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A review of pharmacological properties, pharmacognosy and therapeutic actions of *Putranjiva roxburghii* Wall. (Putranjiva)

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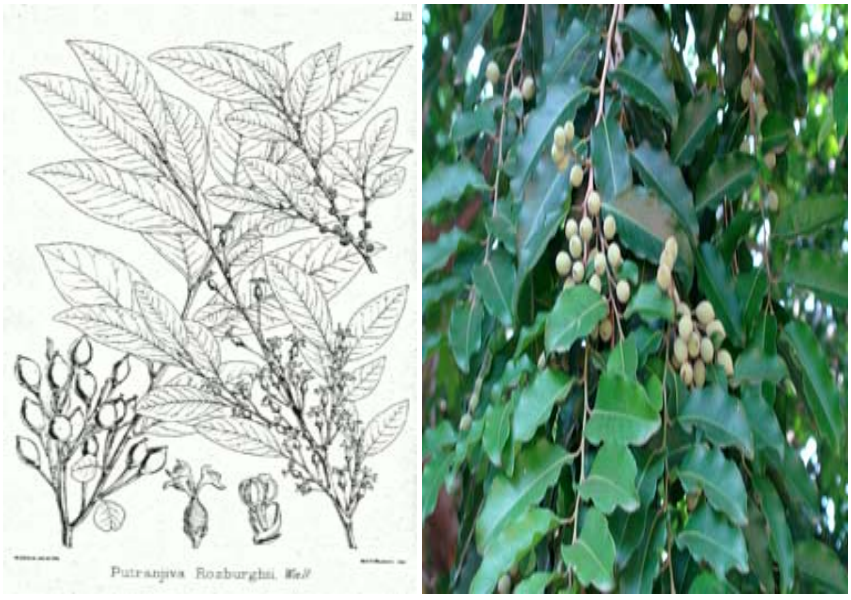
Abstract
Putranjiva roxburghii Wall. is a well-known plant which has been ascribed an important role in Ayurvedic texts as an antipyretic, anti-inflammatory & anti-rheumatic herb useful in gynaecological and fertility ailments. The pharmacognosy of its leaves, fruits, root and stem bark indicates the presence of many glycosides, saponins, triterpenes and flavonoids. Its leaf extract has been found suitable in biological methods of gold nanoparticle production. During pharmacological analysis, its leaf extract exhibited significant anti-hyperglycemic, analgesic, antipyretic and anti-inflammatory properties. The significant cytotoxicity and presence of active phytochemical compounds in seeds indicate its efficient protection roles against various diseases. Similarly, high antibacterial activity was seen in methanol, ethanol and acetone extracts during evaluation. Putranjiva oil can be blended up to 30% with diesel as an alternative fuel giving similar efficiency and better emissions. Its seed kernel oil also showed potential as a preservative for sissoo seeds against spoilage during storage.

Keywords: Anti-inflammatory, antimicrobial, antioxidant, Putranjiva

1. Introduction



Kingdom:	Plantae
Subkingdom:	Tracheobionta
Division:	Tracheophyta
Subdivision:	Spermatophyta
Class:	Magnoliopsida
Sub Class:	Rosidae
Order:	Malpighiales
Family:	Euphorbiaceae / Putranjivaceae
Genus:	Putranjiva
Species:	roxburghii [1]

1.1 Related species & Synonyms

Some of the species which are closely related to *Putranjiva roxburghii* Wall include *Putranjiva formosana* Kaneh. & Sasaki ex Shimada, *Putranjiva matsumurae* Koidz., *Putranjiva zeylanica* (Thwaites) Müll. Arg., *Drypetes roxburghii* (Wall.) Hurusawa, *Drypetes confertiflora*, *Drypetes elata* (Bedd.) Pax. & Hoffm., *Drypetes longifolia* (Blume) Pax & K. Hoffm. and *Drypetes malabarica* (Bedd.) Airy Shaw. *Putranjiva roxburghii* Wall is known by various local names in many languages. In Sanskrit, it is called as Putranjiva, Pavitra, Garbhad, Sutajeevak, Kutajeeva, Apatyajeeva, Arthasadhak & Garbhakar, while in Hindi it is also known as Putranjiva or Putijia. Lucky Bean Tree, Child's amulet tree, Child life tree& spurious wild olive are some of its common names in English [1, 2].

