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DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.397>

ETHNOMEDICINAL AND PHARMACOLOGICAL USES OF *RHEUM AUSTRALE* D. DON: A COMPREHENSIVE REVIEW

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(Date of Receiving-08-07-2025; Date of Acceptance-21-09-2025)

ABSTRACT

Rheum australe D. Don (Himalayan rhubarb) has been used as a medicinal herb in folk or traditional medicines since antiquity. It is used for the treatment of wide range of ailments like constipation, indigestion, diarrhea, muscular pain, skin problems, and cough. It also shows variety of pharmacological activities like anticancer, antimicrobial, antioxidant, anti-inflammatory, antidiabetic, antiulcer, immune-enhancing, hepatoprotective, and nephroprotective etc. However, these therapeutic uses need some studies to be done on isolated compounds to validate their traditional uses in human models. Due to high ethnomedicinal and pharmacological uses its demand in pharma industries is increasing, therefore the species is overexploited in its natural habitats, rendering it endangered. Hence, this plant requires immediate and effective conservation strategies. The present article reviews on ethnomedicinal and pharmacological uses of *Rheum australe* which would be useful in further studies of this plant.

Key words: *Rheum australe* D. Don, Ethnomedicinal uses, Pharmacological uses

Introduction

The English word 'Rhubarb' is of Latin origin derived from the word 'rhabarbarum' where 'rha' means river and 'barb' means barbarian land. It is called so because in ancient times Romans used to import the roots of this plant from barbarian lands which were beyond the Rha (Vogue or Volga) river. As per Lindley's Treasury of Botany, and in allusion to the purgative properties of the root, some authorities are known to derive the name from the Greek word 'rheo' which means to flow (Malik *et al.*, 2016).

Rheum australe is a perennial stout herb belonging to family polygonaceae and commonly known as Himalayan Rhubarb/Indian rhubarb and Red-veined Pie Plant. *Rheum australe* D. Don. As per written record, it is for the first time collected by N. Wallich between 1828 and 1849 (1727.1, lectotype of *Rheum australe* deposited in Kew) and was described by Don in Prodrum Florae Nepalensis (1825). The synonym of *Rheum australe* is *Rheum emodi* which is given by C. Meissner in 1832

which is actually a misnomer. Therefore, *Rheum australe* is used as the accepted name for this plant (Press *et al.*, 2000). Classification of *Rheum australe* is given in Table 1.

Rheum australe is a rhizomatous robust medicinal plant containing long and thick leafy stalks. It has broad heart-shaped and red veined leaf blade. Its panicle inflorescence is very long (1 foot) with densely branched papilliferous flowers. Pedicellate flowers are small (3 mm) in size and dark reddish-purple in colour. It flowers in June and July and fruit sets in August and September (Li *et al.*, 2003, Malik *et al.*, 2016, Rokaya *et al.*, 2012) Morphological description of *Rheum australe* in brief is given in Table 2.

Rheum australe is endemic to the Himalayan region, occurring in the areas of Bharat, Bhutan, China, Nepal, Myanmar and Pakistan. It grows in grassy or rocky slopes from subalpine to alpine region at an altitudinal range of 3200–5200 m (Li *et al.*, 2003). It has been cultivated over 5000 years for its medicinal properties. It propagates

Table 1: Classification of *Rheum australe* D. Don (Malik *et al.*, 2016).

Taxonomic Ranks	Taxons
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Caryophyllales
Family	Caryophyllales
Genus	Polygonaceae
Species	<i>Rheum australe</i> D. Don
Synonym	<i>Rheum emodi</i> Wall. ex Meisn

both by rootstocks and seeds. Rootstocks sprout successfully when they are cut into pieces and planted in natural habitat or cultivated lands during May through June. Mature seeds germinate successfully when collected at October end and sown in its natural habitat or in cultivated land either at the beginning of November or in February through April (Nautiyal *et al.*, 2002, Bhattarai and Ghimire, 2006).

