



Givotia Rottleriformis Griff Ex Wight: Pharmacognostical, Phytochemical and Pharmacological Review

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ABSTRACT

The plant *Givotia rottleriformis* Griff belongs to the family Euphorbiaceae is a softwood tree species which is of high economic importance with wide applications. The seeds and bark powder of this tree species are known to have medicinal properties and used for the treatment of rheumatism, psoriasis and dandruff. The present is therefore, an effort to give a detailed survey of literature on pharmacognostical, phytochemical, as well as the pharmacological activities of the plant.

Keywords: *Givotia rottleriformis*, *Givotia mollucana*, antipsoriasis, catamarans.

INTRODUCTION

G*ivotia rottleriformis* Griff (family Euphorbiaceae) is a softwood tree species which is of high economic importance with wide applications.¹ The wood of this species is light and soft and used for carving figures, toys and fancy articles in toy making industry. It is also used for making boxes, catamarans, and for purposes where lightness is required.² The seeds and bark powder of this tree species are known to have medicinal properties and used for the treatment of rheumatism, psoriasis and dandruff.³ In addition, seeds possess high oil content which is valuable and used for lubricating fine machinery.^{4,5}

Vernacular Names

English : White Catamaran Tree

Kannada : Polike, bellitalai

Marathi : Polki

Telugu : Tellapoliki

Tamil : Thaalamar, Kottaithanuku, VellaiPoothalai, Vendalai

Taxonomical Classification

Kingdom : Plantae

Division : Angiospermae

Class : Magnoliopsida

Order : Euphorbiales

Family : Euphorbiaceae

Genus : *Givotia*

Species : *rottleriformis*

Botanical name : *Givotiarottleriformis*

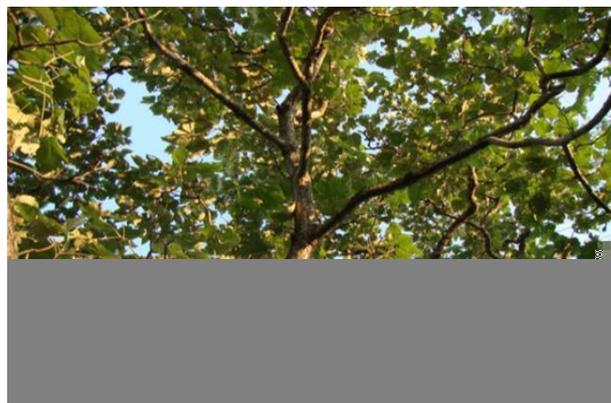
Synonymn: *Givotiamoluccana*. (L.) Sreem.

Plant Description⁶

Habit and Habitat

The moderately sized tree is commercially valuable in building Catamarans and hence the English name, White Catamaran Tree. The white wood of the tree is

exceedingly light, soft, even grained and durable. It is also used in carving figures, toys and fancy items. The distribution of this tree is noticed only in limited areas of the forests of Tamil Nadu, Andhra, Karnataka, West Bengal and coastal Sri Lanka. The commercial value and poor germination of its seeds affecting propagation have made the Puththalai tree an endangered species.



Entire Plant of *Givotia rottleriformis*

Morphology

Leaves: Leaves are alternate, broadly ovate or orbicular, coarsely dentate, acuminate, glabrous above yellowish tomentose below 5-nerved.

Flowers: The flowers are in sub-terminal pendulous panicles, flowering from April-July.

Fruits: Fruits are a drupe, subglobose or ellipsoid fulvous-tomentose.

Seed: Seed, globose or ellipsoid with a bony testa, fruiting from May-June.

Bark: Bark smooth brown, peeling off in circular scales. Bruised bark yields a blood red sap.



Distribution

The tree has limited distribution and confined to small regions in forests of Andhra Pradesh, Karnataka, Tamil Nadu and West Bengal states of India.

