



## Review

## *Rheum australe* D. Don: A review of its botany, ethnobotany, phytochemistry and pharmacology

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## ABSTRACT

**Ethnopharmacological relevance:** *Rheum australe* D. Don (Polygonaceae) has been commonly used in traditional medicine for a wide range of ailments related to the circulatory, digestive, endocrine, respiratory and skeletal systems as well as to infectious diseases.

**Aim of the review:** To provide the up-to-date information that is available on the botany, traditional uses, phytochemistry, pharmacology and toxicology of *Rheum australe*. Additionally, to highlight the possible uses of this species to treat different diseases and to provide a basis for future research.

**Materials and methods:** The present review covers the literature available from 1980 to 2011. The information was collected from scientific journals, books, theses and reports via a library and electronic search (Google Scholar, Web of Science and ScienceDirect).

**Results:** Ethnomedical uses of *Rheum australe* have been recorded from China, India, Nepal and Pakistan for 57 different types of ailments. The phytochemical studies have shown the presence of many secondary metabolites belonging to anthraquinones, stilbenes, anthrones, oxantrone ethers and esters, chromones, flavonoids, carbohydrate, lignans, phenols and sterols. Crude extracts and isolated compounds from *Rheum australe* show a wide spectrum of pharmacological activities, such as antidiabetic, anti-inflammatory, antifungal, antimicrobial, antioxidant, anticancer, hepatoprotective and immun-enhancing activities, as well as a usefulness for improving renal function.

**Conclusion:** *Rheum australe* has been widely used source of medicine for years without any adverse effects. Many studies have provided evidence for various traditional uses. However, there is a need for additional studies of the isolated compounds to validate the traditional uses in human models. The present review on the botany, traditional uses, phytochemistry and toxicity has provided preliminary information for further studies and commercial exploitations of the plant.

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**Abbreviations:** AAS, atomic absorption spectroscopy; ALP, alkaline phosphatase; ALT, alanine transaminase; AST, aspartate transaminase; CAMP, The Conservation Management Assessment Plan; CCl<sub>4</sub>, carbon tetrachloride; DPPH, 2,2-diphenyl-1-picrylhydrazyl; GPT, glutamate pyruvate transaminase; LDH, lactic dehydrogenase; LPI, lipid peroxidation; MeOH, methanolic extract; MIC, minimal inhibitory concentration; NRs, Nepali Rupees; *R. australe*, *Rheum australe*; *R. emodi*, *Rheum emodi*; TBIL, total bilirubin; W-INS, methanolic water-insoluble; W-S, methanolic water-soluble.

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## 1. Introduction

The use of medicinal plants in the Indian subcontinent can be traced back to the Vedic period. The texts mentioning the uses of different medicinal plants are the Rigveda (written between 4500 and 1600 BC), the Atharveda (2000–1000 BC), the Charaka Samhita (~900 BC) and the Sushruta Samhita (~600 BC); these texts are written in Sanskrit (Anonymous, 1970; Singh et al., 1979; Dev, 1999). Various ancient texts have mentioned *Rheum australe* D. Don (Polygonaceae) being used for udara roga (stomach problems), amala pitta (gastritis), yakrit vikar (liver diseases), rakta moksha (blood purification) and rakta pradhara (menstrual problems). In addition to the Ayurveda system, *Rheum australe* is widely used in many traditional medical systems, such as the Chinese, homeopathic, Tibetan and Unani systems (Anonymous, 1972; Coburn, 1984; Lama et al., 2001; Babu et al., 2003; Bhatia et al., 2011; Rokaya et al., 2010).

There has been a tremendous interest in *Rheum australe*, as evidenced by the many studies carried out in recent years (e.g., Zargar et al., 2011 and references there in). It is important to establish an association between the traditional uses and the recent studies of *Rheum australe*, as has been performed for many other plants (e.g., Singh et al., 2011; Patel et al., 2011). The present review compiles the fragmented information on the botany, traditional uses, phytochemistry, pharmacology and toxicology of this plant. We hope that this information will highlight the importance of *Rheum australe* and will provide a new direction for researchers in the future. Specifically, we aimed to answer the following questions. (1) What information is available on the traditional uses, botany, phytochemistry and toxicity of *Rheum australe*? (2) Are there any pharmacological studies that validate its traditional uses? (3) What are the different therapeutic potentials and future research opportunities for *Rheum australe*?