Ethnomedicinal Uses of *Rheum australe*

Rheum australe is an important medicinal plant commonly known as Himalayan rhubarb. There are so

Table 2: Morphology features of *Rheum australe*.

Botanical Features	Botanical Description	Reference
Habitat	Near the stream areas, forest margins, grassy/rocky slopes, crevices and moraines at an altitude of 3200–5200 m, prefers moist and humus-rich soil with heavy loam and medium clay soil	Press <i>et al.</i> , (2000), Pandith <i>et al.</i> , (2018)
Habit	<i>Rheum australe</i> is a rhizomatous robust perennial herb, 1-2 (3) m of height with thick leafy stalks	Li <i>et al.</i> , (2003), Malik <i>et al.</i> , (2016), Rokaya <i>et al.</i> , (2012)
Stem	Smooth, streaked green and brown with purple to red shade, glabrous or pubescent at nodes	
Leave	Heart-shaped, red veined, rough, wrinkled and roundish leaf blade with entire margin and sinuate with an obtuse apex, long petiole and thick blade with 5-7 basal veins, basal leaves are larger, upper leaves are smaller	
Inflorescence	Long panicle inflorescence (around one foot), fastigiately branched and densely papilliferous	
Flower	Pedicellate, small (3 mm) and dark reddish-purple, perianth spread is 3–3.5 mm in diameter with outer parts smaller and oblong-elliptic, flowering time June and July	
Fruit (Ripened ovary)	Ovoid-ellipsoid/ovoid-oblong in shape, small in size (13 mm), narrow winged, cordate base and notch at apex, fruiting time is August and September	
Seed (Ripened ovule)	Seeds are winged and harvested when turned into dark brown in colour, seeds formed in late August to mid of September	

Table 3: Ethnomedicinal uses of *Rheum australe*.

S. No.	Ailments/ Uses	Plant Parts	Method of use	Place (India)	Vernacular name	Reference
1	Cold	Rhizome	Oral administration of rhizome paste	Ukhimanth, Uttarakhand	Archu	Semwal <i>et al.</i> , (2010)
2	Cough	Rhizome	Paste is taken orally	Ukhimanth, Uttarakhand	Archu)	Semwal <i>et al.</i> , (2010)
3	Constipation	Rhizome	The liquid extract is administered orally.	Parvativally, Himachal Pradesh	Chukri, Leechu Chuchi	Sharma <i>et al.</i> , (2004)
4	Boils	Rhizome	A decoction combined with ghee or oil is used twice daily for 2–3 days around boils	Lahul-Spiti, Himachal Pradesh	Tukshu, Lichu, Artho, Chucha	Lal and Singh (2008)
5	Bone ache	Rhizome	Turmeric is fried in ghee to create a paste, which is then applied	Jaunsar region, Dehradun	Archu, Dolu	Bhatt and Negi (2006)

