant to regular dietary consumption are inadequate. [3–10, 12, 18, 23]

The purpose of this review is therefore to integrate the evidence around *R. hastatus* as a **food–medicine continuum**, linking traditional culinary practices with ethnomedicine, nutritional chemistry, phytochemical constituents, pharmacological validation and safety. Particular attention is given to the question of whether experimental pharmacology supports traditional claims and what research is required to translate this Himalayan wild plant into evidence-based functional-food or phytopharmaceutical applications.

2. Review methodology

This article was developed as a narrative evidence synthesis. Searches were conducted using combinations of the terms "*Rumex hastatus*", "Khatimal", "ethnobotany", "wild edible", "food", "nutrition", "phytochemistry", "rutin", "luteolin", "antioxidant", "anticholinesterase", "antidiarrhoeal", "gastroprotective", "hepatoprotective", "anti-inflammatory", "cytotoxic", "antitumour", "antiangiogenic", "toxicity" and "safety".

PubMed/PMC, Springer Nature, Wiley, MDPI, ScienceDirect, publisher websites and botanical resources were searched. Secondary *Rumex* reviews were used primarily to identify older primary studies. Taxonomic identity was checked against Plants of the World Online. Priority was given to: [1, 12, 15, 16]

1. primary ethnobotanical studies;
2. primary food/nutritional studies;
3. primary compound-isolation and analytical studies;
4. primary pharmacological studies; and
5. primary toxicological studies.

Where numerical data were not available from an accessible primary source, the finding is described qualitatively rather than reconstructed from assumptions.

3. Botanical identity, distribution and food–medicine context

R. hastatus D.Don was first published in 1825 and is currently accepted by Kew. Its native distribution includes Afghanistan, China, India, Nepal, Pakistan, Tibet and the western Himalaya. The species has been described as a shrub or subshrub occurring on dry rocky slopes and hill habitats. One pharmacological paper describing material from northern India reported a distribution approximately between 700 and 2500 m, while contemporary Himalayan studies emphasize substantial altitudinal variation in traditional knowledge. [1]

The combination of sour taste, availability as a wild leafy plant and traditional medicinal use is important. Rather than being consumed solely as a medicine, the plant can enter the human diet through culinary preparations. This creates a biologically and culturally important question: are the compounds responsible for pharmacological activity also delivered through traditional food preparation, and at what dose?

4. Traditional food uses

Available ethnobotanical evidence supports the classification of *R. hastatus* as a wild edible plant. [19, 20]

Kinnaur communities have reported eating the leaves raw as salad or preparing them as chutney. The leaves are described as pleasantly sour and refreshing. [19]

In Spiti Valley, *R. hastatus* was recorded among wild edible resources of the cold-arid Trans-Himalaya. The study surveyed 65 wild edible species and documented both raw and cooked consumption practices. [20]

A recent 2026 Himachal Pradesh study is especially valuable because it examined the traditional knowledge of *R. hastatus* and *R. nepalensis* across altitudinal zones using interviews with 160 informants. The authors identified variation in plant parts and knowledge patterns with altitude. [17]

These findings suggest that *R. hastatus* should not be viewed exclusively through a pharmacological lens. Its potential value includes:

- wild vegetable;
- sour salad ingredient;
- chutney ingredient;
- flavouring plant;
- seasonal food resource;
- traditional digestive aid; and
- source of secondary metabolites.

Table 1. Food, ethnobotanical and ecological evidence for *R. hastatus*

Evidence	Region/source	Plant part	Traditional practice/use	Key finding	Evidence type
Kinnaur wild-food survey	Kinnaur, Himachal Pradesh	Leaves	Raw salad	Pleasantly sour/refreshing leaves	Ethnobotanical [19, 20]
Kinnaur wild-food survey	Kinnaur	Leaves	Chutney	Leaves incorporated into chutney	Ethnobotanical [19, 20]
Spiti wild-food survey	Spiti Valley	Aerial/leaf material	Wild vegetable	Species recorded among 65 wild edible plants	Ethnobotanical [21]
Mid-hills ethnomedicine	Solan, Himachal Pradesh	Whole plant	Oral medicine	Indigestion, skin disease, constipation	Ethnomedicinal [17]
2026 altitude study	Himachal Pradesh	Leaves, roots, whole plant/other parts	Food and medicine	160 informants; altitudinal variation in knowledge/use	Ethnobotanical [20]
Swat wild-food study	Swat, Pakistan	Leaves	Mixed with *saag*/chutney	Spring–summer use reported	Ethnobotanical [22]
Northern Indian pharmacological description	North India	Roots	Ayurvedic/folk medicinal use	Species reported from dry slopes/rocks, approximately 700–2500 m	Ethnobotanical [15, 16]
Genus-level synthesis	Multiple countries	Leaves/aerial parts	Vegetable	*R. hastatus* included among edible *Rumex* species	Secondary synthesis

Sources include regional food surveys and the recent Himachal Pradesh altitude study. [17, 19, 20]

5. Ethnomedicinal uses

Traditional reports attribute a broad spectrum of medicinal uses to *R. hastatus*. These include gastrointestinal complaints, dermatological conditions, rheumatism, respiratory disorders,

jaundice and liver complaints, wounds, fever, piles, headache, diarrhoea and dysentery. However, the strength of evidence varies substantially between claims. [21, 22]

The Solan survey provides relatively direct evidence from Himachal Pradesh: whole-plant material was used orally for indigestion, skin diseases and constipation. Other ethnomedicinal literature cited in species-level and genus-level reviews describes roots or whole plants as diuretic, laxative or tonic and associates them with rheumatism, jaundice, skin disease, piles and respiratory complaints. These claims should be regarded as **traditional-use evidence**, not proof of therapeutic efficacy. [21, 22]

