**Review**

Ethnobotany and phytopharmacology of *Pinus roxburghii* Sargent: a plant review

Pawan Kaushik, Dhirender Kaushik, Sukhbir Lal Khokra
Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra-136119, Haryana, India

**ABSTRACT:** Traditional medicine is a blend of information gathered over generations from various communities and cultures. *Pinus roxburghii* Sargent (Pinaceae) commonly known as “chir pine” is widely used in traditional and folkloric systems of medicine. The all parts of the plant are believed to possess medicinal qualities in Ayurvedic and Unani systems of medicine. In these traditional systems of medicine, the plant is used to heal many diseases, including afflictions of the eyes, ears, throat, blood, and skin. The plant parts are rich in various bioactive compounds such as α-pinene, abietic acid, quercetin and xanthone. Resin acids and flavanoid form a major portion of these bioactive compounds. This review presents examples of traditional medicinal uses for *P. roxburghii*, and subsequently explores the current understanding of the chemical, pharmacological, and biochemical properties of the extracts and the main active constituents found in each tissue of the plant. Clinical trial information is also included where available. Careful evaluation of these data may be helpful for scientists and researchers to discover and evaluate the specific chemical entities responsible for the traditional medicinal uses of *P. roxburghii*.

**KEYWORDS:** *Pinus roxburghii* Sargent; phytochemistry; pharmacology; ethnopharmacology; review

DOI: 10.3736/jintegrmed2013053
Received May 13, 2013; accepted July 22, 2013.
Open-access article copyright © 2013 Pawan Kaushik et al.
Correspondence: Pawan Kaushik; Tel: +91-9467648830; E-mail: pwn.kaushik1@gmail.com

1 Introduction

*Pinus roxburghii* Sargent (family: Pinaceae) is commonly known as “chir pine” and has a long history of medicinal use\(^1\). *Pinus* consist of 110 to 120 species that are distributed throughout temperate regions of the Northern Hemisphere\(^2\). *P. roxburghii* is a pine inhabitant to the Himalaya, the region extends from northern Pakistan (North-West Frontier Province, Azad Kashmir, Punjab, Himachal Pradesh, Uttrakhand and Sikkim) and Nepal to Bhutan\(^3\). In addition to being a commercially important species in the Himalayan region, where it is known for its timber, paper pulp, terpentine and resin yield\(^4\), *P. roxburghii* also has many traditional medicinal uses (e.g., antiseptic, diuretic, diaphoretic, tonic, vermifuge and rubefacient), as well as cultural uses (e.g., charcoal, pigment, herbicide, resin and wood)\(^5\). In Ayurvedic medicine, *P. roxburghii* is prescribed as an intestinal antiseptic, antidyshlipidemic, spasmyloytic and antioxidant\(^6\), whereas, in other parts of its range, traditional medicinal uses include treating diseases of the eyes, ears, throat, blood and skin, bronchitis, diaphoresis, ulcer, inflammations and itching\(^7\). The chief chemical constituents of turpentine oil from *P. roxburghii* are α-pinene, β-pinene, car-3-ene and longifolene\(^8\).

2 Ethnobotanical uses

*P. roxburghii* has a long history of ethnobotanical applications in diverse cultures\(^9\); many ethnic groups considered it as a cure for all ailments\(^10\). Wood, resin, gum, oil, seeds, needles and bark from the plant are each used in medical preparations throughout the region where the plant is found.

A hot decoction of the leaves is applied locally to treat sprains. The resin (*khaida* or *leesa*) is applied to boils, heel cracks, and on either side of the head just above the...
eye to alleviate swelling. Persons suffering from tuberculosis were advised to stay for two months in a hut built in the pine forest to aid in recovery from the disease. The resinous wood (dol) of P. roxburghii is burnt and the soot is collected from the underside of a metallic disc inverted over the flame. This collected carbon is mixed with mustard oil and is made into a paste (kajal), which is applied inside the lower eyelids to keep the eyes clean and attractive.\[14\]

Similarly, in Nepal, the resin of P. roxburghii, known locally as Ahule sallo, is used to alleviate the symptoms of a cough. An ointment prepared from resin was applied to the affected parts regularly before bedtime to soften scar tissue\[15\], heal boils and cracks\[16\] and on the either side of the eyes to reduce swelling, gastric troubles and in tuberculosis\[17\]. Resin (locally called ganda baroja) extracted from the main stem is used to treat ulcers, snake bites and skin diseases\[18,19\]. The resin is also used as hair remover\[20\], and as a stimulant. The wood of the chin pine is diaphoretic and a stimulant. It is used to cure burning sensation in body, and to treat cough, fainting and ulceration\[21\]. Wood and oleoresin from the plant are used in the treatment of snake bites and scorpion stings\[22\]. The needles can be used as diuretic\[23\].

Oil extracted from the wood is used as a hemostatic, expectorant diuretic, and nerve tonic. Bark is used for skin diseases, burns, and cracking\[24,25\].

