

## Pharmacological Profile of *Pterocarpus marsupium* with a note on its Therapeutic Activity: A Review

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### ABSTRACT

*Pterocarpus marsupium* (Leguminosae), commonly known as Bijayasara or Asana in Bengali, Bijasal in Hindi, Indian kino or Malabar kino in English, is a large deciduous tree widely distributed in the central, Western and Southern regions of India. It is an important medicinal plant of Indian traditional system of medicines and has been used in India for several medicinal purposes. It is a good source of tannins and hence used as powerful astringent, cooling, constipating, anodyne, alternant, rejuvenating agent and also in treatment of fractures, bruises, leprosy, leucoderma, diarrhea and dysentery, passive haemorrhage, toothache and in diabetes. It is also used as anti-inflammatory, anthelmintic, analgesic and in treatment of indigestion, diabetic anaemia, gout, Rheumatoid arthritis, cough, asthma, bronchitis, greyness of hair, elephantiasis, erysipelas, urethrorrhea and ophthalmic complications. This paper reports on its pharmacognostic properties such as antidiabetic, antioxidant, analgesic, antibacterial, hepato-protective, anti-inflammatory and memory enhancing activities of *Pterocarpus marsupium*.

**Keywords:** *Pterocarpus marsupium*, Analgesic, Antibacterial, Antidiabetic, Antioxidant, Hepato-protective.

### INTRODUCTION

Use of plants as a source of medicine has been an ancient practice and is an important component of the health care system in India. Nature has bestowed on us a very rich botanical wealth and a large number of diverse type of plants growing in different parts of the country. Plants form a major part of the therapeutic ingredients in almost all systems of medical sciences<sup>1</sup>. Herbal medicines have been used since the dawn of civilization to maintain health and to treat diseases. In the recent few years, researchers have attention on medicinal plants for the development of new drug. Many of evidences are available to demonstrate the potential of medicinal plants used in various traditional, complementary and alternative systems of medicines. The world health organization estimates that plant extracts or their active constituents are used as folk medicine in traditional therapies of 80% of the world population<sup>2</sup>. Over 50% of all modern clinical drugs are of natural product origin<sup>3</sup>. Interest in plant derived drugs has been increasing, mainly due to the current widespread belief that "green medicine" is safer and more dependable than

costly synthetic drugs, many of which have adverse side effects<sup>4</sup>.

The basis of systems among traditional medicine has been derived from plants which have given rise to some important drugs still in use today. A lot many of Countries have known the importance of herbal medicinal plants that brings more cure. Existence of the plants and their use to treat diseases are as old as man. Dependability of man on plants has in no way decreased, although there are comprehensive documentations of the plants, used for their medicinal properties including parts such as leaves, stem and roots. Decoctions of plants are used for the treatment of diseases such as diabetes, stroke, urinary problems, asthma, stomachache, hypertension, diarrhea and wounds. People have been using plants as a source of medicine since the beginning of human civilization perhaps as early as Neanderthal man, plants were believed to have healing power. The traditional society across the world has always used herbs to promote healing. In today's world herbal medicine is the most predominant means of healthcare in developing countries where about 80% of their total population depends on it for their well being. Plants form the basis for the development

of modern drugs and medicinal plants have been used for many years to treat disease all throughout the world in the daily course of life.

World health organization reports that 70% of populations from many countries use herbal medicines to cure various ailments. Since a long time plants have represented the only source of therapeutical agents known to man. Plants have become the primary source of substances for drug development<sup>5</sup>. Awareness of medicinal plants usage is a result of the many years of struggles against illnesses due to which man learned to pursue drugs in barks, seeds, fruit bodies and other parts of the plants<sup>6</sup>. In developing countries, all over the world, 80% of population continues to use traditional medicine in primary medical problems<sup>7</sup>. In the rural areas, people collect their requirements of medicinal plants from forests and communities practiced sustainable concepts with minimal damage to the habitats in which these precious plants are found. Medicinal plants are plants containing inherent active ingredients used to cure disease or relieve pain<sup>8</sup>. The use of traditional medicines and medicinal plants in most developing countries as therapeutic agents for the maintenance of good health has often been reported<sup>9</sup>.

