

Pterospermum acerifolium Linn. : A Comprehensive Review with Phytochemical and Pharmacological Investigation

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ABSTRACT

Pterospermum acerifolium (Sterculiaceae) is an herb distributed throughout the world. Plant is commonly known as Kanakchampa, Karnikara, Muchukunda and Matsakanda. The leaves of the plant are widely used for the treatment of diabetes and as a haemostatic in Indian proprietary medicines. The plant is documented to possess beneficial effects as antioxidant, antiulcer, anti-inflammatory, analgesic, hypoglycaemic, immunosuppressive, wound healing, hepatoprotective, antihelmentic, antimutagenic and anticancer activity. It is believed to be used in inflammation, abdominal pain, ascites, cures ulcers, leprosy, constipation, urinary discharges and tumours. The present review is an attempt to highlight the various ethnobotanical and traditional uses as well as phytochemical and pharmacological reports on *Pterospermum acerifolium*.

Keywords: *Pterospermum acerifolium*, ethnobotanical uses, phytochemistry, pharmacological activities.

INTRODUCTION

Traditional systems of medicine provide an extremely vast body of source material for the development of new drugs and natural products which have become increasingly important as sources of pharmacotherapeutics¹⁻². *Pterospermum acerifolium* (PA) wild (Sterculiaceae) is a shrub distributed in India and found particularly in sub-Himalayan tract, outer Himalayan valley and hills up to 4000 ft³. The plant is commonly known as Kanakchampa, Karnikara, Muchukunda and Matsakanda. It grows to a height of 60ft. The bark is gray, thin and smooth. The wood consists of red coloured heart wood and an outer cover of sapwood which is lighter in color. Even though hard and closely grained, it is easy to work with⁴⁻⁵. As per Ayurvedic text it has traditionally been used for haemostatic, anti-inflammatory, ear pain, stomach-ache, blood troubles, small pox, leucorrhoea, leprosy, ulcer, tumours, as laxative and anthelmintic⁶⁻⁹.

Description

This herb is seen everywhere in north India. The bark of the bayur tree is grey in color and is considered to be fairly soft. Small twigs and new growth can sometimes seem feathery and are commonly more of a rusty-brown color. The leaves of the tree are palmately ribbed and have stipules. The leaves grow in an alternate arrangement. Leaf shape can range from oblong, broadly obovate to ovate. Leaf edges are commonly dentate (toothed) or irregularly lobed. Many leaves tend to droop downward, giving the tree the appearance that it is wilting, when in fact it could have a sufficient amount of water available. The top side of the leaves is a dark green color with a glabrescent texture. The leaves are rough and rubbery to limit the loss

of moisture in a hot climate. The bottom side of the leaves range from a silver to rust color and are pubescent. Leaves have a peltate blade base, meaning the insertion of the petiole is at the center of the leaf¹⁰⁻¹²

Reproduction

The Bayur tree produces large, white, finger shaped flowers in the spring. Flowers begin as one long bud, then separating into five more slender sepals as it matures. Each sepal can be up to seven inches long. The sepals of the flower curl outward and around the white and gold stamen located at the center. The flowers are nocturnal and exceptionally fragrant, suggesting they attract moths for pollination. Successfully pollinated flowers produce a fruit in the form of a hard capsule. The fruit has a very rough texture and is sometimes covered in brown hairs. Fruits can take a very long time to completely mature; up to an entire year. The capsule then splits open releasing a massive number of "winged seeds." Because it takes such a long period to reproduce, it seems the Bayur tree can be out-competed by other faster growing plants. It is not widely distributed or common in natural environments, but is popular plant in gardens and landscaping¹³⁻¹⁵.

Traditional and ethnobotanical use

Ayurvedas *Pterospermum acerifolium* flowers are used in tonic, laxative, anthelmintic, removes "kapha", inflammation, abdominal pain, ascites, cures ulcers, leprosy, urinary discharges and tumours. In the Konkan the flowers and bark, charred and mixed with kamala, are applied in suppurating small pox. The leaves are used as haemostatic and antimicrobial. Anti hyperglycaemic activity has been found in the leaves of this plant in type 2 diabetic model rats. A subfraction of the ethanol extract of

Table 1: Taxonomy of *Pterospermum acerifolium*.

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnolipsida
Family	Malvaceae
Subfamily	Sterculiaceae
Genus	<i>Pterospermum</i>
Species	<i>acerifolium</i>

the bark of the plant has now been tested both for its acute and chronic effects on glycaemic status as well as on lipid levels in the same model. It is commonly used herb in ayurvedic anticancer treatment. The flowers are mixed with sugar to be applied locally¹⁶.