Propagation

Germination of seeds is very poor because of 3 layers of a thick seed coat, which contains a high percentage of phenolics that are mainly responsible for a long dormancy period of 1 to ½ years under natural conditions. The difficulty in seed germination and absence of proper vegetative propagation techniques have rendered non-availability of this timber in required quantities to toy making manufacturers, which is posing severe problems for these communities. In vitro propagation offers promise in achieving rapid propagation of *Givotia*.

Ethno pharmacology

The bark and seeds of the tree are used in indigenous medicine in the treatment of rheumatism, dandruff and psoriasis.⁷ The juice is extracted from the bark and administered to cure jaundice. The Palliyar tribes of southern Tamil Nadu give endosperm of the seeds mixed with milk (10gms to 100ml) for three days to improve digestion in children. Its stem-bark paste is applied and its leaves are used as bandage during deep cuts by ethnic people of Krishna district, Andhra Pradesh. Oil extracted from the seeds is used in lubricating machinery⁴. Muthukumarasamy et al.,⁸ reported that the Palliyar tribe of southern Tamil Nadu give endosperm of the seeds mixed with milk (10gms to 100ml) for three days to improve digestion in children.

Pharmacognostical Review

Pharmacognostical studies provide qualitative standard and reveal the type of cell, its arrangement, and cell content.

Leaves

Preliminary pharmacognostical screening was conducted in *Givotiamoluccana* leaves which includes macroscopic and microscopic analysis, fluorescence analysis and physicochemical determinations. Powder analysis of the leaf showed the presence of microsphenoidal crystals shaped calcium oxalate crystals. Xylem vessels were wide with reticulate and spiral thickening, numerous bordered pits and lignified surface. Epidermal trichomes were unicellular, conical, thick walled with warty cuticle and curved at the base. Starch grains were rounded or angular, simple or 2-5 compounds and presence of lignified and non-lignified fibers.⁹

Bark

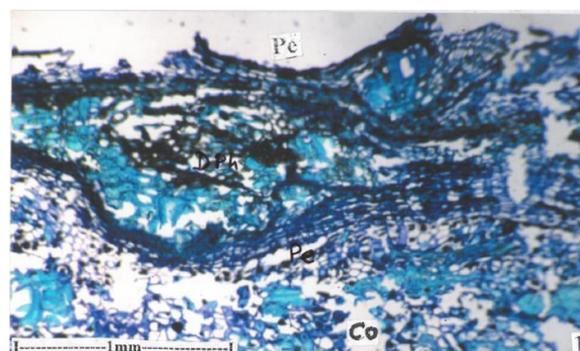
The macroscopy, microscopy, histochemical analysis, physico-chemical constants, fluorescence analysis and inorganic mineral analysis of *G. rottleriformis* bark was carried out¹⁰. Morphological study had provided a characteristic identity of bark which was smooth brown

colour, bitter taste yielding blood red sap from the bruised bark and leaf which was green in colour, bitter taste with characteristic odour. The various distinguishing features of *G. rottleriformis* bark observed through anatomical studies.

Transverse section of the bark exhibits outer rhytidome periderm and inner secondary phloem that extends from the inner border of the rhytidome up to the cambial zone. The secondary phloem comprises outer wider collapsed phloem and inner narrow non collapsed phloem. The collapsed phloem includes highly dilated phloem rays, scattered irregular masses of sclerenchyma cells and dark thick tangential streaks of crushed sieve elements. The non-collapsed phloem includes wide rectangular sieve tubes, phloem parenchyma cells and wavy phloem rays.

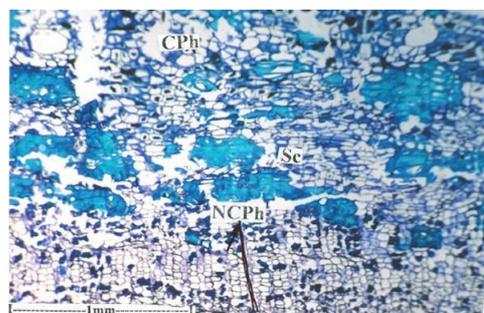
Tangential longitudinal sections of the bark show uniseriate, narrow and hetero cellular phloem rays with terminal upright cells and middle procumbent cell. Prismatic crystals and druses of Calcium oxalate crystals are sparsely seen in the bark.