1.2 Botanical Description

Putranjiva roxburghii Wall. also called as Putranjiva or Putrajeevak a well-known moderate-sized, evergreen treegrowing up to 12 m in height. It has pendant branches and dark grey bark having horizontal lenticels. Leaves are simple, alternately arranged, dark green, shiny, elliptic-oblong, distantly serrated. Male flowers are found with short stalks, in rounded axillary clusters and female flowers are in 1-3 in leaf axil. Fruits are ellipsoid or rounded drupes, white velvety; seed normally one, stone pointed, rugose, very hard. Its flowering time is between March to April while fruits appear during January- March. It is widely grown in Thailand, Nepal, Bangladesh, India, Myanmar and Sri Lanka [3]. In folklore medicine, its leaves and fruits have been traditionally used for the treatment of fever, muscle twisting, arthralgia and rheumatism [4]. They have also been used as anti-nociceptive, antipyretic & anti-inflammatory while the whole plant of *P. roxburghii* has been used for the treatment of fever and haemorrhoids [1, 2].

2. Therapeutic uses

Putranjiva roxburghii Wall. has been historically ascribed an important role in the traditional Ayurvedic and Unani systems of holistic health and herbal medicine of the East. The leaves of *Putranjiva roxburghii* Wall. are reported to have good medicinal values in these traditional systems of medicine.

The name of this plant is sometimes misleading since it has been wrongly interpreted as a medicine for obtaining only male child. However, there is no mention of any such property or action ascribed to or associated with Putranjiva in the Ayurveda or any other ancient traditional medicine text. However, these texts prescribe its usage in female patients to increase the strength of their female genital systems and also for curing of diseases like leukorrhea, infertility, menstrual problems, etc.

The use of Putrajeevak has been associated with many beliefs and practices. It is said to increase fertility in women, it aids and facilitates conception and its fruits are worn in the form of a necklace by pregnant women to prevent miscarriage. The seeds of its fruits are strung together to form rosaries and used as a necklace to protect children from diseases and by persons suffering from acute cough and cold, while its dried fruits are used in a garland to cure skin allergy and itching [1,5].

3. Ayurvedic Properties

Guna:	Guru, Pichhil
Rasa:	Madhur, Katu
Vipak:	Madhur
Veerya:	Sheet
Prabhav:	Garbhakar
Doshkarma:	Vatapittashamak [1]

4. Medicinal value

The paste of its leaves and seeds is applied externally for treatment of burning sensation, filarial, inflammatory and eye diseases. Seeds are used orally in the form of powder in burning sensation, thirst, elephantiasis, constipation, dysuria, ophthalmic, aphrodisiac, semen disorders, infertility and diseases of female genital organs [1].

5. Pharmacognosy

The fruit pulp contains a large quantity of mannitol, a saponin glucoside and an alkaloid, while the seeds contain fatty oil. Kernel contains an essential oil with mustard smell, isothiocyanate yielding glycosides, glucoputranjivin, glucocochlearin, glucojiaputin and glucocleomin. The seed coat yields triterpene saponins, putranjivoside, β-sitosterol and its glucoside, saponins and pyranosides A-D.

Its leaves contain β-amyrin and its esters, putrone, putrol, putranjivic acid, methyl putrajivate, stigmasterol and hydrocarbons, triterpene roxburghonic acid and biflavones, whereas the bark yields triterpenes - friedelin, friedelanol, roxburgholone, putranjivadione, putranjic acid and putric acid [6, 7]. The Leaves also contain saponins A, B, C and D [8].