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6	Asthma/ bronchitis	Rhizome	Rhizome pills made from powder roasted with butter are given for about a month	Nanda devi, Uttarakhand	Archu, Chukri, Leechu	Rana <i>et al.</i> , (2010)
7	Dysentery	Root/ Rhizome	The powder or paste is ingested with water	Tamil Nadu, , Parvativally, Himachal Pradesh, Ukhimanth, Uttarakhand	Latechuk, Archu, Chukri, Leechu	Kunwar & Adhikari (2005), Sharma <i>et al.</i> , (2004), Semwalet <i>et al.</i> , (2010)
8	Earache	Rhizome	The juice from the rhizome is placed in the ear to relieve ear pain	Parvati valley	Chukri, Leechu, Chuchi	Sharma <i>et al.</i> , (2004)
	Flatulence	Whpl	Unspecified	Himachal	Archo	Sharma <i>et al.</i> , (2011)
9	Diarrhoea	-	It can be taken with gum of acacia and dried roses	Pradseh		Daniyal et al. (2019)
10	Frost bite	Rhizome	A paste is spread on the impacted areas of the body	Kashmir	Pan Tsalen	Malik <i>et al.</i> , (2011)
11	Goiter	Rhizome	1 gram of paste is administered daily for a duration of seven days	Niti valley, Uttarakhand	Dolu	Phondani <i>et al.</i> , (2010)
12	Headache	Root	A paste is put onto the forehead	Nepal and Parvati valley	Chukri, Leechu	Kunwar & Adhikari (2005)
13	Injury (internal)	Rhizome	Paste is taken orally	Ukhimanth, Uttarakhand	Archu	Semwal <i>et al.</i> , (2010)
14	Injury (external)	Rhizome	Paste is mixed with water And then applied externally	Parvati valley	Chukri, Leechu	Sharma <i>et al.</i> , (2004)
15	Joint pain	Roots	Powder mixed with mustard oil and then is applied on joints pain.	Kishtwar, Jammu and Kashmir	Chukri	Kumar <i>et al.</i> , (2009)
16	Mumps	Rhizome	Paste is mixed with water and applied externally	Parvati valley	Chukri, Leechu	Sharma <i>et al.</i> , (2004)
17	Scabies/ Skin disease	Roots	Decoction is applied twice a day for 2–3 days	Lahul-Spiti, Himachal	India Tukshu, Lichu, Artho, Chucha	Lal and Singh (2008)
18	Bruises	Roots	Taken with grapes water	Unspecified	Unspecified	Sina, (2010)
19	Haemoptysis	Root	The crushed root is chewed for some time			
20	Stomach ache	Rhizome	Powder roasted with butter, made into pills and one pill is taken twice a day for 30–45 days, Paste is taken orally	Ukhimanth, Nanda Devi, Uttarakhand, Parvati valley, Himachal Pradesh	Archu, Chukri, Leechu	Rana <i>et al.</i> , (2010), Sharma <i>et al.</i> , (2004), Semwal <i>et al.</i> , (2010)

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21	Swelling	Rhizome	Whole plant is crushed and poultice is made in a cotton cloth. This is then heated and applied affected part	Chhota Bhangal, Himachal, Kishtwar, Jammu and Kashmir	Chukri	Uniyal <i>et al.</i> , (2006), Kumar <i>et al.</i> , (2009)
22	Teeth cleaning	Root	Powder is used in teeth cleaning	Himachal Pradesh	Archa, Chuchi, Chukri, Tukshu,	Chauhan (1999)
23	Tonsillitis	Rhizome	The watery extract is given orally	Parvati valley, Himachal Pradesh	Chukri, Leechu	Sharma <i>et al.</i> , (2004)
24	Wounds	Rhizome/Root	Powder is sprinkled over the wound	Himachal Pradesh	Archa, Chuchi, Chukri, Chukri, Leechu,	Chauhan (1999)
25	Body pain	Rhizome	Rhizome/mixture of rhizome paste, turmeric powder and refined fat is used	Uttarakhand	Archu	Semwal <i>et al.</i> , (2010)
26	rhinitis	Root	The root powder is used with honey	Unspecified	Unspecified	Singh <i>et al.</i> (2017)
27	Paralysis,	Root	Taken with Aloe vera	Unspecified	Unspecified	
28	Migraine	Root	Taken with Aloe vera	Unspecified	Unspecified	
29	Indigestion	Root	Taken with lukewarm water or Aloe vera	Unspecified	Unspecified	Malik <i>et al.</i> (2016)
30	Skin marks and freckles	Root	Paste of Rheum australe root mixed with vinegar is applied to the affected part	Unspecified	Unspecified	

Table 4: Phytochemicals of *Rheum australe*.