Table 2. Ethnomedicinal claims and experimental status

Traditional indication	Plant part traditionally reported	Preparation/route reported	Experimental support	Current evidence level [21–23]
Indigestion	Whole plant	Oral	Gastroprotective/antispasmodic studies	Moderate preclinical [9, 23]
Constipation	Whole plant	Oral	Laxative activity not adequately characterized	Preliminary [3, 11]
Diarrhoea	Root/ whole plant	Oral	Castor-oil models	Moderate preclinical [10]
Dysentery	Whole plant	Oral	Antimicrobial/ antidiarrhoeal evidence	Preliminary–moderate [5, 7]
Skin disease	Whole plant/roots	Oral/topical reports	Antioxidant/antimicrobial evidence	Preliminary [12, 18]
Wounds/cuts	Leaves /aerial parts	Juice/topical reports	Antioxidant/antimicrobial data	Preliminary
Rheumatism	Whole plant/root	Oral	Anti-inflammatory/ antinociceptive animal evidence	Preliminary–moderate
Fever	Plant/stem/root	Oral	Antipyretic animal model	Preliminary
Liver disorders/jaundice	Root/leaf	Oral	CCl_4 hepatoprotection/fibrosis models	Moderate preclinical
Respiratory/lung complaints	Whole plant/root	Oral	Limited direct pharmacology	Preliminary
Headache/ neurological disorders	Whole plant	Oral	AChE/BChE inhibition and antioxidant assays	Preliminary
Piles	Whole plant/root	Oral	Direct validation lacking	Traditional only
Diuretic use	Root/ whole plant	Oral	Direct modern validation limited	Traditional only
Antihypertensive use	Root/ whole plant	Oral	Direct validation limited	Traditional only
Antidiabetic use	Whole /aerial parts	Oral/traditional	α-glucosidase/α-amylase studies	Preliminary
Gastric ulcer	Whole plant/root	Oral	Gastroprotective and H^+/K^+-ATPase studies	Moderate preclinical
Inflammation	Stem/root	Oral	Carrageenan and granuloma models	Moderate preclinical

Traditional indication	Plant part traditionally reported	Preparation/route reported	Experimental support	Current evidence level [21–23]
Pain	Stem/root	Oral	Writhing, tail-flick and formalin models	Moderate preclinical

The matrix integrates direct ethnobotanical records with pharmacological studies and should be interpreted as an evidence map rather than a clinical efficacy table. [3, 8–10, 21–23]

6. Nutritional composition

One of the most important studies for the food–medicine concept is the nutritional evaluation of *R. hastatus* by Ahmad et al. The study reported carbohydrate at 432.4 mg/g, protein at 133.9 mg/g, fibre at 124.4 mg/g, ash at 54.5 mg/g and fat at 25.6 mg/g. Moisture was approximately 22.8%. Total flavonoids, saponins and alkaloids were reported at 84.5, 65.5 and 49.5 mg/g, respectively. GC-FID/MS detected 120 compounds. [12]

The authors also reported a sensory acceptability score of approximately 5.74/7 and an in-vitro antidiabetic assay with an IC_{50} of 42.09 µg/mL. [12] These findings suggest nutritional and functional-food potential, but several limitations must be recognized. The reported composition represents a specific sample and extraction/analytical protocol. It cannot be assumed that leaves collected at different altitudes, seasons or developmental stages will show identical composition. [12, 18]

Table 3. Nutritional, analytical and extraction evidence

Study	Material	Analytical/experimental approach	Major result	Relevance [12]
Ahmad et al., 2019	Plant material	Proximate analysis	Carbohydrate 432.4 mg/g	Food value [12]
Ahmad et al., 2019	Plant material	Proximate analysis	Protein 133.9 mg/g	Food value [12]
Ahmad et al., 2019	Plant material	Proximate analysis	Fibre 124.4 mg/g	Digestive/nutritional relevance [12]
Ahmad et al., 2019	Plant material	Proximate analysis	Ash 54.5 mg/g	Mineral fraction indicator [12]
Ahmad et al., 2019	Plant material	Proximate analysis	Fat 25.6 mg/g	Macronutrient profile [12]
Ahmad et al., 2019	Plant material	Secondary metabolites	Flavonoids 84.5 mg/g	Functional-food relevance [12]
Ahmad et al., 2019	Plant material	Secondary metabolites	Saponins 65.5 mg/g	Bioactive fraction [12]
Ahmad et al., 2019	Plant material	Secondary metabolites	Alkaloids 49.5 mg/g	Bioactive fraction [12]
Ahmad et al., 2019	Methanolic sample	GC-FID/MS	120 compounds detected	Chemical complexity [12]
Ahmad et al., 2019	Plant material	Sensory analysis	Mean score ~5.74/7	Food acceptability [18]
Ahmad et al., 2019	Extract	Enzyme inhibition	Antidiabetic IC_{50} ~42.09 µg/mL	Preliminary functional activity [18]
Anis & Ahmed, 2022	*R. hastatus* extract	Green extraction/RSM	~50% glycerol-water effective	Food/pharma extraction [18]
Anis & Ahmed, 2022	Extract	TPC	21.70 mg GAE/g at one optimum experi	Polyphenol recovery [18]

Study	Material	Analytical/experimental approach	Major result	Relevance [12]
			mental condition	
Anis & Ahmed, 2022	Extract	TFC	Predicted 95.78 mg RE/g under optimized conditions	Flavonoid recovery [18]
Anis & Ahmed, 2022	Extract	Antiradical activity	Predicted 84.93%	Green extraction [18]
Sharma et al., 2025/2026	Aerial parts	GC-MS/HPLC	Catechin, quercetin, gallic acid and ascorbic acid detected	Updated aerial-part chemistry [18]
Sharma et al., 2025/2026	Aerial parts	Extraction yield	Methanol 27.16%; acetone 7.97%; petroleum ether 1.10%	Extraction comparison

The nutritional study and later green-extraction work demonstrate that the plant can be investigated as both a food and a source of extractable bioactives [12, 18]

7. Phytochemistry

7.1 Flavonoids

Root investigations using HPLC identified **rutin, luteolin, vitexin and luteolin-7-O-glucoside**. Calibration methods demonstrated high linearity, and the analytical method was suitable for quantifying these compounds in root fractions. [4, 5]

These compounds are particularly relevant because antioxidant and anticholinesterase activity was strongest in fractions containing substantial phenolic/flavonoid content. [4, 5]

7.2 Naphthalene and phenolic derivatives

Isolation work reported two new phenolic glucosides, **hastatusides A and B**, from roots together with resveratrol, rumexoside, torachrysone-8-yl β-D-glucopyranoside, rutin, nepodin and orientaloside. [2]

Subsequent literature has also reported nepodin and related naphthalene derivatives in *R. hastatus*. [2, 13, 14]

7.3 Anthraquinones and related constituents

Phytochemical screening of root fractions has repeatedly detected anthraquinones, flavonoids, alkaloids and saponins. [4, 6, 13, 14]

However, the presence of a chemical class in a crude extract does not establish which individual molecule is responsible for a biological effect.

