

OVERVIEW OF INDIAN MEDICINAL TREE: *BAMBUSA BAMBOS* (DRUCE)

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ABSTRACT

India has a great wealth of various naturally occurring plant drugs which have a great potential for pharmacological activities. *Bambusa bambos* family Graminae is highly reputed Ayurvedic medicinal tree commonly known as bamboo. It is tall sized tree growing throughout India. It also occurs in Srilanka, Malaya, Peru and Myanmar. *Bambusa bambos* has been proven to have great pharmacological potential with a great utility and usage as folklore medicine. It is widely used in folk medicine for its anti-inflammatory, astringent, laxative, diuretic, anti-ulcer, anti-arthritis, anti-obesity and abortifacient activities. The various chemical constituents reported in this plant are oxalic acid, chorogenic acid, ferulic acid, coumaric acid, protocatechuic acid, vanillic acid, caffeic acid, reducing sugars, resins, waxes, hydrogen cyanide (HCN), benzoic acid, diferuloylarabinoxylanhexasaccharide, diferuloyl oligosaccharide, (5, 5'-diferuloyl-9,9'-diolyl)-[α -L-arabinofuranosyl-(1 \rightarrow 3)-O- β -D-xylopyranosyl-9-(1 \rightarrow 4)-D-xylopyranose] (taxiphyllin), arginine, cysteine, histidine, isoleucine, leucine, lysine, methionine, phenylamine, threonine, valine, tyrosine, niacin, riboflavin, thiamine, betain, choline, proteolytic enzymes, nuclease, urease. Pharmacological evaluation of various parts of the plant have demonstrated antioxidant, anthelmintic, diuretic, anti-inflammatory, anti-ulcer, anti-diabetic, anti-bacterial, anti-fertility, hypothermic, anti-thyroid anti-tumour and ecobolic activities. Various phyto-pharmacological evaluations have been reported in this literature which indicates the potential of *Bambusa bambos* as a therapeutic agent. This review mainly focuses on traditional, botanical, phytochemical and pharmacological information of *Bambusa bambos*.

Keywords: *Bambusa bambos*, traditional uses, phytochemical constituents, pharmacological properties.

INTRODUCTION

Bambusa bambos, commonly known as Indian thorny bamboo, is a species of clumping bamboo native to several countries in South and East Asia¹. It mainly occurs throughout India, Srilanka, Malaya, Peru and Myanmar. Bamboo consists of fresh leaves and dried fruits of *Bambusa bambos* Graminae. Bamboos are members of Graminae (Poaceae) family, as are corn, sugarcane and other grasses. However bamboos differ from other members of grasses family by presence of branches at each node. *Bambusa bambos* has been widely used in Indian folk medicine. In Ayurveda, the entire plant is used as astringent, laxative, for inflammatory conditions and as diuretic. Shoots of the plant are used for dislodgement of worms from ulcer. Leaves are used in treatment of leprosy, amenorrhoea, dysmenorrhoea, eye troubles, lumbago, haemorrhoids and hematemesis². Leaf juice is given for strengthening the cartilage in osteoarthritis and osteoporosis. It plays an important role in maintaining the integrity of the bones, arterial walls, skin, teeth, gums, hair and nail. It is also used to alleviate eczema and psoriasis. Silicates of *Bambusa* are very useful in creation of body's structural matrix for forming and repairing connective tissue³. Paste or ash of roots is used locally in skin disorders, ringworm infection, rabies and dermatoses. Fruits are useful in fat metabolism and obesity⁴. The leaves of bamboo are being used as abortifacient in early conception by the tribal women around Salem in Tamil Nadu, India⁵. Decoction prepared from leaf bud encourages the free discharge of menses and is used in treatment of amenorrhoea. It is also used as an anti-spasmodic to relieve pain in dysmenorrhoea. An ointment prepared from roots of the plant is used to treat cirrhosis and hard tumours; especially tumours of stomach, abdomen, liver and spleen. Tabasheer is a siliceous secretion of plant containing up to 97 % SiO₂ which is considered as an aphrodisiac, coolant and tonic in asthma⁶. The Kani tribes of Kanyakumari district of India believe that the seeds of *Bambusa bambos* enhance the fertility⁷. Decoction of leaves

is given after childbirth to humans and animals which acts as a laxative and helps in expulsion of placenta⁸. In Mauritius an infusion prepared from the leaves is used to take bath for healing of measles⁹.

Botanical Description

It is described as tall woody bamboo with stems thorny and numerous, tufted on a stout root-stock. It grows up to a height of 30-40 meters, curving at the top. Culms are 15-18 cm across; nodes prominent, lower emitting horizontal almost naked shoots armed at nodes with 2-3 stout re curved spines, internodes are 30-45 cm long¹⁰⁻¹². Leaves are 17.5-20.5 × 2-2.5 cm, linear or linear lanceolate, tip stiff, glabrous or puberulous beneath, margins scabrous, base ciliate, mid-rib narrow, leaf-sheath ending on a thick callus and shortly bristly auricle. Inflorescence consists of enormous panicles often occupying the whole stem. Caryopsis oblong, 5-8 mm long, grooved on one side. Flowering and fruiting occurs once in lifetime, often during September- May^{11,12}.

