ISSN: 0976-7126

INTERNATIONAL JOURNAL OF PHARMACY & LIFE SCIENCES

Pterospermum acerifolium Linn. : A comprehensive review with significant pharmacological activities

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Abstract

Pterospermum acerifolium (Sterculiaceae) is an herb distributed throughout the world. 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 and antihelmentic. It is believed to be used in inflammation, abdominal pain, ascites, cures ulcers, leprosy, constipation, urinary discharges and tumours. A scrutiny of literature revealed some notable pharmacological activities of the plant such as antidiabetic (showed the leaves extract lower the glucose level, in type 2 diabetic models in rats), antimicrobial, haemostatic, free radical scavenging and anti-inflammatory. The present review is an attempt to highlight the various ethnobotanical and traditional uses as well as Phytochemical and pharmacological reports on *Pterospermum acerifolium*.

Key-Words: *Pterospermum acerifolium*, ethnobotanical uses, pharmacognosy, pharmacological activities, phytochemistry.

Introduction

Pterospermum acerifalium wild (Sterculiaceae) commonly known as 'Kanak champa' is shrubs distributed in tropical Asia and an ever green tree with very conspicuous presence in the lower hill forests of Darjeeling and south Sikkim. It much more available at the east of Tista river and hardly occurs in central Darjeeling. The plant is commonly known as Kanak champa, Muchkund (Hindi), Muskanda (Bengali), Matsakanda (Telugu), Moragos (Assamese), Vennangu (Tamil), Mushkundo (Oriya), Karnikar (Marathi).

Pterospermum acerifolium Linn. has a wide application in traditional system of Indian medicine for example, in ayurvedic anticancer treatment flowers are mixed with sugars and applied locally[1]. Flowers and bark, charred and mixed with kamala applied for the treatment of small pox. Flowers made into paste with rice water used as application for hemicranias[2]. Stem bark of the plant was found to have antimicrobial activity[3].

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Isolation of boscialin glucosides from leaves of *P. acerifolium* have been reported[4]. Hepatoprotective effect of ethanolic extract of leaves of *P. acerifolium* was also reported[5]. Chronic effects of *P. acerifolium* on glycemic and lipidemic status of type 2 model diabetic rats was found beneficial[6]. The barks are reported to be used as anti-ulcer[7] anti-inflammatory analgesic[8] and anti-oxidant activity[9]. Flavonoids like keampferol, keampferide, luteolin, steroids and triterpenoids like sitosterol, taraxerol, friedelin, sugars, and fatty acids are present in the plant[10-11]. Thus present study was undertaken to review the traditional and medicinal uses as well as phytochemical and pharmacological reports on *Pterospermum acerifolium.*

Plant description

Pterospermum acerifolium grows to a height of 60ft. The bark is grays, 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 with.[12-13]

Reviewing literature it has been found that *Pterospermum acerifolium* (L) Willd (Family-

ISSN: 0976-7126

Sterculiaceae) commonly known as dinner plate Tree (Eng.) is a virgin with regards to its phytochemical characterization and pharmacological screening. But the leaves are extensively used in folks medicine as haemostatic and for its wound healing, hepatotoxic and antidiabetic properties. It is also used in fever, menorrhagia and puerperium etc.

Taxonomy of *Pterospermum acerifolium*

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnolipsida
Family	Malvaceae
Subfamily	Sterculiaceae
Genus	*Pterospermum*
Species	*acerifolium*

Pharmacognosy of *Pterospermum acerifolium* (L.) Willd

The interesting part of the tree is obviously leaves. Its broad and dense leaves give complete shade. It must be releasing the maximum amount of oxygen into the atmosphere. These are large usually peltate and take a close resemblance to the shape of an elephant pugmark. These are used for making plates of a disposable type and also as a fodder. Leaves are altunate, stipulate, petiolate, leaf blade usually palmately veined, entire or various lobed.

The large flowers are unique in shape and have an exotic fragrance. The grounded flower petals cure chronic headache. The outer sepal is of jack color and the inner sepal is of yellow color. The flower is funnel shaped and white. The whole flower gives the look of a designer garment. This golden-hued flower has a beautiful tassel-like form which makes it look very ornamental. It has an intense fragrance, perceptible even from a great distance while it is on the tree. The fragrance starts fading the moment it is plucked. The golden pendant flowers of the karnikara adorn the ears of Sri Krishna in the Bhagavatam (karnayoh karnikaram).

Pharmacognostic and preliminary phytochemical investigations

Qualitative investigation

The macroscopic features of the fresh wood of *Pterospermum acerifolium* were determined using the method of Evans[14]. Anatomical sections and powdered samples for the microscopy and chemo-microscopy were carried out according to methods outlined by Brain and Turner[15].

