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## A CONTEMPORARY LITERARY REVIEW OF *PTEROSPERMUM ACERIFOLIUM* (KANAK CHAMPA) WITH SPECIAL REFERENCE TO IT'S PHARMACOLOGICAL AND MEDICINAL ASPECTS

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### Keywords:

*Pterospermum acerifolium*, ethnobotanical uses, phytochemistry, pharmacological activities

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**ABSTRACT:** *Pterospermum acerifolium* belonging to Sterculiaceae family, commonly known as Bayur Tree, Dinner-plate tree is well distributed in India, particularly in the sub-Himalayan zone and outer Himalayan valleys. It is commonly known as Kanakchampa or Muchukunda. Different parts of the tree have been used to treat many diseases for thousands of years in traditional medicine. Mainly it is used for earache, smallpox, leprosy, inflammation, ulcers, diabetes syndrome, constipation, ascites, abdominal pain, urinary discharge, wound healing, immunosuppressive, hepatoprotective, antihelminthic, antimutagenic, anticancer activity. The descriptions of morphology, vernacular names, taxonomy, pharmacological activities, chemical constituents, ethnobotanical use, therapeutic use are richly found in Ayurvedic and contemporary literature. The review article will help the researchers to explore more about the said plant for the larger benefit of society.

**INTRODUCTION:** Medicinal plants are local heritage with global importance. Among millions of plants and their different species, Muchakunda has therapeutic predominance in certain disease conditions like kindisease, inflammation, bleeding disorder, gout, arthritis, psoriasis, bleeding piles, and uterine bleeding <sup>1</sup>. *Pterospermum acerifolium* (L) Willd belonging to the family Sterculiaceae, is a tall tree having high medicinal value. It is an angiosperm indigenous to Southeast Asia, from India to Burma.

The geographical distribution of the plant extends from North East India to Bangladesh (Chittagong), Burma and Malayasia; cultivated in Pakistan and North America <sup>2</sup>. Reviewing the biological activity of the plant, it was reported that flowers are the organ used as a tonic, anthelmintic, anti-inflammatory, laxative and to cure abdominal pain, ascites, ulcers, leprosy, urinary discharges, and tumors. Also, flowers and bark are charred, mixed with (kamala), and applied in suppurating smallpox <sup>3-4</sup>.

Concerning the anti-diabetic activity, two studies were found; the first one investigated the action of the methanolic extract of the barks of *P. acerifolium* towards non-diabetic, type-1, and type-2 diabetic models rats. In addition to the effect of the chloroformic extract of the leaves on diabetic type-1 rats <sup>5</sup>.

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The second study investigated the acute and chronic effects of the ethanolic extract of the bark of *P. acerifolium* on glycemic and lipidemic status of type-2 diabetic model rats <sup>6</sup>. Many triterpenes and flavonoids were isolated from the different organs of *P. acerifolium*. Leaves and bark were found to contain taraxerol, friedelin, friedelin-3-one,  $\beta$ -sitosterol, and  $\beta$ -sitosterol glucoside <sup>7</sup>.

$\beta$ -amyrin, 24 $\beta$ -ethylcholest-5-en- $\beta$ -O- cellobioside were isolated from petroleum ether extract of the flowers <sup>8</sup>. Kaempferol, kaempferide-7-O- $\beta$ -D gluco-pyranoside <sup>9</sup>, kaempferol-3-O- $\beta$ -D-galactopyranoside, luteolin and luteolin-7-O- $\beta$ -D-glucoside were isolated from the flowers. Leaves were reported to contain the same glycosides in addition to luteolin-7-O- $\beta$ -glucuronide <sup>10</sup>.

The chloroform and ethyl acetate fractions obtained from the ethanolic extract of the powdered fruits of *Pterospermum acerifolium* Willd, afforded three phenolic acid derivatives (methyl ester of protocatechuic acid, vanillic acid, protocatechuic acid), in addition to  $\beta$ -sitosterol-3-O- $\beta$ -D-glucoside <sup>11</sup>.

Reviewing the literature about protocatechuic acid, it was shown that it has antioxidant <sup>12</sup>, anticancer <sup>13-15</sup>, and hepato-protective activities <sup>16-17</sup>. Vanillic acid and methyl protocatechuate also showed antioxidant activities <sup>18-19</sup>.

**Morphology:** *Pterospermum acerifolium*, commonly known as Bayur Tree, a Dinner-plate tree, is a tree of Indian origin, which reaches a height of 50-70 ft. The bark of the tree is grey in color and fairly soft. Small twigs and new growth seem feathery and are commonly more of a rusty-brown color.

Leaves have grown in alternate insertion arrangements. Leaf shape can range from Oblong, broadly Obviate, 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.

The top side of the leaves is a dark green color. The leaves are rough and rubbery to limit the loss of moisture in a hot climate. Stipules linear; petiole robust, striate; leaf blade nearly Orbicular or Oblong, sometimes leathery.

