INTRODUCTION

*Curcuma pseudomontana* J. Graham belongs to the family Zingiberaceae, commonly known as hill turmeric. It is an endemic to the Western and Eastern Ghats, of peninsular India. *C. pseudomontana* rhizome is beneficial against leprosy, dysentery, and cardiac diseases. The Savara, Bagata, and Valmiki tribes of Andhra Pradesh use tuber extracts to cure jaundice and Bagata tribes use this plant for diabetes. In the present study, the preliminary phytochemical study and antioxidant activity of the rhizome extracts of *C. pseudomontana* were evaluated. Phytochemical screening indicated that the rhizomes are rich in a variety of primary and secondary metabolites such as carbohydrates, alkaloids, Vitamin C, Vitamin E, flavonoids, phenols, glycosides, and saponins. The study highlights the biochemical and ethnopharmacological significance of an endemic *C. pseudomontana*. The results of pharmacognostic analysis will be helpful in developing standards for quality, purity, and sample identification. The current review summarizes the pharmacognostic parameters such as macroscopic, microscopic, physicochemical constituents, fluorescence analysis, nutritive value, behavior analysis of rhizome powder, and pharmacological activities prove it is a useful medicinal plant.

Keywords: *Curcuma pseudomontana*, J. Graham, Phytochemical properties, Endemic, Hill turmeric.

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Tamil: Kattumanjal
Malayalam: Kattumanjal
Ayurveda: Tavaksheera
Telegu: Adavi pasupu

Synonyms [27]
Curcuma grahaimiana Voigt
Curcuma ranadei Prain

Habitat
This species is a rhizomatous herbaceous perennial, which is found in usually moist shady places on the fringes of wet forests or grasslands, in riparian areas, at moderately high altitude along the western side of the Western Ghats [28]. The taxon occurs both in moist deciduous forest and semi-evergreen forest [29]. Mycorrhizal associations have been found [30]. Curcuma is a taxonomically difficult genus and problematic for plant hunters, herbarium technicians, as well as taxonomists. This taxon, originally described from the Western Ghats, has a confused taxonomy as it closely resembles C. montana for the side corms. C. pseudomontana and C. montana share many common floral and vegetative characters and occur in similar habitats. The inflorescence of C. pseudomontana is lateral in the early part of the rainy season and terminal later in the season. The color of the coma is variable within the species [28]. Molecular marker-based genetic diversity analysis has not yet been conclusive on the legitimacy of both taxa as species. A close relook into the morphotaxonomic traits of the two species is warranted before according a permanent separate status to them [30].

PHARMACOGNOSTIC EVALUATION
It is known that plants are rich in a variety of secondary metabolites such as tannins, terpenoids, alkaloids, flavonoids, phenols, steroids, glycosides, saponins, and volatile oils. It is necessary to identify the phytochemical components of local medicinal plants usually employed by herbalists in the treatment of diseases [31].

Phytochemical screening of the rhizome extracts of C. pseudomontana revealed the presence of different phytochemicals. Indeed, phytochemical investigations of this plant have resulted in occurrences of carbohydrates, alkaloids, glycosides, saponins, flavonoids, phenols, Vitamin E, and Vitamin C. The qualitative analysis of carbohydrates (Benedict’s reagent test) and glycosides (Borntrager’s reagent) was carried out in all extracts, i.e., aqueous (s1), methanol (s2), acetone (s3), and chloroform (s4) extracts. The solutions turning red and pink confirmed the presence of carbohydrates and glycosides, respectively.

The hydrophilic carbohydrates and glycosides were present in water, whereas hydrophobic carbohydrates and glycosides were detected in rest of the organic solvents (s2, s4). The Mayer’s test of extract (S2) displayed appearance of white turbidity for alkaloids. The alkaloids were absent in S1, S3, and S4 extracts. The dark brown coloration test for phenols was observed in S2-S4 extracts. The water-soluble phenols were absent in all the extracts. The extracts S1-S4 were shaken with distilled water. The persistence of froth in S1 and S2 was observed, indicated the presence of saponins. The hydrophilic flavonoids were detected in extract S1. The water-soluble Vitamin C was found in S1 and the Vitamin E was qualitatively analyzed by high-performance liquid chromatography method in extracts S3 of C. pseudomontana. The rhizome powder of C. pseudomontana showed the presence of steroids, tannins, starch, alkaloids, flavonoids, and protein [32]. Flavonoids such as luteolin, rutin, epiginerin, saponins, hesperidin, and Coumaric acid by

### Table 1: Physicochemical analysis

| Sr. no. | Physicochemical parameter | Result % (w/w) |
|---------|---------------------------|----------------|
| 1       | Ash value                 |                |
|         | Total ash value           | 13.98          |
|         | Water-soluble ash value   | 4.25           |
|         | Acid-insoluble ash value  | 1.40           |
| 2       | Extractive value          |                |
|         | Chloroform extractives    | 2.0            |
|         | Alcohol-soluble extractives | 13.68       |
|         | Water-soluble extractives | 18.95          |
| 3       | Moisture content          | 4.0            |
| 4       | pH                        | 3.8            |