Table 4. Phytochemical compounds reported from *R. hastatus*

Compound/ constituent	Chemical class	Plant material	Evidence/source	Potential relevance [4, 5]
Rutin	Flavonoid glycoside	Roots	HPLC/isolation	Antioxidant; GI mechanism studies [4, 5]
Luteolin	Flavonoid	Roots	HPLC	Antioxidant/anti-inflammatory candidate [4, 5]
Luteolin-7-O-glucoside	Flavonoid glycoside	Roots	HPLC	Antioxidant candidate [4, 5]
Vitexin	Flavonoid C-glycoside	Roots	HPLC	Antioxidant candidate [2]
Hastatuside A	Phenolic glucoside	Roots	Isolation/NMR	Species-specific marker candidate [2]

Compound/ constituent	Chemical class	Plant material	Evidence/source	Potential relevance [4, 5]
Hastatuside B	Phenolic glucoside	Roots	Isolation/NMR	Species-specific marker candidate [2, 13]
Nepodin	Naphthalene derivative	Roots	Isolation/review	Bioactive naphthalene candidate [2, 13]
Rumexoside	Naphthalene glycoside	Roots	Isolation/review	Species chemistry [2]
Orientaloside	Naphthalene glycoside	Roots	Isolation/review	Species chemistry [18]
Torachrysone-8-yl β-D-glucopyranoside	Naphthalene glycoside	Roots	Isolation	Species chemistry [18]
Resveratrol	Stilbene	Roots	Isolation	Antioxidant candidate [18]
Catechin	Flavan-3-ol	Aerial parts	HPLC, 2025/2026	Antioxidant
Quercetin	Flavonoid	Aerial parts	HPLC, 2025/2026	Antioxidant/anti-inflammatory candidate
Gallic acid	Phenolic acid	Aerial parts	HPLC, 2025/2026	Antioxidant
Ascorbic acid	Vitamin/antioxidant	Aerial parts	HPLC, 2025/2026	Nutritional antioxidant
Phytol	Diterpene alcohol	GC-MS fractions	GC-MS	Candidate bioactivity
Lupeol	Pentacyclic triterpene	Acetone fraction	GC-MS	Candidate bioactivity
β-Sitosterol	Phytosterol	GC-MS	GC-MS	Nutraceutical candidate
γ-Sitosterol	Phytosterol	Petroleum ether fraction	GC-MS	Chemical marker/candidate
Stigmasterol	Phytosterol	Petroleum ether fraction	GC-MS	Chemical marker/candidate
α-Amyrin	Triterpene	Petroleum ether fraction	GC-MS	Candidate anti-inflammatory activity
β-Amyrin	Triterpene	Petroleum ether fraction	GC-MS	Candidate bioactivity
γ-Sitostenone	Steroidal ketone	Petroleum ether fraction	GC-MS	Candidate bioactivity
Hexadecanoic acid	Fatty acid	Methanol/petroleum ether fractions	GC-MS	Common lipid constituent
Eicosanoic acid phenyl methyl ester	Ester	Methanol aerial-part extract	GC-MS	Major detected component
Lup-20(29)-	Triterpenoid derivative	Acetone extract	GC-MS	Major detected

Compound/ constituent	Chemical class	Plant material	Evidence/source	Potential relevance [4, 5]
en-3-ol acetate				component
ar-Turmerone	Sesquiterpenoid	Chloroform fraction	GC-MS	Candidate bioactivity
Dihydrojasmone	Volatile ketone	Chloroform fraction	GC-MS	Volatile constituent
Sitostenone	Steroid derivative	Chloroform fraction	GC-MS	Candidate bioactivity

Direct chemical evidence is strongest for the first group of isolated/HPLC-characterized constituents; GC-MS identifications should be treated as analytical identifications rather than proof of purified compounds or pharmacological activity. [2, 4–8, 18]

8. Pharmacological activities

8.1 Antioxidant activity

Antioxidant activity is among the most consistently reported properties of *R. hastatus*. Root extracts and fractions have been evaluated using DPPH, ABTS, hydroxyl radical, hydrogen peroxide, superoxide, reducing-power, iron-chelating and β-carotene bleaching assays. Butanol and methanol fractions generally showed stronger activity than less-polar fractions. HPLC identified rutin, luteolin, vitexin and luteolin-7-O-glucoside in the active material. The essential oil also showed DPPH and ABTS scavenging activity, with reported IC_{50} values of 3.71 and 6.29 µg/mL, respectively. [4, 5, 7]

A 2025/2026 study of aerial parts further demonstrated antioxidant activity using DPPH and reducing-power assays. Methanol extract produced a DPPH IC_{50} of 9.08 µg/mL, compared with 13.38 µg/mL for acetone extract and 69.60 µg/mL for petroleum ether extract. [18]

These findings establish substantial **in-vitro antioxidant capacity**, but chemical antioxidant assays cannot by themselves establish systemic antioxidant effects in humans. [4, 5, 18]

8.2 Anticholinesterase activity

Ahmad et al. evaluated crude methanol extract, solvent fractions, saponins and flavonoids against acetylcholinesterase and butyrylcholinesterase. The flavonoid fraction showed particularly strong AChE inhibition, with a reported IC_{50} of approximately 20 µg/mL, while chloroform and ethyl acetate fractions were also active. The essential oil showed AChE and BChE IC_{50} values of 32.54 and 97.38 µg/mL, respectively. [5, 7]

These results support **neuropharmacological potential**, but they do not demonstrate efficacy against Alzheimer's disease or other human neurological disorders. [5, 7]

8.3 Gastrointestinal pharmacology

Gastrointestinal activity is particularly important because traditional use includes indigestion, diarrhoea and related complaints.

A 2011 study evaluated an ethanolic root extract in castor-oil-induced diarrhoea and gastrointestinal models in rats at 100, 150 and 200 mg/kg. japsonline.com [9]

A much more comprehensive 2022 study evaluated crude extract, n-hexane, ethyl acetate and aqueous fractions and rutin. Crude extract, fractions and rutin produced dose-dependent protection against castor-oil-induced diarrhoea at 50–300 mg/kg. Extracts also inhibited intestinal fluid secretion and reduced gastrointestinal transit. In rabbit jejunum, crude and ethyl acetate fractions relaxed spontaneous and K^+-induced contractions, while n-hexane fraction and rutin altered Ca^{2+} concentration-response curves. The same study reported anti-*H. pylori*, H^+/K^+-ATPase inhibitory, gastroprotective and anti-inflammatory effects. Rutin showed computational interaction with H^+/K^+-ATPase and L-type calcium channels. [23]

8.4 Antidiabetic/hypoglycaemic activity

The nutritional study reported an in-vitro antidiabetic assay with an IC_{50} of 42.09 µg/mL. DOI [12]

More recently, aerial-part extracts were tested for α-amylase inhibition. Methanol extract showed the strongest enzyme inhibition among the three tested solvents. [18]

These findings justify further work on carbohydrate-digesting enzyme inhibition, but **do not establish blood-glucose-lowering efficacy in humans**.