Radial longitudinal sections of the bark show hetero cellular, square shape or horizontally elongated phloem rays in horizontal lines. The rays consist of upper rows of vertically elongated upright cells and middle part of procumbent cells.



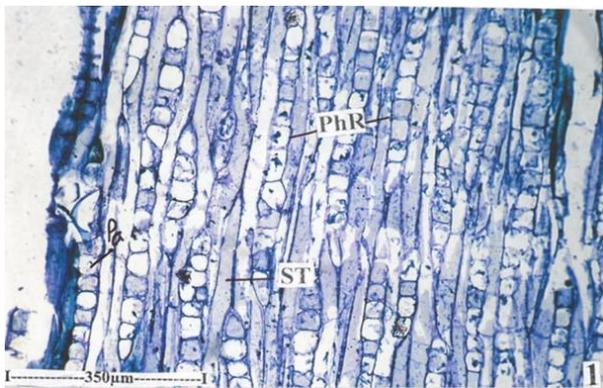
Transverse Section of Bark: Periderm (Rhytidome) – Portion enlarged

(Co: Cortex; DPh: Dead Phloem tissue; Pe: Periderm)



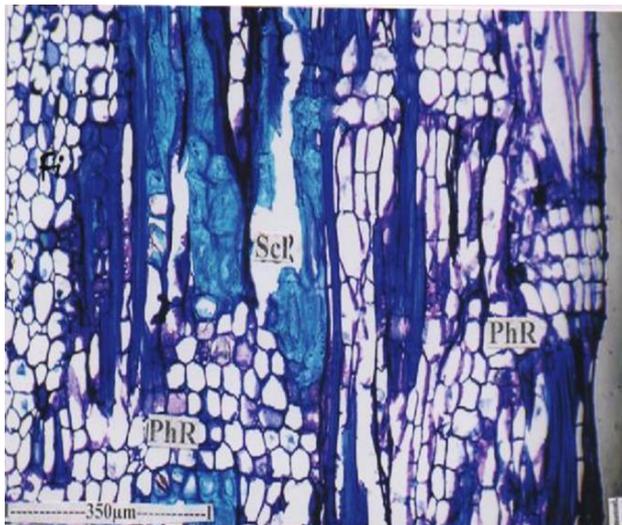
Transverse Section of Bark: Outer Collapsed Phloem and inner Non Collapsed Phloem

(CPh: Collapsed phloem; NCPH: Non-Collapsed Phloem; Sc: Sclereids)



Transvers Longitudinal Section of the Bark

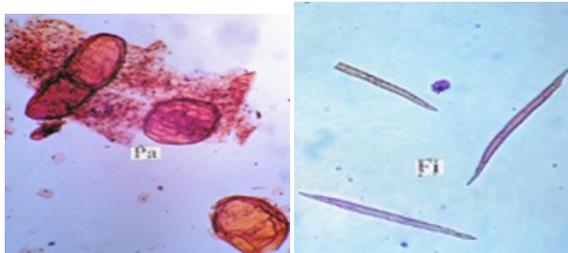
(Pa: Parenchyma cells; PhR: Phloem Ray; ST: Sieve Tube)



Radial Longitudinal Section of the Bark: Phloem in RLS View - Showing horizontal bands of ray cells

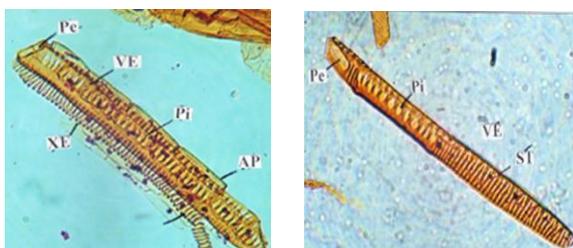
(PhR: Phloem Rays; Scl: Sclereids)

The microscopical examination of the powder showed brachysclereids, short, narrow thick walled libri form fibres in thick bundles or in small broken pieces and rectangular thin walled parenchyma cells.