### Table 2: Fluorescence analysis

| Sr. no. | Treatment       | Visible light | UV short (254 nm) | UV long (365 nm) |
|---------|-----------------|---------------|-------------------|------------------|
| 1       | Powder          | Brown         | Brown             | Brown            |
| 2       | Powder + NaOH   | Pale yellow   | Yellowish-green   | Dark blue        |
| 3       | Powder + 1N HCl | Pale orange   | Dark brown        | Brown            |
| 4       | Powder + nitric acid | Pale yellow | Pale green         | Dark green       |
| 5       | Powder + sulfuric acid | Brownish-red | Brown             | Blackish-brown   |
high-performance thin-layer chromatography reveal strong medicinal value in all the rhizome extracts [33].

PHYSICOCHEMICAL EVALUATION [34]

Physicochemical evaluation of the rhizome of C. pseudomontana is given in Table 1.

FLUORESCENCE ANALYSIS [35,36]

Fluorescence analysis of the rhizome of C. pseudomontana is given in Table 2.

ANALYSIS OF NUTRITIVE VALUE AND MINERAL CONTENT [37]

Nutritive value and mineral contents are given in Table 3.

BEHAVIOR OF C. PSEUDOMONTANA [38]

Behavior of C. pseudomontana is given in Table 4.

TRADITIONAL USE

Rhizomes of C. pseudomontana are said to be a traditional source, used in the treatment of leprosy, dysentery, cardiac disease, jaundice, diabetes, lactation antimicrobial, and antioxidant. In terms of traditional medicinal uses, they have been used for the treatment of enlarged liver, spleen, stomach ulcer, diabetes, cough, hepatic disorders, chest pain, skin diseases, boils, blood purifier, and rheumatism [39-42].

Curcumin is primary active compound of all curcuma plant, it is responsible for yellow color of curcuma [43], older investigation shows that curcumin has antimicrobial [44-46], anti-inflammatory [47], dyspepsia and gastric ulcer [48], irritable bowel syndrome [49-51], pancreatitis, rheumatoid arthritis [52,53], osteoarthritis [54], and antioxidant [55].

PHARMAEOLOGICAL ACTIVITY

Antimicrobial activity

All extracts of rhizome of C. pseudomontana were screened in vitro for their antimicrobial activities against clinically isolated bacterial and fungal strains such as Staphylococcus aureus, Salmonella typhi, Escherichia coli, and Aspergillus terreus. In result, it is found that methanolic extract showed 4 mm zone of inhibition against S. typhi, 6 mm against S. aureus, and 8 mm against E. coli. There were 2 mm zone of inhibition in acetone, 6 mm in methanol, and aqueous against A. terreus. There were no zone of inhibition in chloroform against all the microorganisms and acetone as well as aqueous against Salmonella typhi, S. aureus, and E. coli conducted by Begam et al. [56].

Antitubercular activity

Rhizome extract exhibited significant antitubercular activity against Mycobacterium tuberculosis H37 RV conducted by Hiremath et al. [57].

Anticancer activity

Cancer is the second leading cause of death in the world [58]. Plants play an important role as a source of effective anticancer agents. Currently, over 60% of anticancer agents are derived from natural sources including plants, marine organisms, and microorganisms [59]. Different extracts of C. pseudomontana contain certain types of active compounds; these active compounds show anticancer activity. These active compounds are extracted with appropriate solvent (organic/ inorganic). Selection of solvent depends on the type of active compound conducted by Bisht et al. [60].

Antifertility activity

Methanolic extract of C. pseudomontana showed antifertility activity. However, when compared to both Curcuma longa and C. pseudomontana, C. longa is shown more significant. In spermatogenic activity, there is no significance at lower dose of 100 mg/kg bw of C. pseudomontana compared to higher dose of 200 mg/kg bw of C. pseudomontana and C. longa. The anti-implantation and abortifacient activity also showed more significance with C. longa 200 mg/kg bw when compared to other treatment groups conducted by Promod Reddy et al. [61].

CONCLUSION

C. pseudomontana is very useful for treating various types of disease; various studies have demonstrated that C. pseudomontana possess antioxidant, anti-inflammatory healing, antimicrobial, and anticancer activity. The chemical constituents such as phenolic acid, flavonoid, and other important constituents are responsible for these activities. Review of the literature concluded that C. pseudomontana is considered to be useful herbal medicinal plant.

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AUTHORS’ CONTRIBUTIONS

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Miss. Jyoti Sing collected the data and analyzed the data. Dr. (Mrs.) Vanita Kanase proofread the whole manuscript, and suggested the necessary changes, and helped in designing manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.
Beneficial effects of the bioflavonoids curcumin Curcuma longa table

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