The Ethanol extraction of fresh leaves of *P. roxburghii* proved convenient for the isolation of polyphenolic compounds. In addition to triterpenoids, this extract yielded ellagic acid, gallic acid, gallocatechin, ellagi-and gallo-tannins and saponins. The main components of the root bark were triterpenoids, friedelin, putranjivadione, roxburgholone, methyl putrate and saponins derived from oleanolic acid [9].

Chemical investigation of the stem bark and leaves of *Putranjiva roxburghii* resulted in the isolation of a new ellagic acid glycoside along with four saponins. The structures of the isolated compounds were established by detailed spectral analysis. Putranoside-A methyl ester was isolated for the first time from this species and the saponins exhibited potent DNA topoisomerase IB inhibitory activity [10]. Two triterpenoids, namely putranjivanonol and putranjic acid, were isolated from the trunk bark of *P. roxburghii* [11]. The isolation of four other triterpenoids, friedelin, putranjivadione, friedelanol and roxburgholone, from the bark of *P. roxburghii* has also been described [12]. Roxburghonic acid, a triterpene acid, and putraflavone, a biflavonoid, were isolated from the alcoholic extract of *P. roxburghii* leaves [13].

HPTLC method for simultaneous determination of β-amyrin and stigmasterol in *Putranjiva roxburghii* wall. was developed and validated. The analytes were separated on silica gel 60F254 HPTLC plates with n - hexane: chloroform: methanol (3: 6.5:0.5 v/v/v) as mobile phase after chamber saturation for 10 min. The development distance was 80mm. The derivation was done by using anisaldehyde – sulphuric acid reagent. Detection and quantification were performed by densitometry, with a tungsten lamp at 580 nm. The response to β-amyrin and stigmasterol was linear in the concentration range 0.045 to 0.360 µg per band and 0.041 to 0.328 µg per band respectively. The validated method was used for quantitative analysis of β-amyrin and stigmasterol in *Putranjiva roxburghii* wall. and can be used for routine quality-control analysis of leaf powder of *Putranjiva roxburghii* wall [14].

Nowadays, the preparation of nanoscale gold materials has become very important due to their unique properties, which are different from those of the bulk materials. The properties of these particles in applications as diverse as catalysis,

sensors and medicine depend critically on the size and composition of the nanoparticles which can be produced mainly by either chemical, physical or biological methods. Since noble metal nanoparticles such as gold, silver and platinum nanoparticles are widely applied to human contacting areas, there is a growing need to develop environmentally friendly processes of nanoparticles synthesis that do not use toxic chemicals. Biological methods of nanoparticles synthesis using microorganisms, enzymes and plant or plant extracts have been suggested as possible ecofriendly alternatives to chemical and physical methods. Development of eco-friendly processes for the synthesis of nanoparticles is one of the main steps in the area of nanotechnology research. The Biological synthesis of gold nanoparticles using *Putranjiva roxburghii* plant leaf extract as the reducing agent has already been studied. Reduction of Au^{3+} ions was initiated by addition of 5 mL leaf extract of *Putranjiva roxburghii* Wall. to 95 mL of 1mM aqueous HAuCl4.3H2O solution in a 500 mL Erlenmeyer flask. The pH of the extract was found to be neutral. Reduction of the Au^{3+} ions was monitored by measuring the UV-VIS spectra of the solution at regular intervals on a UV-1800 CP Schimadzu spectrophotometer operated at resolution of 1nm. The synthesized nanoparticles are confirmed by color changes and it was characterized by UV-visible spectroscopy, scanning electron microscopy (SEM), energy-dispersive spectroscopy (EDAX) and X-ray diffraction (XRD). The plant based route could be considered to be an environmental friendly or green biological method of nanoparticles production [15].

6. Pharmacological activities

6.1 Hypoglycaemic activity

Diabetes mellitus is the most common endocrine disorder that impairs glucose homeostasis resulting in severe diabetic complications including retinopathy, angiopathy, nephropathy and neuropathy and causes neurological disorders due to perturbation in utilization of glucose. *Putranjiva roxburghii* Wall. has been claimed to possess antidiabetic properties by many investigators. Therefore, the hypoglycaemic activity of the leaves of Putrajeevak plant was studied on animal models. In these studies, diabetes was induced in albino rat models with alloxan monohydrate to screen the hypoglycemic activity of ethanol extracts of leaves of *Putranjiva roxburghii*. The results showed that it has significant anti-hyperglycemic effect in experimental model of diabetes mellitus [16].