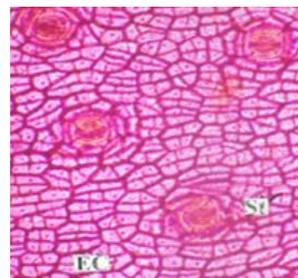
(a)

(b)

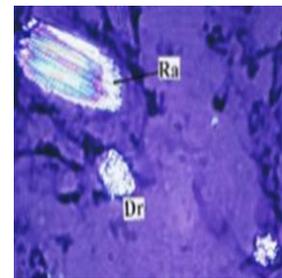


(c)

(d)



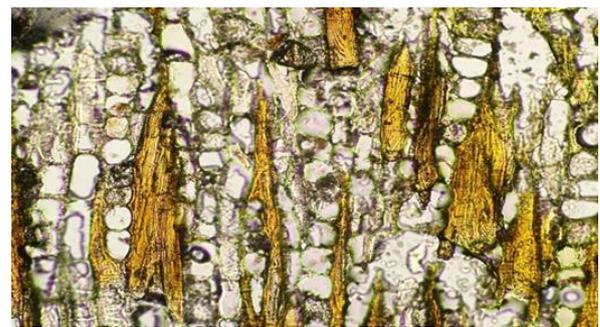
(e)



(f)

Powder microscopy: (a) parenchyma; (b) Xylem fibres; (c) Spiral Xylem element; (d) Vessel element with sclariform pits; (e) Cyclocytic stomata; (f) Calcium oxalate crystals

Histochemistry is mainly used to localize the chemical compounds within the cells and tissues using some chemical reagents have been done and it showed the presence of alkaloids, and flavonoids.



Longitudinal section of Phloem showing presence of flavonoids



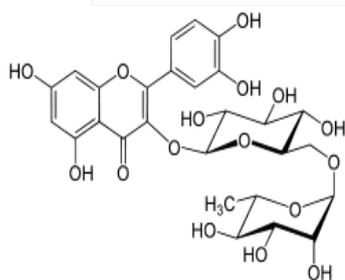
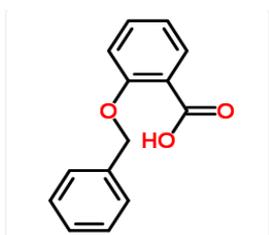
Longitudinal section of Phloem showing presence of Alkaloids

Various physico-chemical parameters such as ash values, extractive values, loss on drying and crude fibre content were found to substantiate its standard values. The Inorganic analysis showed the presence of minerals calcium, chloride, magnesium, phosphorus, potassium, sodium and sulphur. The trace elements include chromium, cobalt, copper, iodine, zinc, molybdenum, nickel, selenium etc. In fluorescence analysis, the powder of *Givotiarottleri formis* bark showed light yellow fluorescence with methanol in UV light at 254 nm.

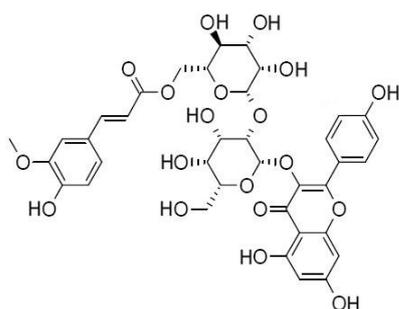
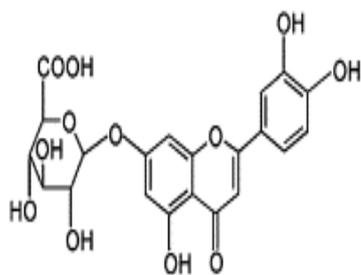
Phytochemical Review