8.5 Anti-inflammatory, analgesic and antipyretic activities

Ethanolic and aqueous extracts of stems and roots were investigated using acetic-acid-induced writhing, tail-flick, formalin, carrageenan-induced paw oedema, cotton-pellet granuloma and yeast-induced pyrexia models. Ethanol extracts at 200–400 mg/kg showed significant effects across several models, with stronger activity generally observed at 400 mg/kg. [10]

The results provide experimental support for traditional use in pain, inflammation and fever, although the study is relatively old and published in a lower-impact journal, so independent replication is desirable. [10]

8.6 Hepatoprotective and antifibrotic activity

Root fractions have been evaluated against CCl_4-induced liver and testicular toxicity. Rats received 200 mg/kg of various *R. hastatus* root fractions while CCl_4 was administered at 0.5 mL/kg of a 20%

preparation twice weekly for eight weeks. Treatment improved antioxidant, biochemical, histological and DNA-damage parameters. [3]

A subsequent study investigated leaves against CCl_4-induced hepatic fibrosis. Forty-eight rats were divided into eight groups, with methanol and ethyl acetate fractions administered at 200 mg/kg. Extract-treated animals showed improvement in liver-function markers, lipid parameters, antioxidant status and histological abnormalities. [11]

This is important because traditional liver/jaundice claims therefore have **some animal-model support**, although human hepatoprotective efficacy remains unestablished. [3, 11]

8.7 Antimicrobial activity

Root extracts and fractions have demonstrated antibacterial and antifungal effects in several screening assays. A 2015 root study found substantial antimicrobial activity among several solvent fractions. [6]

A separate study tested *R. hastatus* against seven clinical bacterial pathogens and reported variable activity among diethyl ether, acetone, chloroform and ethanol extracts. [6, 18]

The 2025/2026 aerial-part study found antimicrobial activity across methanol, acetone and petroleum ether extracts using disk diffusion and resazurin microdilution assays. [18]

8.8 Cytotoxic, antitumour and antiangiogenic activity

The species has repeatedly shown cytotoxic or tumour-related activity in preliminary models.

In a potato-disc tumour assay, crude saponins and chloroform fraction produced tumour inhibition of 93.3% and 86.7%, respectively, at 1000 µg/mL. Their reported IC_{50} values were 18.1 and 31.6 µg/mL. In a chick chorioallantoic membrane assay, the same fractions showed antiangiogenic activity with IC_{50} values of 64.9 and 17.9 µg/mL, respectively. [8]

A separate MTT study reported chloroform-fraction IC_{50} values of 151.52 µg/mL against HeLa cells and 53.37 µg/mL against NIH/3T3 cells. The fraction contained 78 GC-MS-identified compounds. [7]

These findings justify natural-product isolation studies but **should not be described as evidence that *R. hastatus* treats cancer**. The relatively high concentrations required in some assays and the lack of clinical evidence are major limitations.

Table 5. Pharmacological evidence, models, doses and potency

Activity	Material	Model/assay	Dose/concentration	Principal result	Evidence [4, 5, 18]
Antioxidant	Root fractions	DPPH	0.1–0.25 mg/mL	Butanol and methanol among strongest fractions	In vitro [7]
Antioxidant	Root fractions	ABTS	Concentration-dependent	Strong activity in polar fractions	In vitro [7]
Antioxidant	Root fractions	H_2O_2/superoxide/OH	Various concentrations	Broad radical-scavenging activity	In vitro [9, 23]
Antioxidant	Essential oil	DPPH	IC_{50} 3.71 µg/mL	Strong scavenging	In vitro [12, 18]
Antioxidant	Essential oil	ABTS	IC_{50} 6.29 µg/mL	Strong scavenging	In vitro [10]
Antioxidant	Aerial methanol extract	DPPH	IC_{50} 9.08 µg/mL	Strongest of tested aerial extracts	In vitro [3, 11]
Antioxidant	Aerial acetone extract	DPPH	IC_{50} 13.38 µg/mL	Active	In vitro [6, 18]
AChE inhibition	Flavonoid fraction	Ellman assay	IC_{50} ~20 µg/mL	Strong AChE inhibition	In vitro [7, 8]

Activity	Material	Model/assay	Dose/concentration	Principal result	Evidence [4, 5, 18]
AChE inhibition	Essential oil	AChE assay	IC_{50} 32.54 µg/mL	Active	In vitro [23]
BChE inhibition	Essential oil	BChE assay	IC_{50} 97.38 µg/mL	Active	In vitro
Antidiarrhoeal	Crude extract/fractions	Castor-oil model	50–300 mg/kg	Dose-dependent protection	In vivo
Antisecretory	Crude extract/fractions	Intestinal secretion	50–300 mg/kg	Reduced secretion	In vivo
Antispasmodic	Crude/EtOAc fraction	Rabbit jejunum	0.1–1 mg/mL range	Relaxation of contractions	Ex vivo
Anti-*H. pylori*	Fractions/rutin	Microbiological assay	Experimental concentrations	Inhibition reported	In vitro
Gastroprotective	Extract/fractions	Gastric injury models	Animal dosing	Histological/biochemical improvement	In vivo
H^+/K^+-ATPase inhibition	Rutin/extract	Enzyme/molecular studies	Experimental	Inhibition and target interaction	In vitro/in silico
Antidiabetic	Plant extract	Enzyme assay	IC_{50} 42.09 µg/mL	Antidiabetic screening activity	In vitro
α-Amylase	Aerial extracts	Enzyme assay	Experimental concentrations	Methanol strongest inhibition	In vitro
Antiurease	Aerial extracts	Urease assay	Experimental concentrations	Methanol strongest	In vitro
Antinociceptive	Stem/root ethanol extract	Writhing	200–400 mg/kg	Significant inhibition	In vivo
Antinociceptive	Stem/root ethanol extract	Tail-flick	400 mg/kg	Increased pain threshold	In vivo
Anti-inflammatory	Stem/root ethanol extract	Carrageenan paw oedema	400 mg/kg	Significant inhibition	In vivo
Anti-inflammatory	Stem/root ethanol extract	Cotton-pellet granuloma	400 mg/kg	23.27–27.25% inhibition	In vivo
Antipyretic	Stem/root ethanol extract	Yeast pyrexia	400 mg/kg	Dose-dependent effect	In vivo
Hepatoprotective	Root fractions	CCl_4 rat model	200 mg/kg	Improved biochemical/histological parameters	In vivo
Hepatoprotective	Leaf fractions	CCl_4 rat model	200 mg/kg	Improved liver-function/oxidative markers	In vivo