The bark has tannins and coloring matter, used for coloring the leather\[26\]. The bark from the roots and stems of P. roxburghii is also used as an antidiabetic\[27\].

The oil contained in the plant is an irritant and most of its medicinal uses appear to be linked to that property. It is used often to treat flatulence and chronic bronchitis and is sometimes used in the treatment of typhoid or minor hemorrhages (such as from the gums, nose, etc.). Given as an enema, it reportedly treats constipation. The oil is commonly used as liniment in rheumatic pains. Inhaling the vapors of turpentine is often prescribed for relief of bronchitis\[28\]. The chin pine seeds are edible and source of edible oil\[29\].

4 Pharmacological activities

The pharmacological activities of P. roxburghii have been investigated scientifically in animal models to validate the potential of the plant as a treatment for a variety of ailments as shown below.

4.1 Hepatoprotective activity

P. roxburghii wood oil at doses of 200, 300 and 400 mg/kg body weight was studied for hepatoprotective activity on rat liver damage induced by carbon tetrachloride and ethanol. The noticeably high serum levels of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, total bilirubin, malondialdehyde (MDA) and decreased level of reduced glutathione (GSH) and total protein induced by hepatotoxins were significantly restored towards normal levels by the wood oil at doses of 200 and 300 mg/kg\[38\].

4.2 Antibacterial and antifungal activities

Essential oil of the needles of P. roxburghii showed maximum activity against Staphylococcus aureus and Bacillus subtilis while no activity was observed against Escherichia coli, Salmonella typhi and Enterobacter aerogenes\[38\]. In case of antifungal activity, essential oil significantly and dose-dependently inhibited the growth of all the fungi\[39\]. Antibacterial activity of stem essential oil was observed against S. aureus and B. subtilis while no activity was observed against E. coli and E. aerogenes. Similarly, antifungal activity of P. roxburghii essential oil was also found to be active against Aspergillus flavus, Aspergillus terrus, Aspergillus versicolor, Aspergillus candidus, Aspergillus niger and Trichoderma viride\[39\]. Maximum inhibition was recorded for needle extract of P. roxburghii against Klebsiella pneumonia\[46\]. Aqueous and alcoholic extracts from P. roxburghii stem, leaves, bark, female cone and male cone were tested for growth-inhibitory activity against the bacterial plant pathogen Agrobacterium tumefaciens and against four human pathogens, E. coli, Salmonella arizonae, S. typhi and...
S. aureus. All the extracts showed inhibitory activity against Agrobacterium tumefaciens. All the extracts except stem extract showed inhibitory activity against E. coli. Only the alcoholic extracts of leaves and female cones were found active against Salmonella arizonae. All the extracts showed inhibitory activity against S. typhi except for aqueous extract of stem. In case of inhibition against S. aureus all the extracts showed inhibitory activity except for alcoholic extract of bark and aqueous extract of male cone. In other work, the volatile oil, as well as chloroform and the methanol extracts of P. roxburghii wood were screened for antibacterial and antifungal activities against Pseudomonas aeruginosa, E. coli, S. aureus, Streptococcus pyogenes, B. subtilis, Candida albicans, A. niger, and Aspergillus clavatus using the agar diffusion method. It was observed that the volatile oil and chloroform extracts showed significant antibacterial activities while the least antibacterial activity was recorded with the methanolic extracts. P. roxburghii litter extracts were found to be inhibitory against Lepidium virginicum L. and Lolium perenne (allelopathic activity)

4.3 Antidyslipidemic and antioxidant activity

The needles of P. roxburghii were investigated for antidyslipidemic activity in high-fat diet-fed hyperlipidemic golden Syrian hamsters. Antioxidant activity of needles was assessed by trolox equivalent antioxidant capacity assay, and activity was found to be significant in the alcoholic extract as well as in the n-butanol insoluble fractions. The antioxidant activity of bark and needle extracts was evaluated by Maimoona et al, who found that the polar fraction of both parts showed significant antioxidant activity.

4.4 Analgesic and anti-inflammatory activity

Analgesic and anti-inflammatory activity of alcohol extracts of P. roxburghii bark has been shown in experimental animal models (analgesic activity was evaluated by acetic acid-induced writhing and tail immersion tests in Swiss albino mice; acute and chronic anti-inflammatory activity was evaluated by carrageenan-induced paw oedema and cotton pellet granuloma in Wistar albino rats) at the doses of 100, 300 and 500 mg/kg body weight.
4.5 Anticonvulsant activity

The alcohol extract of *P. roxburghii* was evaluated for anticonvulsant activity using maximal electroshock- and pentylenetetrazole-induced seizure at various doses (i.e., 100, 300 and 500 mg/kg). The extract reduced all the phases of convulsion significantly. All the animals recovered from seizures completely at all doses of extract\(^5\(^1\)\).

