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Ceropegia juncea Roxb.: A Review

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Abstract

Plants are a rich source of bioactive compounds, and many herbs yield phyto-constituents that can be isolated for therapeutic use. This review examines the distribution, morphology, phytochemistry, and pharmacology of *Ceropegia juncea* Roxb. Preliminary phytochemical screening revealed steroids, terpenoids, anthocyanins, anthracene glycosides, coumarins, flavonoids, fatty acids, phenolic compounds, alkaloids, carotenoids, tannins, saponins, carbohydrates, lipids, sugars, potassium, lupeol, and stigmasterol. Fourier-transform infrared spectroscopy (FTIR) identified functional groups corresponding to alcohols, aldehydes, alkynes, alkenes, and amines, with no esters detected. High-performance liquid chromatography (HPLC) and high-performance thin-layer chromatography (HPTLC) confirmed the presence of ceropegin, which has been reported to possess hypotensive, hepatoprotective, antiulcer, and antipyretic activities. Coumarins isolated from *C. juncea* Roxb. exhibit anticoagulant, antioxidant, antiallergic, antithrombotic, anti-inflammatory, antiproliferative, antiviral, anticancer, analgesic, cytoprotective, and modulatory effects. Both ceropegin and coumarins are traditional constituents of soma drink preparations, and twenty-nine distinct components have been isolated to date. Antimicrobial studies further demonstrate the plant's inhibitory effects against several bacterial pathogens. This review synthesizes the medicinal significance of *Ceropegia juncea* Roxb. in both traditional and Ayurvedic medicine.

Keywords

Phytochemistry, pharmacology, antimicrobial, soma drink, ceropegin.

Introduction

Herbal medicines play a vital role in primary healthcare worldwide. Industrialization and modernization have reshaped lifestyles and increased reliance on natural remedies. *Ceropegia juncea* Roxb. a twining perennial herb of the subfamily Asclepiadoideae (family Apocynaceae) thrives in tropical regions including Southeast Asia, the Canary Islands, New Guinea, Tropical Arabia, Africa, the Mediterranean, and northern Australia. In India, it is endemic to the Western Ghats and comprises one of more than 55 *Ceropegia* species documented in the region (Muthukrishnan et al., 2013). Globally, the tribe Ceropegieae encompasses approximately 200 species distributed around the Indian Ocean margins (Subbiyan et al., 2015). *C. juncea* Roxb. is classified as "threatened" by the IUCN (Uma & Parthipan, 2015) and bears close resemblance to *Sarcostemma acidum* Wight & Arn. and *Cynanchum viminale* L. in phytochemical composition and traditional uses (Deepak et al., 2021).

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Morphologically, *C. juncea* Roxb. produces fascicled tuberous roots and lanceolate leaves on young, scaly stems; mature stems lack foliage. The inflorescences are axillary umbels of yellow-green to purple, goggle-shaped corolla tubes dotted with purple pigmentation. Pollen is aggregated into pollinia, and fruits develop as elongated follicles bearing winged seeds adapted for anemochory (Chintha Pradeepika, 2018; Karuppusamy & Pullaiah, 2009). Flowering and fruiting occur annually between July and November (Sri Rama Murthy et al., 2012). Vegetative propagation is achieved via root tubers and stem cuttings (Shete, 2014). Historical botanical records such as *Flora of the Madras Presidency* (Gamble, 1935) and *Flora of Tamil Nadu Carnatic* (Mathew, 1991) have documented its traditional identification.

Local vernacular names include:

- **Tamil**: Pulicha kodi, Velipulichan
- **Sanskrit**: Somalata, Somaraji, Soma valli
- **Hindi**: Somalata
- **Telugu**: Pullakada, Bellagada
- **Malayalam**: Somalata, Bhutumbi (Sudha Karayil & Veeraiah, 2014)

Traditional Uses

Indigenous communities have long utilized *C. juncea* Roxb. extracts for their rich antioxidant content. The plant is a principal ingredient in soma drink formulations, reputed to treat gastrointestinal disorders, fevers, hypertension, and act as a sedative and local anesthetic (Visveshwari et al., 2017; Binish et al., 2018; Bhardwaj & Sharma, 2019). Decoctions of stems and leaves are administered to alleviate ulcers, bacterial infections, and inflammation (Mownika et al., 2021). Among the Paliyan tribe of the Sirumalai Hills, crushed stems combined with goat milk serve as an oral ulcer remedy (Uma & Parthipan, 2015).

Threatened Status

Overexploitation for its medicinal and ritual uses, habitat loss, low seed set and germination, and anthropogenic disturbances have placed *C. juncea* Roxb. at risk (Sri Rama Murthy et al., 2012; Subbiyan et al., 2015). Conservation efforts are impeded by limited public awareness and reproductive constraints under natural conditions.

Phytochemistry

Qualitative analyses of *C. juncea* Roxb. consistently report the presence of alkaloids, carotenoids, steroids, terpenoids, anthocyanins, anthracene glycosides, coumarins, flavonoids, fatty acids, phenolics, saponins, carbohydrates, sugars, and potassium (Sharma Paras et al., 2011; Visveshwari et al., 2017; Sudha Karayil et al., 2014; Muthukrishnan et al., 2013). HPTLC profiling confirmed lupeol and stigmasterol, while GC-MS analysis of methanolic extracts identified p-(dimethylamino)benzaldehyde oxime among twenty-nine other components (Deepak et al., 2021). FTIR spectra exhibited characteristic peaks for O–H (alcohol), C=O (aldehyde), C≡C (alkyne), C=C (alkene), and N–H (amine) groups; ester functionalities were absent (Visveshwari et al., 2017). Polyuronoids and chlorogenic acids were not detected via TLC (Sudha Karayil & Veeraiah, 2014).