### 1.1. Taxonomy and morphology

*Rheum australe* D. Don was first collected by N. Wallich between 1828 and 1849 (1727.1, lectotype of *Rheum australe* deposited in Kew) and was described by Don in *Prodromus Florae Nepalensis* (1825). The synonym of *Rheum emodi* Wall. ex Meisn. given by C. Meissner in 1832 was a misnomer; thus, *Rheum australe* is used as the accepted name (Press et al., 2000).

*Rheum australe* ( $2n=22, 44$ ) is a robust, perennial, 1–2 (-3) m tall, glabrous herb with stout rhizomes. The stems are glabrous or pubescent at the nodes. The basal leaves have 30–40 long petioles and thick blades. The leaves are thick, orbicular, ovate-elliptic or broadly ovate with 5–7 basal veins, a cordate base, entire margin and sinuate with an obtuse apex. The upper leaves are smaller. The inflorescence is large, fastigiate branched and densely papilliferous. The flowers are pedicellate and dark purple. The perianth is spreading, 3–3.5 mm; the three outer parts of the perianth are smaller and oblong-elliptic. The filaments are subulate. The ovary

is rhomboid-obovoid, and the stigma is oblate and muricate. The fruit is ovoid-ellipsoid, broadly ellipsoid or ovoid-oblong in shape, large (0.5–1.5 cm), long and purple, with wings more narrow than thick and notched at both ends. *Rheum australe* flowers from June to August and fruits from July to September (Li et al., 2003; see Fig. 1).

### 1.2. Distribution and propagation

*Rheum australe* is endemic to the Himalayan region, covering the areas of Bhutan, China (southern Tibet or S. Xizang), India (Kashmir, Sikkim), Myanmar, Nepal and Pakistan. It grows in grassy or rocky slopes at higher altitudes and in forest margins at an altitude of 3200–5200 m (Press et al., 2000; Li et al., 2003).

Plant propagation is by either rootstocks or seeds. Rootstocks can be cut into pieces. They can successfully sprout when planted in soil in *Rheum australe*'s natural habitat or in cultivated land during May through June. Mature seed collected at the end of October will successfully germinate both when sown in *Rheum australe*'s natural habitat or in cultivated land at the beginning of November, immediately after collection (Nautiyal et al., 2002), or in February through April (Bhattarai and Ghimire, 2006). Germination starts after 7–10 days and continues for one month, and better germination occurs when the seeds are soaked in water for 10–12 h before sowing (Bhattarai and Ghimire, 2006). It is best to maintain the seedlings for one year in the same sown area and then to transplant them in March or April to another place. Propagation is best in well-drained, sandy, porous soil that is rich in humus. Petioles can be harvested after a year, but good rootstocks with the highest percentage of active contents are obtained 4–5 years after germination (Nautiyal et al., 2002).

There have been attempts to develop *in vitro* techniques for the mass propagation of *Rheum australe* from the shoot tip leaves (Lal and Ahuja, 1989, 1993), the rhizome buds or the stem segments (Pandey et al., 2008; Malik et al., 2009). These techniques, however, remain experimental procedures, and additional studies are required for improved output.

### 1.3. Trade and conservation status

Like most medicinal plants, *Rheum australe* is generally collected from the wild (Edwards, 1996; Acharya and Rokaya, 2005; MoFSC/DF (2008/2009)). According to a report from Nepal (MoFSC/DF (2008/2009)), the total traded amount of *Rheum australe* in 2009 was 47,066 kg, with total revenue amounting to 467,895 Nepali Rupees (NRs) (6684 US\$, 1 US\$ = 70 NRs). As per Forest regulations (1995), the revenue for rootstock is 5 NRs per kg and for petioles is 3 NRs per kg (MoFSC/FDP, 1995). The Conservation Management Assessment Plan (CAMP) workshop held in Nepal (2001) classified *Rheum australe* as vulnerable due to the threat of over-harvesting for trade. Moreover, this species falls under the list of 30 prioritised medicinal and aromatic plants that was developed by the Government of Nepal and is highly recommended for research

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