6.2 Anti-nociceptive, antipyretic, and anti-inflammatory activity

The anti-nociceptive, antipyretic and anti-inflammatory pharmacological actions of the ether extract of the leaves of this plant were evaluated by Hat Yai, Songkhla *et al*. on rodent experimental animals by using the writhing, hot plate, and formalin tests for nociceptive responses in mice and the antipyretic activity was determined in yeast-induced fever in rats. Anti-inflammatory activities were also investigated using carrageenan-induced paw edema in rats and croton oil-induced ear and anus edemas. The ether extract (100, 200, and 400 mg/kg, p.o.) of *P. roxburghii* dose-dependently produced analgesic activity in acetic acid-induced writhing in mice. The extract had no significant effect in the hot plate test in mice. At the dose of 400 mg/kg, the extract significantly suppressed the licking activity in the late phase of the formalin test in mice and decreased fever induced by yeast in rats. The extract exhibited moderate inhibitory activity of inflammation in carrageenan-induced paw edema in rats. The extract inhibited croton oil-induced ear edema in a dose-dependent manner (1.25, 2.5, and 5.0 mg/year) in mice. The extract decreased anus edema induced by croton oil at the high dose of 800 mg/kg in rats. The results indicated that the ether extract of *P. roxburghii* leaves possesses analgesic, antipyretic, and anti-inflammatory properties [17].

6.3 Cytotoxic activity

The methanolic extract of the seeds of *Putranjiva roxburghii* Wall showed cytotoxicity with LC_{50} of 427.74 µg/ml in brine shrimp lethality assay and also the presence of chemical compounds like phenols, alkaloids, saponins, steroids, flavonoids and glycosides. The significant cytotoxicity activity and the presence of such active phytochemical compounds in the plant indicateits efficient protection and treatment roles against various diseases including cancer [18].

6.4 Antioxidant and Anti-inflammatory Activity

The in-vitro antioxidant and anti-inflammatory activities of the leaf extract of *Putranjiva roxburghii* were studied along with preliminary phytochemical investigation. The leaf of the plant contains mainly anthracene, cardiac and flavonoid glycosides along with phenolic compounds. Since many flavonoids have remarkable anti-inflammatory activity, the study aimed at evaluating the anti-inflammatory activities of *Putranjiva roxburghii* by HRBC membrane stabilization technique. The ethanolic extract of the leaf was analyzed for antioxidant activity by DPPH method at different concentrations. During these studies, the leaf extract showed potent antioxidant activity. Moreover, the antioxidant activity was found to be concentration dependent and may be attributed to the presence of high flavonoid content in the leaves of *Putranjiva roxburghii* [19, 20].

6.5 Antimicrobial Activity

Antibacterial activities of *P. roxburghii* extracts were determined by disc diffusion method. A total of 12 bacterial strains were investigated for potentially active antibacterial property of different plant extract samples. Among them four were Gram positive bacteria and eight were Gram negative bacteria. Plant samples were extracted by using different solvents (i.e. acetone, aqueous, ethanol and methanol). Nutrient agar plates were prepared and swabbed with bacterial strains by using sterilized cotton swabs. Sample loaded discs were placed on bacterial strain containing nutrient agar plates. The plates were allowed for diffusion for 30mins and incubated for 24 hours. Both positive control and negative control were placed along with the sample loaded discs. After 24 hours, inhibition zones were measured around the sample discs. The highest antibacterial activity was seen in methanol extract followed by ethanol and then acetone extracts [21].