A new acyl derivative of Salicylic acid, the benzoysalicylic acid (BzSA) also known as 2-(benzoyloxy) benzoic acid was isolated from the seed coats of *Givotia rottleriformis*. Gallic acid and methyl gallate was isolated from bioassay guided methanolic (MeOH) seed coat extracts of *G. rottleriformis*.¹¹

Preliminary phytochemical screening of the hydro-alcoholic extract of the bark of *Givotia rottleriformis* shows the presence of carbohydrates, alkaloids, flavonoids, glycosides, saponins, steroids, tannins, triterpenoids. Three flavonoids namely, Rutin (I), Luteolin-7-O- β -D-Glucuronide (II) and Kaempferol 3-O-[2-O-(6-O-feruloyl)- β -D-glucopyranosyl]- β -D-galactopyranoside (III) were isolated from the ethanol extract of the bark of *Givotiarottleriformis*.¹²



BenzoysalicylicRutin



Luteolin-7-O- β -D-glucuronide Kaempferol 3-O-[2-O-(6-O-feruloyl)- β -D-glucopyranosyl]- β -D-galactopyranoside

Pharmacological Activity

Antipsoriatic activity

Antipsoriatic activity of *Givotia rottleriformis* bark was investigated using ultraviolet B (UV-B)-induced photodermatitis model in rats. The irradiated rat skin treated with ethanol extract of *Givotia rottleriformis* (400 mg/kg) has shown a significant reduction in the total epidermal thickness indicating that it has an influence to retard the hyper proliferation of the keratinocytes that occurs when the skin is exposed to UV radiation. The significant retention of the stratum granulosum is probably due to its ability to enhance the keratinization process, which is a protective strategy adopted by the skin when exposed to penetrating radiation. Further, ethanol extract of *G. rottleriformis* (400 mg/kg) produced useful changes in the epidermis of the irradiated skin, showing its potential use in psoriasis treatment.¹³

Vijayalakshmi et al.,¹² reported antipsoriatic activity of the flavonoids Rutin, Luteolin-7-O- β -D-Glucuronide and Kaempferol 3-O-[2-O-(6-O-feruloyl)- β -D-glucopyranosyl]- β -D-galactopyranoside isolated from the ethanol extract of the bark of *Givotiarottleri formis* using in-vitro and in-vivo model. In-vitro antiproliferant assay of the ethanol extract and isolated flavonoids were done on HaCaT cell lines. Mouse tail test was used for the evaluation of antipsoriatic activity of ethanol extract (100, 200 and 400 mg/kg b.w.) and bioactive flavonoids (50 mg/kg b.w.) in Swiss albino mice. In mouse tail model, a significant reduction in epidermal thickness with respect to control was observed in groups treated with isolated flavonoid glycoside Luteolin and Kaempferol and significant orthokeratosis was observed in groups treated with ethanol extract (200 and 400 mg/kg) and isolated flavonoid glycoside Luteolin and Kaempferol.

Hepatoprotective activity

The aerial parts of *Givotia moluccana* L. showed hepatoprotective activity in CCl_4 -induced hepatotoxicity in wistar rats. The study was conducted using the popular inducing agent carbon tetrachloride (0.1 ml/kg) in 1% olive oil and silymarin (20 mg/kg, p.o.) was used as reference standard in the respective model to treat for 21 days. The aqueous ethanolic extract of aerial parts of *Givotia moluccana* L. has shown very significant hepatoprotection against CCl_4 -induced hepatotoxicity in wistar rats, evidenced by marked reduction in marker enzymes in the serum.¹⁴

Antimicrobial Study

The dried and powdered leaves of *Givotia rottleriformis* was extracted successively with hexane, ethyl acetate and methanol and screened for phytochemicals and antimicrobial activity by agar-well diffusion method against the organisms *Bacillus subtilis*, *Proteus vulgaris*, *Pseudomonas fluresences*, *Bacillus megaterium*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*. Methanol extract showed inhibition of

the test organisms *Pseudomonas fluorescens*, *Bacillus megtherium* Ethyl acetate extract showed significant antimicrobial activity against all the test organisms.¹⁵