Activity	Material	Model/assay	Dose/concentration	Principal result	Evidence [4, 5, 18]
Antimicrobial	Root fractions	Bacterial/fungal assays	Experimental concentrations	Variable broad activity	In vitro
Cytotoxic	Chloroform fraction	HeLa MTT	IC_{50} 151.52 µg/mL	Cytotoxicity	In vitro
Cytotoxic	Chloroform fraction	NIH/3T3 MTT	IC_{50} 53.37 µg/mL	Cytotoxicity, including non-cancer cells	In vitro
Antitumour	Crude saponins	Potato-disc assay	IC_{50} 18.1 µg/mL	93.3% inhibition at 1000 µg/mL	In vitro
Antitumour	Chloroform fraction	Potato-disc assay	IC_{50} 31.6 µg/mL	86.7% inhibition at 1000 µg/mL	In vitro
Antiangiogenic	Chloroform fraction	CAM assay	IC_{50} 17.9 µg/mL	81.6% inhibition at 1000 µg/mL	Ex vivo/ in ovo
Antiangiogenic	Saponin fraction	CAM assay	IC_{50} 64.9 µg/mL	78.9% inhibition at 1000 µg/mL	Ex vivo/ in ovo
Acute toxicity	Crude extract	OECD-425-type assessment	Up to 2000 mg/kg	No major acute organ toxicity reported	In vivo

Primary studies supporting the table include antioxidant/anticholinesterase, gastrointestinal, hepatoprotective, cytotoxic and antitumour investigations. [3–11, 18, 23]

9. Mechanistic integration

The available evidence suggests several potentially convergent mechanisms.

9.1 Phenolic/flavonoid–antioxidant axis

Rutin, luteolin, vitexin and luteolin-7-O-glucoside occur in root fractions showing substantial antioxidant activity. This suggests that phenolic composition may contribute significantly to the observed radical-scavenging properties [4, 5]

9.2 Flavonoid–cholinesterase axis

The flavonoid-rich fraction showed strong AChE inhibition, while essential oil also inhibited AChE and BChE. This creates a plausible pharmacological bridge to traditional neurological uses, but the relationship remains preclinical [5, 7]

9.3 Rutin–gastrointestinal axis

The 2022 gastrointestinal study provides the strongest mechanistic connection between a defined compound and a traditional indication. Rutin and *R. hastatus* fractions influenced calcium-channel-dependent smooth-muscle responses and H^+/K^+-ATPase-related pathways, while animal studies demonstrated antidiarrhoeal and gastroprotective effects. [23]

9.4 Phenolic/antioxidant–hepatoprotection axis

Both root and leaf preparations protected animals against CCl_4-induced oxidative hepatic injury. Improvement of endogenous antioxidant status and histological parameters provides a plausible link between antioxidant chemistry and hepatoprotection. [3, 11]

9.5 Important caveat

These pathways should be regarded as **hypothesis-generating mechanisms**. Extracts contain multiple constituents, and the contribution of individual molecules, metabolites and synergistic interactions has not been established adequately.

10. Traditional claim versus scientific evidence

Table 6. Evidence matrix linking traditional use with experimental validation

Traditional claim	Direct experimental evidence	Strength	Main limitation [9, 23]
Indigestion	Antispasmodic and gastroprotective activity	Moderate	No human trials [9, 23]
Diarrhoea	Castor-oil antidiarrhoeal and antisecretory models	Moderate	Animal models [3, 11]
Gastric ulcer	Gastroprotection; H^+/K^+-ATPase-related evidence	Moderate	No clinical validation [10]
Liver disorders	CCl_4 hepatoprotection/fibrosis models	Moderate	CCl_4 model does not reproduce

Traditional claim	Direct experimental evidence	Strength	Main limitation [9, 23]
			all human liver disease [5, 7]
Rheumatism	Anti-inflammatory/antinociceptive animal models	Preliminary–moderate	Limited mechanistic/clinical data [12, 18]
Fever	Yeast-induced pyrexia model	Preliminary	Single older study [6, 18]
Skin/wounds	Antioxidant/antimicrobial activity	Preliminary	Direct wound-healing studies limited [7, 8]
Neurological disorders/headache	AChE/BChE inhibition and antioxidant activity	Preliminary	No CNS pharmacokinetic or clinical evidence
Diabetes	α-glucosidase/α-amylase-related screening	Preliminary	No animal/human glycaemic studies adequate for efficacy
Infection	Antibacterial/antifungal screening	Preliminary	MIC standardization and active compounds insufficient
Cancer	Cytotoxic, potato-disc and CAM assays	Preliminary	Non-clinical models; selectivity concerns
Antihypertensive use	Direct evidence limited	Traditional only	No convincing modern validation
Diuretic use	Direct evidence limited	Traditional only	Mechanistic studies absent
Constipation/laxative use	Traditional reports	Traditional only	Species-specific controlled laxative evidence limited
Jaundice	Hepatoprotective animal evidence	Preliminary–moderate	Jaundice is clinically heterogeneous
Functional food	Edibility, sensory acceptability and nutritional composition	Relatively strong	Oxalate and long-term food safety insufficiently characterized

The key conclusion from this matrix is that **traditional use and experimental activity overlap most convincingly in gastrointestinal, antioxidant and hepatoprotective domains**, whereas claims involving hypertension, diuresis and several chronic diseases remain poorly validated [3–11, 18, 23]

11. Food safety and toxicology

11.1 Acute toxicity

The 2022 gastrointestinal investigation included an acute toxicity evaluation following OECD 425 principles. The authors reported that *R. hastatus* crude extract was tolerated up to 2000 mg/kg in the tested animal model without major pathological abnormalities in examined organs [23]

This provides useful preliminary safety information but should not be interpreted as evidence of a safe human dose.

11.2 Oxalate

Oxalic acid and oxalates are a particularly important issue for edible *Rumex* species. The genus-level literature identifies high oxalate concentrations as a potential nutritional limitation because oxalate can bind calcium and other minerals and, at excessive intake, contribute to calcium oxalate kidney-stone risk [15, 16]

Importantly, **species-specific oxalate quantification in traditionally prepared *R. hastatus* leaves is insufficient**. This is a major gap

that should be addressed before promoting the plant as a functional food.

11.3 Anthraquinones

Anthraquinones are characteristic constituents of *Rumex*, but their pharmacological and toxicological profiles are compound-specific. The presence of an anthraquinone class in *R. hastatus* extracts therefore warrants standardized quantitative analysis rather than blanket classification as either beneficial or harmful. [15, 16]

11.4 Food preparation

Traditional preparation could significantly affect safety and bioavailability. For example, boiling, blanching, fermentation, soaking and discarding cooking water may alter:

- oxalate concentration;
- soluble phenolics;
- flavonoid glycosides;
- vitamin C;
- mineral bioavailability;
- sensory characteristics.