6.6 Others uses- Utilization of nonedible oil as fuel

The search for alternative sources of energy has been driven by the increased cost and depletion of supply of fossil fuels. One such important alternative which could be available in plenty is vegetable oil. *Putranjiva roxburghii*, a non-edible vegetable oil can be used in diesel engine for its fuel properties which are comparable with diesel. Blends (10%, 20%, 30%, and 40% v/v) of pure *Putranjiva* oil and diesel were used in Ricardo Variable Compression Diesel Engine to study the performance and emission characteristics at various brake powers. *Putranjiva* oil blends yield better performance at 45° CA bTDC injection timing in comparison to 40° CA bTDC timing for diesel. Maximum 30% blend of *Putranjiva* oil with diesel can be used as an alternative fuel

in diesel engine since it differs very little from diesel in performance and is better than diesel with regard to emissions [22].

6.7 Fumigant Potential of seed kernel oil

Seed samples were collected from 25 places of north eastern U.P from luxuriantly growing and healthy D. sissoo Roxb plants and stored at room temperature for 6 months. Myco-floral analysis through blotter method revealed the presence of 15 fungal species and agar plate method using czapeks dox agar medium showed the presence of 12 fungal species. During observation, one insect-Bruchus bisporum was found to be present in all collected samples.

Volatile constituents extracted in the form of essential oils from 32 plant species were evaluated against the dominant fungi Aspergillus niger and Fusarium solani as well as against insect-Bruchus bisporum. Amongst these species, the seed kernel oil of Putranjiva exhibited the greatest toxicity. The oil was found to be fungicidal and thermostable at its minimum inhibitory concentration (MIC) of 400ppm.The oil was characterized by the determination of its various physicochemical properties. The oil protected the sissoo seeds completely for 6 months at 0.25ml (1000ppm) and 0.38 ml (1500ppm) in container of 250ml capacity holding 200g seeds. It did not exhibit any adverse effect on seed germination, seedling growth and general health and morphology of plants. Thus, the seed kernel oil of Putranjiva showed potential as a preservative for sissoo seeds against spoilage by fungi and insects during storage [23].

7. Conclusion

P. roxburghii is an evergreen tree of South Asia that has been traditionally ascribed with many medicinal properties. In spite of misconceptions related to its name, it has not been mentioned in any traditional medicinal text as providing any special powers for producing only male offspring. However, it has been traditionally used for increasing fertility and curing gynaecological and several other illnesses.

Pharmacognostical analysis of its leaves, fruits, stem and roots revealed the presence of many active polyphenolic compounds which could be associated with its many therapeutic properties. These include saponins, glycosides, triterpenes, ellagic acid, gallic acid and flavonoids. *Putranjiva r*oxburghii leaf extract has also been studied as a biological reducing agent for synthesis of gold nano particles.

Detailed assessment of its pharmacological properties indicated its significant hypoglycaemic, anti-nociceptive, antipyretic, anti-inflammatory, cytotoxic, antioxidant and antimicrobial activities.

Among its other uses, *P. roxburghii* can also be used as an alternative vehicle fuel after suitable blending up to 30% with diesel. Similarly, the seed kernel oil was also found to be efficacious as a preservative against fungi and insects for storage of seeds.

Hence, detailed pharmacognosy and pharmacological evaluation of *P.* roxburghii revealed the presence of many active compounds which could be responsible for its various therapeutic and medicinal properties.