*Pterocarpus marsupium* (Roxb.) is a deciduous tree, commonly called as Indian Kino tree or Malabar Kino, belonging to the family Fabaceae. It is a medium to large sized tree reaching height up to 15-20 meter with dark brown to grey bark having swallow cracks. The bark exudes a red gummy substance called 'Gum Kino' when injured. Leaves are compound and imparipinnate. Flowers are yellow in terminal panicles. Fruit is circular, flat, winged pod. Seed is convex and bony Tree flowers and fruits in the month of March to June<sup>10</sup>.

*Pterocarpus marsupium* is distributed in deciduous forest throughout the India. It is native to India, Nepal and Sri Lanka. In India, it occurs in parts of the Western Ghats in the Karnataka-Kerala region. It is also found to grow in parts of states such as Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamilnadu, Uttar Pradesh, West Bengal and Goa. It is also known by the names Malabar Kino, Benga, Bijiyasal (in western Nepal), Piasal (Oriya)<sup>11</sup>, Venkai (Tamil), and many others<sup>12</sup>.

Leaves are used for food and manure. Its main chemical constituent is a glucosidal tannin namely kinotannic acid. Several other chemical

constituents like pterostilbene, (-)-epicatechin, pterosupin, marsupsin, etc. have been identified and isolated. It also shows promising results in treatment of cataract<sup>13</sup> and hypertriglyceridaemia<sup>14</sup>. This plant also finds its use as cardiotoxic<sup>15,16</sup>, hypoglycaemic<sup>17</sup>, anti-hyperinsulinaemic<sup>18</sup>, antifungal<sup>19</sup>, cox-2 inhibitor<sup>20</sup> and hepatoprotective agent<sup>21</sup>. The flowers are used in the treatment of fever. *Pterocarpus marsupium* is a multipurpose leguminous tree. Heart wood is astringent, bitter, acrid, cooling, anti-inflammatory, depurative, haemostatic, revulsive, anthelmintic, constipating and rejuvenating. The wood is also useful in chest pain, body pain, and indigestion. The paste of seed and wood is useful in diabetic anaemia. The paste of heart wood is useful in body pain and diabetes. Wood of the tree is useful in making the water glasses of the diabetic patients. Bark is useful in vitiated condition of *kapha* and *pitta*, elephantiasis, erysipelas, urethrorrhea, rectalgia, ophthalmopathy, hemorrhages, dysentery, cough and greyness of hair. Aqueous infusions of the bark possess antidiabetic potentia<sup>22</sup>. The powdered bark is mixed with *Schleichera oleosa* and taken with cold water to treat dysentery. Stem bark is used to treat the wounds, fever, stomachache, diabetes and elephantiasis. Bark is useful in urinary discharge and piles. The gum Kino is externally applied to leucorrhoea. Gum Kino is used in the treatment of polyurea and inordinate night sweat and phthisis pulmonalis.

The Kino powder may be dusted on ulcers and bleeding surfaces. The gum is used in the toothache and leaves paste is applied in wounds. Bruised leaves are useful in boils sores, skin diseases, stomachic and cholera. Leaf juice is given in purulent discharges from ear; plant is useful in snakebite and scorpion sting. Fruit cures biliousness and *kapha*. Flowers are bitter, sweet, cooling, appetizing, febrifuge, aphrodisiac and used in fever, often used to treat biliousness, mental aberrations and ulcers<sup>23,24</sup>. The bruised leaves are considered useful as an external application for boils, sores and skin diseases. *P. marsupium* is widely used in 'Ayurveda' as 'Rasayana' for management of various metabolic disorders including hyperlipidemia<sup>25, 26</sup>. Also used to improve eye sight<sup>27</sup>. In combination with other drugs the wood is used to treat snake bites and scorpion stings<sup>28</sup>. Its toxicity, wound healing potential also evaluated in animal studies<sup>29</sup> and also show antioxidant and antimicrobial activity<sup>30</sup>.