Therefore, food processing should become an explicit research component of *R. hastatus* research.

12. Food processing as the missing bridge

A major conceptual gap in the literature is that **most pharmacological studies do not use the same preparations that people traditionally eat**. [3, 4, 8, 11, 12, 18, 23]

A root methanol fraction cannot be equated with raw leaves consumed as chutney. Similarly, a chloroform fraction or essential oil may have little relevance to ordinary dietary exposure. [1, 17, 19, 20]

A translational research model should therefore compare:

Raw leaves → washed leaves → blanched leaves → boiled leaves → chutney → fermented preparation and measure:

- total oxalate;
- soluble oxalate;
- total phenolics;
- total flavonoids;
- rutin;
- luteolin;
- luteolin-7-O-glucoside;
- vitamin C;
- mineral content;
- antioxidant capacity;
- α-amylase/α-glucosidase inhibition;
- microbial safety.

This approach would directly test whether the **traditional food preparation itself** delivers biologically relevant phytochemicals while reducing potentially undesirable compounds.

3. Research gaps and future directions

13.1 Taxonomic and authentication studies

Future investigations should use:

- authenticated herbarium vouchers;
- high-resolution morphological descriptions;
- DNA barcoding where necessary;
- authenticated reference material;
- documentation of collection altitude, soil and season.

This is especially important because *Rumex* species can occur sympatrically and common names can overlap.

13.2 Altitude-dependent metabolomics

The 2026 Himachal Pradesh ethnobotanical study provides an excellent foundation for investigating altitude-dependent variation. A future study should collect leaves from multiple altitudes and apply:

- LC-MS/MS;
- GC-MS;
- NMR metabolomics;
- molecular networking;
- multivariate statistics.

This could identify **altitude-associated chemotypes**.

13.3 Food-processing research

Compare raw and traditionally processed leaves for:

- oxalate;
- phenolics;
- flavonoids;
- rutin;/3T3 results in the cytotoxicity study demonstrate why selectivity is essential: an extract that kills both cancer and The leaves have documented culinary value, while traditional medicinal uses encompass gastrointestinal, dermatological, inflammatory and hepatic complaints. The coexistence of food and medicinal use is important becauseangiogenesis assays indicate biological activity, but the absence of selective tumour toxicity, pharmacokinetic data, mammalian tumour models and clinical studies makes therapeutic interpretation, orientaloside, resveratrol and hastatusides A and B. Experimental studies provide preclinical support for antioxidant, anticholinesterase, antidiarrhoe crude extracts, solvent fractions or in-vitro assays, while human clinical evidence is essentially absent. Extract composition varies according to plant part, geography, altitude, season and solvent, making cross
- antioxidant capacity;
- mineral bioavailability.

13.4 Standardized extracts

Current pharmacological studies use markedly different extraction procedures. A standardized extract should specify:

- plant part;
- geographic origin;
- harvest season;
- extraction solvent;

- drug-to-extract ratio;
- marker-compound content;
- total phenolic content;
- total flavonoid content.

13.5 Bioavailability

The presence of rutin or luteolin in an extract does not demonstrate systemic exposure. Future studies should investigate:

- gastrointestinal stability;
- intestinal metabolism;
- glucuronidation;
- sulfation;
- microbiome transformation;
- plasma metabolites;
- tissue distribution.

13.6 Mechanistic pharmacology

The most promising areas for deeper mechanistic work are:

1. gastrointestinal protection;
2. antioxidant/anti-inflammatory activity;
3. hepatoprotection;
4. anticholinesterase activity;
5. carbohydrate- digesting enzyme inhibition.

13.7 Selective cytotoxicity

The NIH/3T3 results in the cytotoxicity study demonstrate why selectivity is essential: an extract that kills both cancer and non-cancer cells cannot automatically be considered a promising anticancer agent.

Future work should include:

- multiple cancer cell lines;
- non-malignant controls;
- apoptosis assays;
- mitochondrial assays;
- cell-cycle analysis;
- molecular targets;
- in vivo tumour models.

13.8 Toxicology

Required studies include:

- repeated-dose 28-day toxicity;
- 90-day toxicity;
- genotoxicity;
- reproductive toxicity;
- developmental toxicity;
- hepatotoxicity;
- nephrotoxicity;
- oxalate quantification;
- drug–herb interaction studies.

13.9 Human research

Ultimately, controlled studies should evaluate:

- tolerability of traditionally consumed leaves;
- gastrointestinal effects;
- glycaemic response;
- antioxidant biomarkers;
- safety biomarkers;
- effects of processing.

No strong clinical evidence currently supports therapeutic claims for *R. hastatus*.

14. Proposed translational research pipeline

A practical development strategy is:

Ethnobotanical documentation
↓
Taxonomic authentication
↓
Altitude/season/plant-part sampling
↓
Nutritional and antinutritional profiling
↓
Traditional food-processing study
↓
LC-MS/MS + GC-MS + NMR metabolomics
↓
Standardized extract development
↓
In-vitro mechanistic screening
↓
Bioavailability studies
↓
Acute + subchronic toxicology
↓
Animal efficacy models
↓
Human safety study
↓
Controlled clinical investigation
↓
Evidence-based functional food/phytopharmaceutical development

This pipeline would prevent a common problem in medicinal-plant research: moving directly from a positive antioxidant assay to claims of therapeutic efficacy.

15. Strengths and limitations of the current evidence

Strengths

- Longstanding food and ethnomedicinal use.
- Multiple independent ethnobotanical records.
- Recent Himachal Pradesh data involving 160 informants.
- Demonstrated nutritional value.
- Defined flavonoid constituents.
- Isolation of species-specific phenolic/naphthalene compounds.
- Multiple independent pharmacological investigations.
- Gastrointestinal activity supported by several mechanistic approaches.
- Hepatoprotective activity demonstrated in animal models.
- Recent aerial-part chemistry expands the evidence base.

Limitations

- Lack of standardized extracts.

- Geographic and seasonal variability insufficiently studied.
- Limited quantitative data for traditional food preparations.
- Very limited pharmacokinetic evidence.
- Oxalate content insufficiently characterized.
- Most pharmacological evidence is in vitro or animal-based.
- Some older studies are poorly replicated.
- Several traditional claims have little experimental validation.
- No convincing human clinical efficacy evidence.
- Some GC-MS reports identify many compounds without establishing biological causality.