Base cordate margin entire. It has large fragrant nocturnal white flowers occurring in axillary fascicles.

Sepals linear-oblong, petals white, linear-oblong, slightly shorter than sepals. Ovary oblong, 5-angular; ovules many.

Fruit is a capsule woody, angled, furfuraceous, cylindrical, reddish-brown velutinous, glabrescent, base tapering, and apex rounded. Seeds many per locule, obliquely ovate, flat, wing large and thin, brown, smooth <sup>20,21</sup>.

#### Vernacular Names: <sup>22</sup>

Latin name	: <i>Pterospermum acerifolium</i> (L) Willd.
English	: Kanaka Champa flower
Hindi	: Muchukund, Kanaka Champa, Kaniar, Katha Champa
Kannada	: Muchaakunda, Toddagiringa
Malayalam	: Uchakundam, Chittilaplavu
Tamil	: Vennangu, cittilapolavu, vattapolavu
Telugu	: Matsakanda, Lolagu, Marudu, Tadu
Marathi	: Muchakunda

**TABLE 1: TAXONOMY OF *PTEROSPERMUM ACERIFOLIUM***

Class	Eukaryota
Kingdom	Plant
Subdivision	Angiosperm
Class	Eudicots
Sub-Class	Eurosids II
Order	Malvales
Family	Sterculiaceae
Sub-Family	Dombeyoideae
Genus	<i>Pterospermum</i>
Species	<i>acerifolium</i>

**Ethno-Botanical uses:** The *Pterospermum acerifolium* is beneficial in the following conditions: Antiseptic, Depurative, Eruption, Fever, Fumitory, Inflammation, Leprosy, Menorrhagia, Puerperium, Repellant (insect), Smallpox, Sore tonic, Tumor, Laxative, Anthelmintic, Stomachache, Blood disorders, Ulcers <sup>23</sup>.

**Other uses:** The wood of this plant has been used in traditional fabric dyeing. In Malaysia, it is used specifically for dyeing. Orange-red is the most typical color produced by this species.

TABLE 2: PHYTOCHEMICAL CONSTITUENTS

Plant parts	Phytochemical	References
Flowers	24 $\beta$ -ethylcholest-5-en-3 $\beta$ -o-alpha-cellobicide, 3, 7-diethyl-7-methyl-1:5-pentacosanolide, n-hexacosane- 1-26-diol dilignocerate, friedelan-3-alpha- 01 its beta isomer, $\beta$ -amyirin, $\beta$ -sitosterol, n-triacontanol, n-hexacosane-1, 2, 6 diol and a mixture of acids and saturated hydrocarbon from the light petroleum extract.	8
Leaves	Boscialin glucosides Kaemferol-3-o- $\beta$ -Dgalactoside (0.3%) as the major flavonoids, other flavonoids were identified as luteolin, luteolin-7- o- $\beta$ -D-glucoside and luteolin 7-o- $\beta$ -D-glucuronide.	10
Fruits	three phenolic acid derivatives (methyl ester of protocatechuic acid, vanillic acid, protocatechuic acid), in addition to $\beta$ -sitosterol-3-O- $\beta$ -D-glucoside.	11
Seed and seed oil	glycoside in the alcoholic extract of seeds. Seed oil contained malvalic acid as its major cyclopropenoid component and amino acid (tyrosine, cysteine, glycine, alanine) and sugars (lactose, xylose, rhamnose, and glucose).	24
Seed coat	Phytoceramides and acylated phytosterol glucosides.	25
Bark	a new polysaccharide (composed of D-galacturonic acid, D-galactose, and alpha – rhamnose) from the acidic portion.	26

**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 a 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 be inferred that *P. acerifoium* is an anti-inflammatory analgesic agent that blocks histamine and serotonin pathways<sup>27</sup>.

**Antiulcer Activity:** The role of an alcoholic fraction of *Pterospermum acerifolium* bark extract on oxidative damages in the gastric tissue during alcohol-induced ulceration was investigated. The extract showed<sup>29</sup> of tissue lipid peroxidation, catalase, superoxide dismutase, and glutathione were observed to occur with the extract<sup>28</sup>.

**Antioxidant Activity:** In the case of screening of antioxidant activity, the dichloromethane (DCM) extract of bark showed the highest free radical scavenging activity with IC<sub>50</sub> value 26.50  $\mu$ g/ml in comparison with the positive control (BHT). At the same time, the aqueous soluble partitioned of methanolic extract (AQ) also exhibited strong

antioxidant potential having an IC<sub>50</sub> value of 39.0  $\mu$ g/ml. The highest phenolic content was found in dichloromethane and aqueous soluble partitionate of methanolic extract, having TPC values of 28.30 and 17.23 mg of GAE/gm of extractive. Besides, the carbon tetrachloride (CTC) showed moderated antioxidant activity having IC<sub>50</sub> value of 62.50 39.0  $\mu$ g/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 activity<sup>29</sup>.