Quantitative investigation

The moisture content, ash and extractive values of the powdered wood samples and the quantitative microscopy on the anatomical section were carried out. (Table 1)[16]

Preliminary phytochemical investigation

The preliminary phytochemical investigation was done by the standard chemical tests of Evans and Brain and Turner. (Table 2)[16]

Fluorescence analysis

These analyses were carried out as per the standard procedures. In the present study, the powdered wood were treated with various chemical reagents like aqueous 1N Sodium hydroxide, alcoholic 1N sodium hydroxide, 1N hydrochloric acid, 50% sulphuric acid and 50% nitric acid and their extracts were subjected to fluorescence analysis in day light and UV light (254 nm and 366 nm).(Table 3)

Table 1: Physico-chemical characters of the powdered leaves of *P. acerifolium*

Evaluation parameters	**Value (% w/w)***
Moisture content	5.1
Total ash value	3.3
Water-soluble ash value	1.1
Acid-insoluble ash value	1.9
Extractive values	
a) Petroleum ether	1.29
b) Chloroform	2.06
c) Ethyl acetate	4.94
d) Methanol	9.12

*Mean value of six counts

Table 2: Preliminary phytochemical investigation of various extracts of leaves of *P. acerifolium*

Test for active Constituents	**PEE**	**CE**	**EAE**	**ME**
Steroids	+	+	-	-
Triterpenes	+	-	-	-
Saponine	++	+	-	-
Alkaloids	-	-	-	+
Tannins	-	-	-	+
Flavonoids	-	-	+	+
Glycosides	-	-	+	+

Abbr.: PEE= Petroleum ether extract, CE= Chloroform extract, EAE= Ethyl acetate extract, ME= Methanol extract

Table 3: Fluorescence analysis of powdered drugs under ultra-violet light

Powder and reagent	Color in ordinary light	Color in UV light
Powder	Brown	Dark brown
Powder+ Nitrocellulose	Faint brown	Faint greenish
Powder+ NaOH in Methanol	Brownish	Orange brown
Powder+ NaOH in Methanol + Nitrocellulose	Blackish brown	Dark green
Powder+ 1N NaOH in water	Dark reddish brown	Brown
Powder+ 1N NaOH in water+ Nitrocellulose	Dark reddish brown	Yellowish
Powder + HCl	Yellowish	Green
Powder + HCl + Nitrocellulose	Faint yellow	Faint brown
Powder+ HNO3	Faint brown	Brown
Powder+ H2SO4	Faint yellowish	Dark yellow

Phytochemical investigation

Leaves- Flavonoids like Kaemferol-3-o-β-D-galactoside (0.3%) as the major flavonoids, while the other flavonoids were identified as luteolin, luteolin-7-o-β-D-glucoside and luteolin 7-o-β-D-glucuronide.

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-amyrin, β-sitosterol, n-triacontanol, n-hexacosane-1, 2, 6 diol and a mixture of acids and saturated hydrocarbon from the light petroleum extract.

Seeds - 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).

Bark- a new polysaccharide (composed of D-galacturonic acid, D-galactose, and alpha –rhamnose) from the acidic portion.[17-22]

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 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 locally. [23-25]

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.acerifoiimum is an anti-inflammatory analgesic agent that blocks histamine and serotonin pathway. [26]

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 plant. [27]

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 extract. [28]

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 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 production.[29]

Anthelmintic activity

Anthelmintic Activity of crude extracts and fractions were investigated against earthworms (*Pheretima posthuma*), roundworms (*Ascardia galli*) and tapeworms (*Raillietina spiralis*) using Albendazole and Piperazine citrate as reference standards. The results of anthelmintic activity revealed that the ethyl acetate fraction of all the parts were most potent which were well comparable with both standard drugs followed by n-butanol fractions of those parts, but at higher doses. All other fractions, petroleum extracts and remaining crude extract after fractionations of those three parts of the plant were endowed with minute anthelmintic property, which were not up to standards. The present study prooves the potential usefulness of *Pterospermum Acerifolium* as good anthelmintic agent. [30]

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 DNA. [31]

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 studied. [32]

Hepatoprotective activity

The hepatoprotective activity of the ethanol extract of the leaf of *Ptrospermum 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). [33]

Conclusion

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.

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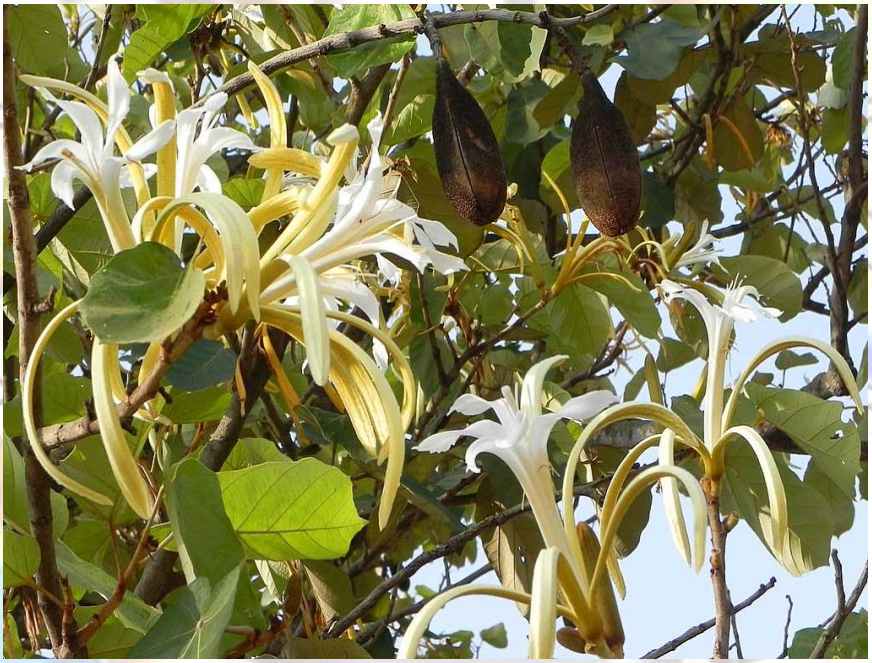

Fig. 1: Flowering and fruiting of *Pterospermum acerifolium* Willd.