The larvicidal activity of bark extracts of *Bischofia javanica*, *Cinnamomum zeylanicum* and *Givotia moluccana*; leaf extracts of *Morinda umbellata*, *Trichopus zeylanicus*, *Erythroxylum monogynum*, *Oxalis corniculata*, *Solanum verbasicum* and *Vitex negundo*; and extracts of shoots with leaves of *Leucasa spera* were determined. Residues of these solvent extracts procured from shoot with leaves of *L. aspera* and leaves of *V. negundo* were found to have significant effects at such dosages, resulting in 100% mortality of the larvae within 24, 48 or 72 h of treatment. Solvent residues of the tested plant parts from the remaining eight Botanicals exhibited relatively less toxicity to these larvae in varying degrees in relation to exposure time and dosage¹⁶.

The antimicrobial studies of ethyl acetate and methanol extract of bark of *Givotia rottleriformis* at different concentration (250ppm, 500ppm, 1000ppm) was carried out against 4 potentially pathogenic microorganisms *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli* and *Candida albicans* by agar diffusion method. In the present study, both methanolic extract and ethyl acetate extract was found to possess the broadest and potent antimicrobial activity against *S. aureus* and moderate active against the *E.coli* and *S. pyogenes*.¹⁷

Antioxidant

Anti-oxidant potential of flavonoids isolated from the ethanol extract (70%v/v) of *Givotia rottleriformis* bark was evaluated using inhibition of hydroxyl radical, 2,2-diphenyl-1-picrylhydrazyl (DPPH), and nitric oxide scavenging methods. The total phenolic content and flavonoid content was found to be 13.80 % w/w and 5.7% w/w respectively. The IC₅₀ values of ethanol extract against hydroxyl, DPPH and nitric oxide radical were found to be 230 µg/mL, 220 µg/mL and 180 µg/mL respectively. The radical scavenging activity of the isolated flavonoids decreased in the following order: rutin (IC₅₀ values 18, 15, 16 µg/mL) > luteolin (IC₅₀ values 22, 20, 18 µg/mL) > kaempferol (IC₅₀ values 25, 28, 24 µg/mL) respectively.¹⁸

Micro propagation

Samuel *et al.*,¹⁹ studied the micro propagation of *Givotia rottleriformis* Griff. As a result of long seed dormancy associated with poor seed germination. Best germination frequency (78.3%) was achieved from mature zygotic embryo axes isolated from acid-scarified fresh seeds when cultured on Murashige and Skoog (MS) medium. However, acid scarification of 1-yr-old seeds decreased the germination frequency of zygotic embryo axes in comparison to those obtained from non-acid-scarified seeds which germinated (96.2%) and converted into plants (80.3%) on MS basal medium.

Ram babu *et al.*,²⁰ reported a protocol for germination of *Givotia rottleriformis* (var. Tel. Thella Poniki) using zygotic embryo culture. 100% germination was obtained by culturing the embryos on Murashige and Skoog medium containing 30 g l⁻¹ sucrose. A sucrose concentration lower or higher than 30 g l⁻¹ resulted in lower germination or promoted callus formation. The seedling growth was promoted by the addition of 100 mg l⁻¹ tyrosine in the medium. Seedlings germinated in the presence of 0.2–0.4 mg l⁻¹ α-naphthaleneacetic acid and 0.3–0.5 mg l⁻¹ indole-3-butyric acid were abnormal, showing a slender stem with slender roots or forming callus with stout roots. Germination also affected embryo orientation in culture; placing embryos upright on the medium was most beneficial for germination. The *in vitro*-germinated seedlings were acclimatized in soil under shady conditions with a survival rate of 60–70%. These plants were phenotypically normal, healthy, and similar to donor plants.

CONCLUSION

The scientific research on *Givotia rottleriformis* suggests some biological potential of this plant. It is strongly believed that detailed information as presented in this review on the phytochemical and various biological properties of the extracts might provide detailed evidence for the use of this plant in different medicines.

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