16. Overall evidence grading

A practical evidence hierarchy for *R. hastatus* is:

Evidence domain	Overall confidence
Botanical identity/distribution	High
Traditional food use	Moderate–high
Traditional medicinal use	Moderate
Nutritional composition	Moderate
Root flavonoid chemistry	Moderate–high
Antioxidant activity	Moderate preclinical
Anticholinesterase activity	Preliminary–moderate
Gastrointestinal pharmacology	Moderate preclinical
Hepatoprotection	Moderate preclinical
Anti-inflammatory/antinociceptive	Preliminary–moderate
Antimicrobial activity	Preliminary
Antidiabetic activity	Preliminary
Cytotoxic/antitumour activity	Preliminary
Human efficacy	Insufficient
Long-term food safety	Insufficient

17. Discussion

The evidence assembled in this review supports *R. hastatus* as a genuine **food–medicine continuum species** rather than simply another medicinal plant. The leaves have documented culinary value, while traditional medicinal uses encompass gastrointestinal, dermatological, inflammatory and hepatic complaints. The coexistence of food and medicinal use is important because regular dietary exposure could provide a low-dose route of exposure to phytochemicals that are otherwise investigated at substantially higher concentrations in pharmacological experiments.

The strongest experimental convergence occurs in the gastrointestinal domain. Traditional use for indigestion and diarrhoea is supported by animal studies showing antidiarrhoeal, antisecretory, antispasmodic and gastroprotective effects. The identification of calcium-channel and H^+/K^+-ATPase-related mechanisms and the investigation of rutin strengthen the biological plausibility of these findings.

The second major convergence is antioxidant activity. Root fractions rich in flavonoids demonstrate activity across numerous chemical assays, and more recent aerial-part work confirms substantial antioxidant activity. Nevertheless, antioxidant capacity measured by DPPH or ABTS should not be equated with clinical antioxidant efficacy. The biological relevance of a phytochemical depends on absorption, metabolism, tissue exposure and interaction with endogenous systems.

Hepatoprotection is another promising area. Both root and leaf fractions have demonstrated protection against CCl_4-induced injury. These findings provide experimental support for traditional liver-related applications but should not be interpreted as evidence for treating viral hepatitis, cirrhosis or other specific human liver diseases.

The anticancer evidence is more preliminary. Cytotoxicity, potato-disc tumour inhibition and CAM antiangiogenesis assays indicate biological activity, but the absence of selective tumour toxicity, pharmacokinetic data, mammalian tumour models and clinical studies makes therapeutic interpretation premature.

From a food-science perspective, the largest unresolved issue is **safety versus bioactivity**. *Rumex* species may contain substantial oxalate, and the level of oxalate in *R. hastatus* can reasonably be expected to depend on plant part, age, environment and preparation. Genus-level evidence warns that excessive oxalate exposure can reduce mineral absorption and increase kidney-stone risk.

Thus, future research should not ask simply whether *R. hastatus* is "medicinal." A more useful question is: **Which traditionally consumed preparation provides the best balance between nutritional value, bioactive phytochemicals, bioavailability and safety?**

This question could transform the species from a catalogue entry in ethnobotanical literature into a scientifically characterized Himalayan functional-food resource.

18. Conclusion

Rumex hastatus D.Don is a culturally important Himalayan wild plant positioned at the interface of food and ethnomedicine. Its leaves are consumed as a sour vegetable, salad or chutney ingredient, while traditional medical systems employ different plant

parts for gastrointestinal, inflammatory, dermatological, hepatic, respiratory and other complaints.

Chemical investigations demonstrate a diverse metabolite profile, including rutin, luteolin, vitexin, luteolin-7-O-glucoside, nepodin, rumexoside, orientaloside, resveratrol and hastatusides A and B. Experimental studies provide preclinical support for antioxidant, anticholinesterase, antidiarrhoeal, gastroprotective, anti-inflammatory, hepatoprotective, antimicrobial, cytotoxic, antitumour and antiangiogenic activities.

However, the evidence should be interpreted conservatively. Most pharmacological findings are based on crude extracts, solvent fractions or in-vitro assays, while human clinical evidence is essentially absent. Extract composition varies according to plant part, geography, altitude, season and solvent, making cross-study comparisons difficult.

The most promising research direction is therefore an integrated **ethnobotany–food chemistry–pharmacology–toxicology** approach. In particular, altitude-dependent metabolomics, traditional food-processing experiments, oxalate quantification, standardized extracts, bioavailability studies and controlled human safety studies should be prioritized.

Overall, *R. hastatus* should presently be regarded as a **promising traditional food and preclinical pharmacological resource**, rather than a clinically established medicinal plant. Its greatest scientific opportunity lies in determining how traditional culinary practices influence the concentration, bioavailability and safety of its potentially beneficial phytochemicals.

Declarations

Funding: No external funding is declared for this review.

Conflict of interest: The author declares no conflict of interest.

Ethical approval: Not applicable because this manuscript is a literature review and does not involve human participants or experimental animals.

Data availability: No new experimental dataset was generated.

Author contribution: The author conceived the review, performed the literature synthesis and prepared the manuscript.

ACKNOWLEDGEMENTS

Thanks are due to Head, Department of Botany, University of Jammu, and Principal Govt. Degree College, Mendhar, Surankote for providing laboratory facilities during the course of this study and to Department of Higher Education, Jammu and Kashmir for financial support.

19. References

1. Royal Botanic Gardens, Kew. *Rumex hastatus* D.Don. Plants of the World Online. Kew Science. Plants of the World Online—Rumex hastatus
2.] Zhang LS, Li Z, Mei RQ, Liu GM, Long CL, Wang YH, et al. Hastatusides A and B: two new phenolic glucosides from *Rumex hastatus*. Helv Chim Acta. 2009; 92:774-778. doi:10.1002/hlca.200800395. DOI: 10.1002/hlca.200800395
3. Sahreen S, Khan MR, Khan RA. Ameliorating effect of various fractions of *Rumex hastatus* roots against hepato- and testicular toxicity caused by CCl4. Oxid Med Cell Longev. 2013; 2013:325406. doi:10.1155/2013/325406. PMID:23766852.DOI: 10.1155/2013/325406 PMID: 23766852
4. Sahreen S, Khan MR, Khan RA. Comprehensive assessment of phenolics and antiradical potential of *Rumex hastatus* D. Don roots. BMC Complement Altern Med. 2014; 14:47. doi: 10.1186/1472-6882-14-47. PMID:24507200.DOI: 10.1186/1472-6882-14-47 PMID: 24507200
5. Ahmad S, Ullah F, Ayaz M, Sadiq A, Imran M. Antioxidant and anticholinesterase investigations of *Rumex hastatus* D. Don: potential effectiveness in oxidative stress and neurological disorders. Biol Res. 2015; 48:20. Doi : 10.1186/s40659-015-0010-2. PMID: 25857346. DOI: 10.1186/s40659-015-0010-2 PMID: 25857346
6. Sahreen S, Khan MR, Khan RA, Ben Hadda T. Evaluation of phytochemical content, antimicrobial, cytotoxic and antitumor activities of extract from *Rumex hastatus* D. Don roots. BMC Complement Altern Med. 2015; 15:211. doi: 10.1186/s12906-015-0736-y. PMID:26138389.DOI: 10.1186/s12906-015-0736-y PMID: 26138389
7. Ahmad S, Ullah F, Sadiq A, Ayaz M, Imran M, Ali I, et al. Chemical composition, antioxidant and anticholinesterase potentials of essential oil of *Rumex hastatus* D. Don collected from the North West of Pakistan. BMC Complement Altern Med. 2016; 16:29. doi:10.1186/s12906-016-0998-z.PMID:26810212.DOI: 10.1186/s12906-016-0998-z PMID: 26810212
8. Ahmad S, Ullah F, Zeb A, Ayaz M, Ullah F, Sadiq A. Evaluation of *Rumex hastatus* D. Don for cytotoxic potential against HeLa and NIH/3T3 cell lines: chemical characterization of chloroform fraction and identification of bioactive compounds. BMC Complement Altern Med.