Pharmacological activities

Following the folk and traditional uses of the plant, it has been investigated scientifically to validate the potential of plant in cure of variety of ailments. The pharmacological activities of *Pterospermum acerifolium* are described below:

Anti-inflammatory and analgesic activity

The role of ethanolic extract of *Pterospermum acerifolium* bark extract on different anti-inflammatory and analgesic models. The extract demonstrated significant anti-inflammatory activity against carrageenan induced, mediators induced and arachidonic acid induced rat paw oedema, significant inhibition of acetic acid induce writhing and tail clip induced analgesia were observed to occur with the extract. On the basis of finding it may inferred that *P.acerifoium* is an anti-inflammatory analgesic agent that blocks histamine and serotonin pathway²³.

Antiulcer activity

The role of alcoholic fraction of *Pterospermum acerifolium* bark extract on oxidative damages in the gastric tissue during alcohol induced ulceration was investigated. The extract showed significant antiulcer activity against ethanol induced ulceration and as well as significant reduction of tissue lipid peroxidation, catalase, superoxide dismutase and glutathione were observed to occur with the extract²⁴.

Antioxidant activity

In case of screening of antioxidant activity, the dichloromethane (DCM) extract of bark showed the highest free radical scavenging activity with IC₅₀ value 26.50 µg/ml in comparison with positive control (BHT). At the same time the aqueous soluble partitionate of methanolic extract (AQ) also exhibited strong antioxidant potential having IC₅₀ value of 39.0 µg/ml. High-est amount of phenolic content was found in dichloromethane and aqueous soluble partitionate of methanolic extract having TPC value of 28.30 and 17.23 mg of GAE/gm of extractive. Besides the carbon tetrachloride (CTC) showed moderated antioxidant activity having IC₅₀ value of 62.50 39.0 µg/ml with total phenolic content of 13.76 mg of GAE/gm of extractives. Therefore a positive correlation was seen between the total phenolic content and anti-oxidant activity²⁵.

Antioxidant and anti-inflammatory potential activity

Leaves of *Pterospermum acerifolium* L. (Sterculiaceae) are used in India for reducing oxidative stress and inflammation. The objective of this study was to investigate the antioxidant and anti-inflammatory activities to justify the use of the plant in folkloric medicine. Antioxidant activity of different fractions were evaluated by using in-vitro antioxidant assays models like determination of total phenolics, DPPH radical scavenging assay, nitric oxide scavenging assay, hydroxy radical scavenging assay and superoxide anion scavenging assay. Anti-inflammatory activity was evaluated using carrageenan induced inflammation and thermally induced protein denaturation. Ethyl acetate fraction of *P. acerifolium* (EAF) showed highest free radical scavenging activity in all the models. EAF also produced significant anti-inflammatory activity in both in-vivo and in-vitro model. The results obtained in this study showed that the leaves of *Pterospermum acerifolium* L. have antioxidant and anti-inflammatory properties which provide a basis for the traditional use of the plant²⁶.

Antimitotic and anticancer activity

Pterospermum acerifolium is used traditionally in the management of tumors. Ethanol and Water extracts showed good antimitotic activity against meristamatic cell growth. Both extracts also showed good inhibition on yeast cell growth with IC₅₀ 47.88 mg/ml and 39.15 mg/ml respectively. The mode of action of both extract with antiproliferative activity is due to fragmentation effect on DNA²⁷.

Hepatoprotective activity

The hepatoprotective activity of the ethanol extract of the leaf of *Pterospermum acerifolium* was investigated in rats for carbon tetrachloride induced hepatotoxicity. Hepatotoxicity was induced in male Wistar rats by intraperitoneal injection of carbon tetrachloride (0.1 ml/kg/d p.o. for 14 d). Ethanol extract of *P. acerifolium* leaves were administered to the experimental rats (25 mg/kg/d p.o. for 14d)²⁸.

The petroleum ether and hydro alcoholic extracts of *Pterospermum acerifolium* belonging to the Sterculiaceae family were studied for hepatoprotective activity against albino rats with liver damage induced by paracetamol. The petroleum ether extract at 50 mg/kg was having best activity as it decreased the mean level of bilirubin from 2.3645 ± 0.07 to 0.2975 ± 0.13. Petroleum ether extract was found to highly protective at both the dose of 25 mg/kg and 50 mg/kg for ALP, SGOT, and SGPT. For LPO level, SOD and Catalase level it was observed that both extract were having significantly protection at 25 mg/kg and 50 mg/kg dose²⁹.