8. References

1. Sharma PV. Introduction to dravyaguna (Indian Pharmacology). Chaukhamba Orientalia: Varanasi 1995, 590-592.
2. Khare CP. Indian Medicinal Plants – an illustrated Dictionary. Springer (India) Private Limited 2007, 528-529.
3. Phuphathanaphong L, Chayamarit K. Flora of Thailand Euphorbiaceae. Natl. Herb Nederland 2006; 336:1877-1887.
4. Boonyaprapat N, Chokechaicharoenporn A. Samunprai Maipuenban, Prachachon, Bangkok. 1999; 3:262-273.
5. Pandit Sri Narhari. Raj Nighantu. Chaukhamba. Orientalia: Varanasi. 2012.
6. Ghani A. Medicinal Plants of Bangladesh with chemical constituents and uses. 2nd ed. Asiatic Society of Bangladesh: Dhaka. 2003.
7. Rastogi RP, Mehrotra BN, SinhaS, Seth R. Compendium of Indian medicinal plants, Central Drug Research Institute and Publications & Information Directorate: New Delhi. 1990, 1.
8. Asolkar LV, Kakkar KK, Charke OJ. Second supplement to glossary of Indian medicinal plants with active principles Part-I (A-K) (1965–1981) New Delhi, India: Publications and Information Directorate (CSIR), 1992.
9. Chopra GR. Chemical components of leaves and root-bark of Putranjivaroxburghii, Indian Journal of Chemistry. 1970; 8(9):776 -778.
10. Kumar A, Chowdhury SR, Chakrabarti T. A new ellagic acid glycoside and DNA topoisomerase IB inhibitory activity of saponins from Putranjiva roxburghii. Nat Prod Commun. 2014; 9(5):675-677.
11. Garg HS, Mitra CR. Putranjiva roxburghii Wall -II Triterpenes of trunk bark. Phytochemistry 1968; 7(11):2053 -2055.
12. Sengupta P, Mukherjee J. Terpenoids and related compounds XI the structure of roxburgholone a new triterpenoid constituent of Putranjiva roxburghii. Tetrahedron. 1968; 24(20):6259-6264.
13. Garg HS, Mitra CR. Roxburghonic acid - Friedelane triterpenoid keto acid of leaf of putranjiva-roxburghii. Phytochemistry. 1971; 10(4):865-869.
14. Badole M, Dighe V, Charegaonkar G. Simultaneous quantification of B-Amyrin and Stigmasterol in Putranjiva Roxburghii Wall. by High-Performance Thin-Layer Chromatography. International Journal of Pharma and Bio Sciences. 2011; 2(4):346-352.
15. Badole MR, Dighe VV. Synthesis of Gold Nano particles using *Putranjiva roxburghii* Wall. leaves extract. International Journal of Drug Discovery and Herbal Research (IJDDHR). 2012; 2(1):275-278.
16. Varma A, Jain SK, Shashi A. Hypoglycemic activity of Putranjiva roxburghii Wall. in alloxan induced diabetic rats. International Journal of Pharmaceutical Sciences and Research. 2011; 2(1):160-164.
17. Hat Yai, Songkhla, Antinociceptive, antipyretic and anti-inflammatory activities of Putranjiva roxburghii Wall. leaf extract in experimental animals, Journal of Natural Medicines. 2009; 63(3):290-296.
18. Raghavendra HL, Kekuda TRP, Valleesha NC. Screening for Cytotoxic activity of Methanol Extract of Putranjiva roxburghii Wall (Euphorbiaceae) Seeds. Pharmacognosy Journal 2010; 2(10):335-337.
19. Rajagopal PL, Kiron SS, Sreejith KR. Phytochemical, antioxidant and anti-inflammatory studies on the leaves of Putranjiva roxburghii. Am. J Pharm Tech Res. 2014; 4(1):429-435.
20. Shahwar D, Raza MA. Antioxidant potential of the extracts of *Putranjiva roxburghii*, *Conyza bonariensis*, *Woodfordia fruiticosa* and *Senecio chrysanthemoids.* African Journal of Biotechnology 2012; 11(18):4288-4295.
21. Minj E, Britto SJ, Marandi RR. Phytochemical Analysis

and Antimicrobial Activity of Putranjiva Roxburghii Wall. World Journal of Pharmacy and Pharmaceutical Sciences. 2016; 5(1):1157-1166.
22. Haldar SK, Ghosh BB, Nag A. Utilization of unattended Putranjiva roxburghii non-edible oil as fuel in diesel engine. Renewable Energy 2009; 34(1):343-347.
23. Kumar N. Fumigant Potential of seed kernel oil of Putranjiva roxburghii Wall against storage pests of seeds of Dalbergia sissoo Roxb, IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) 2014; 9(2):80-89.