Ceropegin

Ceropegin a pyridine alkaloid unique to *C. juncea* Roxb. has been isolated through fractionation techniques (Nikam & Savant, 2009). Pharmacological assays demonstrate its tranquilizing, hypotensive, hepatoprotective, antiulcer, antipyretic, and topical anesthetic activities in animal models, with convulsant effects observed at doses ≥200 mg/kg in mice (Khare, 2007; Chintha Pradeepika, 2018). Ceropegin is also a key constituent of traditional soma beverages (Matsuo & Arase, 1995).

Coumarins

HPLC and TLC analyses have identified 4-methylcoumarin among the bioactive constituents of *C. juncea* Roxb. This compound exhibits a broad spectrum of therapeutic activities, including anticoagulant, hepatoprotective, antioxidant, antiallergic, antithrombotic, anti-inflammatory, antiproliferative, antiviral, anticancer, analgesic, cytoprotective, and modulatory functions and holds significant pharmaceutical potential (Sudha Karayil et al., 2014).

Antimicrobial Activity

Methanolic extracts of *C. juncea* Roxb. exhibit notable inhibitory effects against Gram-negative bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*, and *Klebsiella pneumoniae*, while aqueous extracts inhibit *Proteus vulgaris* (Boomibalagan et al., 2015). No activity was observed against *Candida albicans*. Variations in inhibition zones reflect species-specific susceptibilities. These antimicrobial properties support the plant's traditional use in treating urinary tract infections and related disorders (Visveshwari et al., 2017). Notably, pure ceropegin does not display significant antibacterial activity against selected Gram-positive or Gram-negative strains (Chintha Pradeepika, 2018).

Pharmacology Values

Toxicity studies have shown that *Ceropegia juncea* Roxb. extracts are safe up to a maximum dose of 3000 mg/kg body weight in experimental animals. No observable changes in physical appearance or signs of toxicity, including mortality, were reported. Biological assessments were conducted at doses of 100, 200, 300, and 400 mg/kg body weight (Sharma Paras et al., 2011). Moreover, sub-acute toxicity was significantly reduced with *C. juncea* administration, and minimal side effects were observed (Chintha Pradeepika, 2018).

Gastroprotective properties were evaluated by assessing ulceration using a magnifying lens and measuring the ulcer diameter with a vernier caliper. The ulcer scoring system was as follows:

- Score 1: Diameter ≤ 1 mm
- Score 2: Diameter 1–2 mm
- Score 3: Diameter 2–3 mm
- Score 4: Diameter 3–4 mm
- Score 5: Diameter 4–5 mm
- Score 10: Diameter > 5 mm
- Score 25: Perforated ulcer

The mean ulcer index in the experimental group was 89.36 ± 9.87, with the highest frequency observed in scores 3 and 4. No perforated ulcers were recorded in scores 1 and 2,

whereas perforated ulcers appeared in score 25. The extract significantly reduced ulcer formation by decreasing gastric acidity and increasing the pH of gastric fluids. Compared to the normal control group, pylorus-ligated rats showed increased lipid peroxidation and decreased levels of superoxide dismutase (SOD), catalase, and glutathione—markers of oxidative stress (Sharma Paras et al., 2011).

The ethyl acetate fraction of *C. juncea* exhibited anti-cancer activity, particularly against the HCT-116 human colon cancer cell line, demonstrating promising cytotoxic potential (Chintha Pradeepika, 2018).

Methanolic and ethanolic extracts of both in vitro and in vivo *C. juncea* plants were analyzed for their α-amylase and α-glucosidase inhibitory activities. These enzymes, present in the human colon, are responsible for breaking down carbohydrates into starch and oligosaccharides. Inhibiting these enzymes can reduce carbohydrate absorption and help regulate blood glucose levels (Saraswathy et al., 2017).

In addition, albumin denaturation and membrane stabilization assays revealed that both in vitro and in vivo *C. juncea* extracts possess anti-inflammatory properties. Notably, both forms of the plant exhibited comparable quality and quantity of phytoconstituents (Saraswathy et al., 2017).

Heavy metal analysis of *C. juncea* Roxb. indicated the presence of chromium (0.036 µg/g), manganese (0.017 µg/g), copper (1.637 µg/g), zinc (0.247 µg/g), cadmium (0.053 µg/g), mercury (not detected), lead (0.002 µg/g), and arsenic (0.60 µg/g). These concentrations fall within the permissible limits established by the World Health Organization and are considered safe for therapeutic use (Sudha Karayil et al., 2014).

Free radicals, which contain redox properties, carboxylic groups, and conjugated ring structures, contribute to lipid peroxidation. Essential antioxidant enzymes such as superoxide dismutase (SOD) catalyze the dismutation of harmful superoxide radicals. Administration of *C. juncea* ethanolic extract (CJEE) significantly increased SOD, catalase, and reduced glutathione levels across all tested doses compared to control groups, indicating the plant's protective effects against oxidative stress. CJEE also enhanced the activity of membrane-bound enzymes, including Na^+/K^+-ATPase, Ca^{2+}-ATPase, and Mg^{2+}-ATPase, in experimental models (Sharma Paras et al., 2011).

Conclusion

Ceropegia juncea Roxb. possesses substantial medicinal value, supported by its pharmacological and antimicrobial properties. The presence of bioactive compounds such as ceropegin and coumarin plays a crucial role in the treatment of various diseases. Notably, both in vitro and in vivo studies demonstrate consistent efficacy. As an endemic species with high therapeutic potential, efforts should be made to cultivate and conserve *C. juncea* Roxb. for future medicinal applications and to raise public awareness regarding its significance in traditional and modern healthcare systems.

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