2016;16:308.doi:10.1186/s12906-016-1302-y.PMID:27552817.DOI: 10.1186/s12906-016-1302-y PMID: 27552817

9. Ahmad S, Ullah F, Ayaz M, Zeb A, Ullah F, Sadiq A. Antitumor and anti-angiogenic potentials of isolated crude saponins and various fractions of *Rumex hastatus* D. Don. Biol Res. 2016;49:18.doi:10.1186/s40659-016-0079-2.DOI: 10.1186/s40659-016-0079-2
10. Singh S, Kaur R, Sharma SK. Antinociceptive, antiinflammatory and antipyretic activities of *Rumex hastatus* D. Don stem and roots. Der Pharmacia Sinica. 2013;4(3):95-102. Article record
11. Shakuntala BP, Sachan N, Chandra P, Gahlot K. Evaluation of antidiarrhoeal activity of extract from roots of *Rumex hastatus* (family: Polygonaceae) on experimental animals. J Appl Pharm Sci.2011;1(6):182-185.Article PDF
12. Sahreen S, Khan MR, Khan RA. Evaluation of *Rumex hastatus* leaves against hepatic fibrosis: a rat model. BMC Complement Altern Med. 2017;17:435.doi:10.1186/s12906-017-1943-5. PMID:28854968.DOI: 10.1186/s12906-017-1943-5 PMID: 28854968
13. Ahmad S, Ullah F, Ayaz M, Ahmad A, Sadiq A, Mohani SNUH. Nutritional and medicinal aspects of *Rumex hastatus* D. Don along with in vitro anti-diabetic activity. Food Nutr Res/Journal of Food?2019.doi:10.1080/10942912.2019.1666868.DOI: 10.1080/10942912.2019.1666868
14. Verma KK, Gautam RK, Choudhary A, Gupta GD, Singla S, Goyal S. A review on ethnobotany, phytochemistry and pharmacology on *Rumex hastatus*. Res J Pharm Technol. 2020;13(8):3969-3976.doi:10.5958/0974-360X.2020.00702.7.DOI:10.5958/0974-360X.2020.00702.7
15. Vasas A, Orbán-Gyapai O, Hohmann J. The genus *Rumex*: review of traditional uses, phytochemistry and pharmacology. J Ethnopharmacol. 2015; 175: 198-228. doi:10.1016/j.jep.2015.09.001.PMID:26384001.DOI: 10.1016/j.jep.2015.09.001 PMID: 26384001
16. Li JJ, Li YX, Li N, Zhu HT, Wang D, Zhang YJ. The genus *Rumex* (Polygonaceae): an ethnobotanical, phytochemical and pharmacological review. Nat Prod Bioprospect. 2022;12:21.doi:10.1007/s13659-022-00346-z.PMID:35710954.DOI: 10.1007/s13659-022-00346-z PMID: 35710954
17. Choudhary M, Choudhary A, Ghosh S, Puri S. Synergies of knowledge: a case study on traditional and scientific understandings of *Rumex nepalensis* and *Rumex hastatus* at different altitudes in Himachal Pradesh (India). Plant Biosyst. 2026; 160(2). doi: 10.1007/s44473-025-00020-5. DOI: 10.1007/s44473-025-00020-5
18. Sharma P, Guleria D, Dhiman S, Sehgal AK. Phytochemical profiling and in vitro evaluation of antioxidant, antimicrobial, hypoglycemic, and antiulcer activities of aerial parts of *Rumex hastatus* D. Don. Chem Biodivers. 2025/2026; 23(1):e02151. doi:10.1002/cbdv.202502151. PMID:41240332.DOI: 10.1002/cbdv.202502151 PMID: 41240332
19. Anis N, Ahmed D. Modelling and optimization of polyphenol and antioxidant extraction from *Rumex hastatus* by green glycerol-water solvent according to response surface methodology. Heliyon. 2022; 8 (12):e11992. doi:10.1016/j.heliyon.2022.e11992. PMID: 36478800. DOI: 10.1016/j.heliyon.2022.e11992 PMID: 36478800
20. Singh J, Rajasekaran A, Negi AK, Negi SP. Utilization of edible wild plants as supplementary source of nutrition by indigenous communities in Kinnaur District, Himachal Pradesh, India. 2019.Article record
21. Devi U, Sharma P, Ahmad A, Khan AS. Wild plant resources used as food in Spiti Valley: a cold arid zone of Himachal Pradesh, India. J Med Plants Stud. 2023; 11(4):106-114. doi:10.22271/plants.2023.v11.i4b.1576.DOI: 10.22271/plants.2023.v11.i4b.1576
22. Ethnomedicinal plants used in the health care system: survey of the mid hills of Solan District, HimachalPradesh,India.2021.Full text
23. Gohar M, et al. *Rumex* species: phytochemistry, pharmacology and nutritional potential for food and health applications. Food Sci Nutr. 2025. doi:10.1002/fsn3.71300. DOI: 10.1002/fsn3.71300
24. Ullah A, et al. Pharmacological basis of *Rumex hastatus* D. Don in gastrointestinal diseases with focusing effects on H^+/K^+-ATPase, calcium channels inhibition and

PDE mediated signaling: toxicological evaluation on vital organs. Molecules. 2022; 27(18):5919. PMID:36144661.Article/DOI record PMID: 36144661