S.No.	Phytochemical (classes)	Phytochemical (compounds)	Ref.
1	Anthraquinones	Rhein, 6-methyl-rhein, emodin Aloe-emodin, chrysophanol, physcion	Seo <i>et al.</i> , (2012), Arvindekar <i>et al.</i> , (2015), Mishra (2016)
2	Anthrones	anthrone C-glucosides, cascarioside D, cassialoin	Krenn <i>et al.</i> , (2004),
3	Carbohydrate and Sterol	Sucrose and b-Sitosterol	Wang <i>et al.</i> , (2010)
4	Stilbenes	Rhapontigenin, rheumaustrolin, resveratrol, Desoxyrhaponticin, desoxyrhapontigenin, piceatannol	
5	Lignan	Daucosterol	Babu <i>et al.</i> , (2003)
6	Esters	Revandchinone-1, revandchinone-2	
7	Ethers	Revandchinone-3, revandchinone-4	
8	Phenolics	Catechin, epicatechin, rutin, carpusin, daidzein, kaempferol, myricetin, quercetin,	Singh <i>et al.</i> , (2013)

many ethnomedicinal uses of *Rheum australe* which has been employed in the treatment of number of ailments like cough, cold, cut, swelling, malaria and kidney stones etc. There is list of 30 ailments of different types which are treated by using various parts of this plant. This plant has different vernacular names in different geographical regions and different methods of its ethno-medicinal uses as shown in Table 3.

Pharmacological Uses of *Rheum australe*

Numerous pharmacological investigations have documented the bioactive properties of rhubarb, including antimicrobial, anti-inflammatory, antifungal, anti-cancer, antioxidant, anticoagulant, and anti-platelet properties. Numerous phytoconstituents, including anthraquinones, stilbenes, flavonoids, tannins, saponins, and volatile oils, are found in *Rheum australe*, or rhubarb (Nazir *et al.*,

Table 5: Pharmacological uses of *Rheum australe*.

S. No.	Biological activities	Formulations/compounds	Pharmacological Effects	Ref.
1	Anticancerous activity 1. Human breast cancer 2. Human liver cancer 3. Human hepatocellular cancer 4. Human prostate cancer	Methanolic, aqueous, ethyl acetate extract	Lowers the malignancy and tumor growth that leads to cancer, and it demonstrates selective toxicity toward cancer cells.	Rajkumar <i>et al.</i> , (2011a), Rajkumar <i>et al.</i> , (2011b), Zargar <i>et al.</i> , (2011), Kumar <i>et al.</i> , (2015)
2	Antifungal activity 1. Human skin diseases	Isolated anthraquinone derivatives i.e. rhein, physcion, aloe-emodin, chrysophanol	Prevents the proliferation of various fungi, including <i>Candida albicans</i> , <i>Cryptococcus neoformans</i> , <i>Sporotrichum schenckii</i> , <i>Trichophyton mentagrophytes</i> , and <i>Aspergillus fumigatus</i> , which are responsible for skin diseases.	Agarwal <i>et al.</i> , (2000)
3	Antibacterial activity 1. Dysentery in humans 2. Bacterial acute gastroenteritis in humans	Ethanolic extract, Hydromethanolic extract	Inhibits the proliferation of <i>Shigella dysenteriae</i> , which leads to dysentery. Also stops the growth of <i>E. coli</i> , <i>E. aerogenes</i> , <i>Salmonella infantis</i> , <i>S. typhimurium</i> , and those that cause bacterial acute gastroenteritis, such as Streptomycin.	Aqil & Ahmad (2003), Jiang <i>et al.</i> , (2017)
4	Antioxidant activity	Methanolic and aqueous extracts	Enhances free radical scavenging activity.	Rajkumar <i>et al.</i> , (2011a)
5	Anti-inflammatory activity	Isolated anthraquinone derivatives i.e. Emodin, Aloe-emodin	Blocks the expression of iNOS (inducible nitric oxide synthase) mRNA triggered by lipopolysaccharides, which is well-known to initiate angiogenesis.	Choi <i>et al.</i> , (2013),
6	Antidiabetic activity	Ethanolic extract, Isolated flavonoid derivative Kaempferol, Isolated anthraquinone derivative Rhein	Improves glucose utilization, Safeguards beta-cells from glucotoxic effects, Suppresses the heightened activity of the hexosamine pathway crucial for kidney damage in diabetic conditions.	Radhika <i>et al.</i> , (2010), Zhang and Liu (2011), Hao <i>et al.</i> , (2014)
7	Hepatoprotective activity	Ethanolic extract	Enhances liver cell recovery	Ibrahim <i>et al.</i> , (2008)
8	Anti-platelet aggregation and anti-coagulant activity	Methanolic extract	Stimulates the activity of collagen and thrombin. It extends the activated partial thromboplastin time in coagulation test.	Seo <i>et al.</i> , (2012)
9	Nephroprotective activity	n-butanol extract	Lowers the intensity of kidney injury affected the kidney functions.	Zhang <i>et al.</i> , (2015)