## THERAPEUTIC USES

### **Analgesic activity**

This study assessed three different successive solvent extracts from *P. marsupium* leaf for their analgesic potential by acetic acid induced writhing assay in Swiss albino mice. Intra-peritoneal injection of phenyl paraquinone, bradykinin or dilute acetic acid (1-3% v/v) produces pain reaction that is characterized as writhing response. All the test extracts exhibited significant analgesic activity. The methanol extract was found to be the most potent followed by the ethyl acetate and petroleum ether extracts respectively. The better analgesic effects of ethylacetate and methanol extracts may be due to the presence of polyphenols in them. The present preliminary study demonstrated marked analgesic activity of *P. marsupium* leaf in Swiss albino mice<sup>31</sup>.

### **Antidiabetic activity**

The bark of *Pterocarpus marsupium* is traditionally used in Indian Ayurveda system of medicine as an anti-diabetic drug. An active principle (-) epicatechin was isolated from the ethanolic extract of the bark by Chakraborty BK et al in 1982. They reported the presence of three phenolic principles, pterostilbene,

marsupsin, and pterosupin as antidiabetic agents, in the ethyl acetate-soluble portion of aqueous extracts of the heartwood. However, marsupsin and pterostilbene significantly lowered blood glucose in hyperglycemic rats and effect was comparable to Metformin<sup>32</sup>. An aqueous extract of *Pterocarpus marsupium* wood was screened for hypoglycemic activity on alloxan-induced diabetic rats. During both acute and sub-acute tests, the water extract, at an oral dose of 250 mg/kg, showed statistically significant hypoglycemic activity. In diabetic rats, aqueous extract cannot act indirectly by stimulating the release of insulin since alloxan treatment causes permanent destruction of  $\beta$ -cells. The anti-hyperglycemic effect in the alloxan-diabetic rats suggests that its main mechanism may not be due to potentiation of insulin release from pancreatic cells and thus the drug may be effective in insulin independent diabetes<sup>33</sup>.

### **Antioxidant activity**

Antioxidant activity of aqueous, ethyl acetate and methanol extracts of the bark of Indian Kino tree *Pterocarpus marsupium* have been tested using various antioxidant model systems, viz DPPH, ABTS, NO, OH, SO and inhibition of *in*

*in vitro* lipid peroxidation. The total antioxidant potential has been assessed by FRAP assay. Methanol extract of *Pterocarpus marsupium* is found to possess highest DPPH radical scavenging activity followed by aqueous and ethyl acetate extracts. The aqueous extract of *Pterocarpus marsupium* exhibits potent ABTS scavenging activity. The nitric oxide scavenging activity of *Pterocarpus marsupium* ethyl acetate extract records the highest. With respect to hydroxyl radical scavenging, all the three solvent extracts of *Pterocarpus marsupium* present high activities on par with each other. Methanol extract of *Pterocarpus marsupium* is found to possess higher superoxide scavenging activity at lower concentrations as compared to the other extracts. All the three extracts of *Pterocarpus marsupium* are also found to be good inhibitors of *in vitro* lipid peroxidation. Saturation in the scavenging activity has been attained in a concentration dependent manner. This study indicated significant free radical scavenging potential of *Pterocarpus marsupium* bark which can be exploited for the treatment of various free radical mediated ailments<sup>34</sup>.

#### Anti-inflammatory activity

Several plant species have been traditionally used as anti-inflammatory agents. The use of *P. marsupium* to cure boils, gleet (a watery discharge from the urethra caused by gonorrhoeal infection), urethrorrhea, odontalgia, psoriasis, and wounds has long history in Indian medicine. However, the aqueous extract of *P. marsupium* was reported to possess anti-inflammatory activity. The research work to check the anti-inflammatory effect of this plant was carried out by Mohammed Rageeb et al. They subjected the aqueous and methanol extracts to assess anti inflammatory effect by acute inflammation model using carrageenan induced rat paw Edema technique. Their results indicated that methanol extract (50mg/kg) showed good significant ( $p < 0.001$ ) reduction in paw Edema from 2nd to 4th hour when compared to control group and near similar aqueous extract was significant after 1st hour at 100mg/kg concentration. Thus, they concluded that both extracts (100mg/kg) of treated group showed good significant anti-inflammatory activity<sup>32</sup>.