Wound healing activity

Pterospermum acerifolium, a well-known plant in Indian medicine possesses various therapeutic properties including healing properties and cytokine induction. Wound healing activity of ethanolic extract of *P. acerifolium* flower along with its effect on tumor necrosis factor-α (TNF-α) was assessed using excision model of wound repair in Wistar albino rats. After application of the *P. acerifolium* extract, rate of epithelization with an increase in wound contraction was observed. Animals

Table 2: Phytochemical investigation.

Plant parts	Phytochemical	References
Leaves	Boscialin glucosides	
	Kaemferol-3-o-β-Dgalactoside (0.3%) as the major flavonoids, other flavonoids were identified as luteolin, luteolin-7- o-β-D-glucoside and luteolin 7-o-β-D-glucuronide	17 18
Flowers	24β-ethylcholest-5-en-3β-o-alpha-cellobicide, 3, 7-diethyl-7-methyl-1:5-pentacosanolide, n-hexacosane- 1-26-diol dilignocerate, friedelan-3-alpha- 01 its beta isomer, β-amyirin, β-sitosterol, n-triacontanol, n-hexacosane-1, 2, 6 diol and a mixture of acids and saturated hydrocarbon from the light petroleum extract.	19
Seed and seed oil	glycoside in the alcoholic extract of seeds and Seed oil contained malvalic acid as its major cyclopropenoid component and amino acid (tyrosine, cysteine, glycine, alanine) and sugars (lactose, xylose, rhamnose, and glucose).	20
Seed coat (Fruit)	Phytoceramides and acylated phytosterol glucosides	21
Bark	a new polysaccharide (composed of D-galacturonic acid, D-galactose, and alpha -rhamnose) from the acidic portion	22

Table 3

Plant part	Pharmacological activity	References
Bark	Anti-inflammatory	23
	and analgesic activity	24
	Antiulcer activity	25
	Antioxidant	
Leaves	Antioxidant and anti-inflammatory potential activity	26 27
	Antimitotic and anticancer activity	28, 29
	Hepatoprotective activity	
Flower	Wound healing activity	30
Seed	Immunosuppressive activity	31

tropically treated with 10% *P. acerifolium* extract in petroleum jelly, the wound healing process was observed faster as compared to control group which were treated with petroleum jelly alone. A significant accelerated healing was noticed in animals which were additionally prefed with 250mg/kg body weight of ethanolic *P. acerifolium* extract daily for 20 consecutive days along with the topical application 10% *P. acerifolium* extract. During wound Healing phase TNF-α level was found to be up regulated by *P. acerifolium* treatment. Early wound healing may be pronounced due to *P. acerifolium* extract elevating TNF- α production³⁰.

Immunosuppressive activity

The hexane and ethanolic extracts prepared from the seeds of plant *Pterospermum acerifolium* were evaluated for their immunomodulatory activities by exploiting their effects on the humoral and cellular immune arms of BALB/c mice after oral administration for 14 consecutive days at different log doses. Various immune parameters viz. lymphoproliferative index, oxidative burst in peritoneal macrophages, modulation in T/B cell population and regulation of Th1/Th2 cytokines in mice were monitored to assess the immunomodulatory characteristics of the plant at 3, 10 and 30 mg/kg doses. Both the extracts exerted remarkable dose-dependent immunosuppressive

effect with down-regulation of all the immune markers studied³¹.

DISCUSSION AND CONCLUSION

The emerging importance of biologically active medicinal plants and their constituents as possible therapeutic measures has become a subject of active scientific investigation. It is likely that in future safe and effective medicines will be developed from medicinal plants to treat various degenerative diseases. There are various books and literature available regarding this herbal drug, In recent years, ethnobotanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. They obviously deserve scrutiny on modern scientific lines such as physiochemical characterization, biological evaluation, toxicity studies, investigation of molecular mechanism of action(s) of isolated phytoprinciple and their clinical trials. These are necessary classical approaches in search of new lead molecule for management of various diseases. Many Indian herbs are being used in traditional practices to cure various human ailments. *Pterospermum acerifolium*, has an important place among such antidiabetic medicinal plants, it can also be used in treating inflammation, pain, ulcer and antihyperglycaemic agent. Furthermore, in future study, the isolated principles from *Pterospermum acerifolium* needs to be evaluated in scientific manner using various innovative experimental models and clinical trials to understand its mechanism of action, in search of other active constituents, so that its other therapeutic uses can be widely explored. There will be benefits for an Ayurveda practitioner if researches will be gone through more analysis.

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