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10	Antidyslipidemic activity	Ethanolic extract	Reduces high lipid levels and the risk of cardio vascular diseases	Mishra <i>et al.</i> , (2014)
11	Anti-ulcer activity	Ethanolic extract	Demonstrates significant anti-ulcer properties by preventing different kinds of ulcers	Kaur <i>et al.</i> , (2012)
12	Cardioprotective activity	Isolated anthraquinone derivatives i.e. Emodin	Improves the antioxidant elements of mitochondria to demonstrate protective effects on the heart.	Zhang <i>et al.</i> , (2016)
13	Neuroprotective activity	Isolated anthraquinone derivatives i.e. Emodin	Modulates the expression of connexin 43 and aquaporin 4 to provide neuroprotective effects.	Li <i>et al.</i> , (2018)
14	Anti-SARS activity	Isolated anthraquinone derivatives i.e. Emodin	Blocks the binding of the S protein to the receptor on the host cell.	Ho <i>et al.</i> , (2007)

2013). Stilbenes (piceatannol, resveratrol) and anthraquinones (aloe-emodin, chrysophanol, emodin, physcion, and rhein) with their glycoside derivatives are the active compounds of *Rheum australe* (Kaur *et al.*, 2015, Malik *et al.*, 2010a, Wang *et al.*, 2010). The rhizome of the plant has been shown to contain anthrone C-glucosides and several oxanthrone derivatives, including revandchinone-1, revandchinone-2, revandchinone-3, and revandchinone-4. Furthermore, *Rheum emodi* was found to contain two uncommon auronols, carpusin and maesopsin (Krenn *et al.*, 2003). Moreover, compounds like naphthoquinones, rutin, rheinal, and epicatechin have also been isolated (Singh *et al.*, 2005). The list of important classes of phytochemicals of *Rheum australe* is given in Table 4. The pharmacological uses of various formulations of rhubarb extracts or isolated compounds against different biological activities are given in Table 5.

Conclusion

The present review on *Rheum australe* has shown that it is an important medicinal plant having a wide range of ethnomedicinal and pharmacological uses. It is a plant of Himalayan region which is used in different medicine systems. Roots and rhizomes of this plant contain a variety of phytoconstituents which are effective in ethnomedicinal and pharmacological uses. The pharmacological potential of *Rheum australe* is due to the various classes of chemical compounds like anthraquinones, stilbenes, flavonoids, tannins, saponins and volatile oils. Important anthraquinones are aloe-emodin, chrysophanol, emodin, physcion rhein and important stilbenes are piceatannol, resveratrol etc. The pharmacological studies have tested the validity of traditional uses of this plant for its antifungal, antimicrobial and anti-inflammatory activities.

Ethnomedicinally, the plant is used in the treatment of various ailments like constipation, stomachache, dysentery, blood disorders, broken or fractured bones and sprains etc. The effective measures must be taken care to preserve the wild population of *Rheum australe* to halt its further decline, because this plant is habitat-specific in growth and also vulnerable (leading towards endangered) due to its substantial exploitation for its various phytochemicals with therapeutic properties. In the Himalayan region, the natural populations of *R. australe* are greatly affected by several factors like climate changes, over-harvesting, grazing, and genetic bottlenecks, which contribute to its rare distribution. Cultivation techniques for the propagation of plant must be formulated for the commercial exploitation of its therapeutic potential.

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