4.6 Antiasthmatic activity

The alcohol extract of *P. roxburghii* was evaluated for antiasthmatic activity using guinea pig ileum preparation (in-vitro), histamine-induced bronchospasm in guinea pigs and catalepsy in mice (in-vivo). Anti-allergic activity of the plant was evaluated using milk-induced leukocytosis in mice and passive paw anaphylaxis in rats (in-vivo). The alcoholic extract of *P. roxburghii* demonstrated significant antiasthmatic activities in the tested models\(^5\(^2\)\).

4.7 Contact dermatitis

The sawdust of *P. roxburghii* can cause occupational contact dermatitis\(^5\(^3\)\).

4.8 Cytotoxic activity

Bio-activity assays of the cone essential oil of *P. roxburghii* showed notable cytotoxic activity (100% killing of MCF-7 cells at 100 µg/mL) along with notable brine shrimp lethality (LC\(_{50}\) = 11.8 µg/mL)\(^3\(^7\)\).

4.9 Cognitive effects

Experiments studying the memory-enhancing activity of volatile oil and chloroform extracts of *P. roxburghii* failed to demonstrate any improvements in the Morris water maze paradigm\(^5\(^4\)\).

5 Marketed herbal preparations

5.1 Poly herbal oil extract

There is a traditional Unani medicine containing oleo resin from *P. roxburghii*, which has been shown to have significant analgesic and anti-inflammatory activity\(^5\(^5\)\).

5.2 Rumalaya gel

A potent phytopharmaceutical formulation containing resin from *P. roxburghii*, called Rumalaya gel, has been used in traditional medicine to relieve joint and bone pains associated with various orthopedic ailments\(^5\(^6\)\).

6 Clinical studies

In a study of 40 patients suffering from acute and chronic inflammatory musculoskeletal disorders, patients were advised to apply a small quantity of Rumalaya gel topically to the affected region, with gentle massage, twice daily for a period of three months. The study found a highly significant reduction in the mean score for joint swelling, joint pain, early morning joint stiffness, joint tenderness and muscular pain from one month onwards. This trend continued until the end of the study observation period\(^5\(^7\)\).

7 Miscellaneous

The bark of *P. roxburghii* was evaluated for removal of toxic metals from industrial wastewater\(^5\(^8\)\).

8 Conclusions

India, with its great biodiversity, has huge potential in the budding field of herbal medicine. Plants provide a variety of cultural resources that span the fundamental needs of food, clothing medicine and shelter. Herbal compounds have been utilized therapeutically since before recorded history in both organized (Ayurveda, Unani) and unorganized (folk, tribal, indigenous) medicinal traditions. Recently the medicinal importance of these natural products has gained focus; understanding formal and informal medicinal traditions in a modern clinical context relies on technological advances (such as phytochemical analysis, biological evaluation of experimental animal models, toxicological studies, investigation of molecular mechanism of action of isolated photoprinciples and their clinical trials). While adoption of natural products in the drug discovery process may circumvent some of the complications of developing synthetic drugs, the specificity of these man-made compounds makes them a potent medicinal tool, not to be discarded out of hand. Notwithstanding, herbal remedies, from traditional medicinal practices, provide an excellent source of lead molecules for the treatment of various diseases.

Medicinal plants help in mitigating human suffering and are widely used for home remedies and trade. Thorough screening of literature available on *P. roxburghii* presents an example of a plant that has a rich history of utilization in folk remedies by various ethnic groups to treat diverse ailments. While many potential biologically active compounds have been identified in all parts of the plant, and a growing body of work demonstrates the clinical potential for some of these compounds, there still exists a great need to fully explore the scientific basis for the medicinal uses of this plant.

9 Acknowledgements

We cordially thank Dr. A. Pal, Director, Institute of Pharmaceutical Sciences, Kurukshetra University, India, for providing guidance and necessary facility needed for the work.

10 Conflict of interests

The authors declare that there are no conflicts of interests and no agency is involved in financial support for this work.
REFERENCES


---

**Submission Guide**

*Journal of Integrative Medicine (JIM)* is a PubMed-indexed, peer-reviewed, open-access journal, publishing papers on all aspects of integrative medicine, such as acupuncture and traditional Chinese medicine, Ayurvedic medicine, herbal medicine, homeopathy, nutrition, chiropractic, mind-body medicine, Taichi, Qigong, meditation, and any other modalities of complementary and alternative medicine (CAM). Article types include reviews, systematic reviews and meta-analyses, randomized controlled and pragmatic trials, translational and patient-centered effectiveness outcome studies, case series and reports, clinical trial protocols, preclinical and basic science studies, papers on methodology and CAM history or education, editorials, global views, commentaries, short communications, book reviews, conference proceedings, and letters to the editor.

- **No submission and page charges**
- **Quick decision and online first publication**

For information on manuscript preparation and submission, please visit JIM website. Send your postal address by e-mail to jcim@163.com, we will send you a complimentary print issue upon receipt.

Editors-in-Chief: Wei-kang Zhao & Lixing Lao. ISSN 2095-4964. Published by Science Press, China.