**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 and its effect on tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) was assessed using an excision model of wound repair in Wistar albino rats. After application of the *P. acerifolium* extract, the rate of epithelization with an increase in wound contraction was observed. Animals were topically treated with 10% *P. acerifolium* extract in petroleum jelly, the wound healing process was observed faster than the control group treated with petroleum jelly alone.

A significantly accelerated healing was noticed in animals which additionally preferred with 250 mg/kg body weight of ethanolic *P. acerifolium* extract daily for 20 consecutive days along with the topical application 10% *P. acerifolium* extract. During the wound healing phase, TNF- $\alpha$  level was found to be up-regulated by *P. acerifolium* treatment. Early wound healing may be pronounced

due to *P. acerifolium* extract elevating TNF- $\alpha$  production<sup>30</sup>.

**Anthelmintic Activity:** Anthelmintic Activity of crude extracts and fractions were investigated against earthworms (*Pheretima posthuma*), roundworms (*Ascaridia 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 was most potent, which were well comparable with both standard drugs followed by n-butanol fractions of those parts, but at higher doses. After fractionations of those three parts of the plant, all other fractions, petroleum extracts, and remaining crude extract were endowed with minute anthelmintic properties, which was not up to standards. The present study proves the potential usefulness of *Pterospermum acerifolium* as a good anthelmintic agent<sup>31</sup>.

**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, hydroxyl 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<sup>32</sup>.

**Antimitotic and Anticancer Activity:** *Pterospermum acerifolium* is traditionally used in the management of tumors. Ethanol and Water extracts showed good antimitotic activity against meristematic cell growth.

Both extracts also showed good inhibition of yeast cell growth with IC<sub>50</sub> 47.88 mg/ml and 39.15 mg/ml, respectively. The mode of action of both extracts with anti-proliferative activity is due to the fragmentation effect on DNA<sup>33</sup>.

**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 was administered to the experimental rats (25 mg/kg/d p.o. for 14d)<sup>34</sup>.

The petroleum ether and hydroalcoholic 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 had the best activity as it decreased the mean level of bilirubin from 2.3645  $\pm$  0.07 to 0.2975  $\pm$  0.13. The petroleum ether extract was found to be 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, both extracts had significant protection at 25 mg/kg and 50 mg/kg dose<sup>35</sup>.

**Analgesic, Antipyretic, Antihyperglycemic, and Anti-inflammatory Activities:** The extracts of the fruits have analgesic, antipyretic and anti-hyperglycemic activities. It is compared to be less than half the potency of standard drugs. However, the alcoholic extract of the fruits showed a significant anti-inflammatory effect at a dose (100 mg/kg b.wt.), when compared to that of indomethacin (20mg/kg b. wt.). It showed 37.9% inhibition in carrageenan induced rat paw oedema with regards to that of indomethacin 62.6%. This reflects that the potency of the alcoholic extract of fruits represents 61% of the indomethacin potency<sup>11</sup>.

**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/Tcytokines in mice were monitored to assess the immunomodulatory characteristics of the plant at 3, 10, and 30 mg/kg doses. Both the extracts exerted a remarkable dose-dependent immune-suppressive effect with down-regulation of all the immune markers studied<sup>36</sup>.

**TABLE 3: PHARMACOLOGICAL ACTIVITY OF PLANT PARTS**

Plant part	Pharmacological activity	References
Bark	Anti-inflammatory and analgesic activity	27
	Antiucler activity	28
	Antioxidant	29
	Wound healing activity	30
Flower	Antioxidant and anti-inflammatory potential	32
Leaves	activity	33,35
	Antimitotic and anticancer activity	
	Hepatoprotective activity	
Fruit	Analgesic, Antipyretic, Anti-hyperglycemic and Anti-inflammatory activities	11
Seed	Immunosuppressive activity	36

**DISCUSSION AND CONCLUSION:** Literary Review of *Pterospermum acerifolium* with special reference to its Medicinal aspects highlights different therapeutic uses of it. In this review article the morphology, taxonomy, phytochemical constituents of the plant are given in ethnobotanical way. The emerging importance of biologically active medicinal plants and their constituents as possible therapeutic measures has become active scientific investigation. Safe and effective medicines will likely be developed from medicinal plants to treat various degenerative diseases in the future. Different used parts of the muchakunda along with its suitable dosage form, are also mentioned in many literatures. 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 the molecular mechanism of action(s) of isolated phytoprinciple, and their clinical trials. These are necessary classical

approaches in search of the new lead molecule for the management of various diseases. *Pterospermum acerifolium* is important among such anti-diabetic medicinal plants; it can also be used to treat inflammation, pain, ulcer, and antihyperglycemic agent. Flowers are also used as a general tonic. Overall, this literary work may help herbal researchers explore more medicinal effects of the said drug in validated experimental and clinical models.

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