#### Antibacterial activity

The study was designed to evaluate the antibacterial activity of *Pterocarpus marsupium* (Stem) methanol extract. Antimicrobial activity

was tested against Gram-positive bacteria i.e. *Bacillus coagulans* and *Escherichia coli*, gram negative bacteria. Evaluations were based on the inhibition zone using disc diffusion assay. Where Ciprofloxacin was used as a standard drug to compare the results of experimental plants. All concentrations of the extract showed varying degrees of inhibition against both the bacterial strains. 100 mg/ml concentration showed higher zone of inhibition as compared with the standard drug with both the tested bacteria. Results showed that *Pterocarpus marsupium* showed highly significant results against both the bacteria<sup>35</sup>.

#### Hepatoprotective activity

Hepatotoxicity was induced in male Wistar rats by intraperitoneal injection of CCl<sub>4</sub>. Methanol and aqueous extracts of *P. marsupium* stem bark were administered to the experimental rats (25 mg/kg/day, p.o. for 14 days). The hepatoprotective effect of these extracts was evaluated by the assay of liver function biochemical parameters (total bilirubin, serum protein, alanine amino transaminase, aspartate amino transaminase, and alkaline phosphatase activities) and histopathological studies of the liver. In methanol extract-treated animals, the toxic effect of CCl<sub>4</sub> was controlled significantly by restoration of the levels of serum bilirubin, protein and enzymes as compared to the normal and the standard drug silymarin treated groups. Histology of the liver sections of the animals treated with the extracts showed the presence of normal hepatic cords, absence of necrosis and fatty infiltration, which further evidenced the hepatoprotective activity. This result showed that methanol extract of the stem bark of *P. marsupium* possesses significant hepatoprotective activity<sup>36,37</sup>.

#### Memory enhancing activity

Dementia is a mental disorder characterized by loss of intellectual ability sufficiently severe as to interfere with one's occupational or social activities and it invariably involves impairment of memory. Centrally acting anti-muscarinic drugs (e.g. scopolamine) impair learning and memory both in animals and human beings. Because of the harmful effects of these so used drugs, in the recent years, there has been a phenomenal rise in the interest of scientific community to explore the pharmacological action or to confirm veracity of claims made about herbs. However several plants have been reported to possess nootropic

activity. The phytochemical tests of methanol extract of *P. marsupium* showed the presence of saponins, tannins and flavonoids. It is known that saponin compounds have nootropic activities, which partially explain the mechanism of action of extract. Bhupendra C and Amrendra K.C investigated the effects of methanol extract of *P. marsupium* Roxb. on learning and memory in albino mice. The mice administered with 25 mg/kg of the extract could significantly maintain the equilibrium on the rotating rod. Administration of *P. marsupium* significantly ameliorated scopolamine induced amnesia in elevated plus maze test as indicated by increase in inflexion ratio and reduction in transfer latency. In a way they investigated that *P. marsupium* can be a promising memory-enhancing agent.

### CONCLUSION

Methanolic extracts from the *P. marsupium* leaf showed analgesic potential similar to the standard drug. The better analgesic effects of methanol extracts may be due to the presence of polyphenols in them. An aqueous extract of *Pterocarpus marsupium* wood was found to lower the blood glucose level in alloxan-induced diabetic rats. Methanol extract of *Pterocarpus marsupium* bark is found to possess highest antioxidant activity. Hence *Pterocarpus marsupium* bark can be used for the treatment of various free radicals mediated ailments. The aqueous extract of *P. marsupium* was reported to possess anti-inflammatory activity. Methanolic extract of *Pterocarpus marsupium* stem showed highly significant results against both gram positive and gram negative bacteria. Methanol and aqueous extracts of *P. marsupium* stem bark possesses significant hepatoprotective activity. *P. marsupium* can be a promising memory-enhancing agent.

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