Cultivation and Collection

Climate

Bamboos grow primarily in regions of warmer climate. It is grown as an irrigated crop during June-July and September-October at onset of monsoon. It is harvested at maturity during January- February^{11,14}.

Soil and Preparation of land

Bamboos prefer loamy and sandy loamy soil which is slightly too moderately acidic¹⁴.

Propagation

It is done by direct sowing of seeds before onset of monsoon at a depth of 20-30 cm in pits, 3-5 m apart. Direct sowing of seeds is also done in furrows, 15 cm wide and 3-5 m apart, along the contours. One kilogram of seeds is sown per hectare of land¹⁴.

Manures and Fertilizers

Small doses of nitrogenous fertilizers (200 g of ammonium sulphate or calcium ammonium nitrate) are applied in a furrow during first year of planting. 200 g of superphosphate are applied per plant at the time of planting which promotes better development of roots. A dose of fertilizers in 2nd year is also recommended^{11,14}.

Pests

Plants are protected from rats, porcupines, squirrels, monkeys and insects like *Estigmaena chinensis*, *Cyntotrachelus longimanus*, *Dinoderus minutus*, *Dinoderu socellaris*, *Stromatium barbatum*¹⁵.

Phytochemical Constituents

The siliceous substance found near the joint is white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste^{16,17}. The active constituents of shoots are oxalic acid, reducing sugar, resins, waxes, hydrogen cyanide (HCN), benzoic acid¹⁸, diferuloylarabino oxylanhexasaccharide, diferuloyl oligosaccharide¹⁹, (5,5'-di-(diferul-9,9'-dioyl)-[α -L-arabinofuranosyl-(1 \rightarrow 3)-O- β -D-xylopyranosyl-9-(1 \rightarrow 4)-D-xylopyranose] (taxiphyllin). Seeds contain arginine, cysteine, histidine, isoleucine, lysine, methionine, phenylamine, threonine, valine, tyrosine, niacin, riboflavin, thiamine²⁰. Leaves mainly contain protein gluteline, lysine, methionine, betain, choline, proteolytic enzymes, nuclease, and urease²⁰. Ethanolic extract of leaves contain 17, 20, 20- tri demethyl-20 α -isopranyloleanane and eicosan-1,20-dioic acid²¹. In the course of phytochemical investigation of the plant two compounds namely Stigmast-5, 22-die-3 β -ol and Stigmast-5-en-3 β -ol-D-glucopyranoside were isolated in good quantities which are responsible for hypoglycaemic effect. Two known compounds α -amyrin acetate and urs-12-en-3 β -ol- β -D-glucopyranoside have also been isolate from this plant²¹. Nayak S and Rout GR analysed the isolation and characterization of microsatellites in *Bambusa bambos* and cross species amplification in other bamboos. Six microsatellites, three polymorphic and three monomorphic, were characterized in bamboo species, belonging to family Poaceae²². Aqueous leaf extract contains six phenolic acids namely chlorogenic acid, ferulic acid, coumeric acid, protocatechuic acid, vanillinic acid and caffeic acid²³.

Pharmacology

Acute and Sub Chronic Toxicity Studies on Anti-oxidant of Bamboo Leaves

The anti-oxidant of bamboo (AOB) leaves has recently been certified as a novel kind of natural anti-oxidant by Ministry of health of People's Republic of China and has been used in various food systems²⁴. AOB was subjected to a series of acute and sub chronic toxicological tests to evaluate its safety. The results showed that the maximum tolerated dose (MTD) of AOB was greater than 10 g / kg body weight in both rats and mice, which can be regarded as virtually non-toxic. No mutagenicity evidence was detected in any of the mutagenicity tests. Administration at dose levels of 1.43, 2.87 and 4.30 g / kg per day to rats for 90 days did not induce significant haematological, clinical, chemical and histopathological changes. The no-observed adverse effect level (NOAEL) of 4.30 g / kg per day²⁵. These results indicate that AOB can be regarded as safe for use as food additive²⁶.

Anti-inflammatory and Anti-ulcer Activity

The anti-inflammatory activity of methanol extract of leaves was studied in carrageenan induced paw oedema as well as immunologically induced paw oedema and also its anti-ulcer activity was studied in albino rats. The activity was found to be significant when compared to the standard drugs. The combination of methanol extract and phenylbutazone (Non-steroidal anti-inflammatory drug, NSAID) was found to have the most potent anti-inflammatory activity experimentally with least toxic (no ulcerogenic) activity. Thus the combination of herbal product i.e. methanol extract of *Bambusa bambos* with modern medicine (NSAID) will produce the best anti-inflammatory drug and will be useful for long term treatment of chronic inflammatory conditions²⁷. The anti-inflammatory activity can be attributed to the presence of α -amyrin²⁸ and phenolic compounds²⁹.

Anthelmintic Activity

Ethanol extract of roots of the plant was investigated for its anthelmintic activity against *Pheritima posthuma*. The study involved determination of paralysis time and death time of worms at different dose levels of the extracts (10, 20 and 50 mg / ml). The extract demonstrated anthelmintic activity in a dose dependent manner. The activity was comparable with the reference standard Piperazine citrate (15 mg / ml) and Albendazole (10 mg / ml)³⁰. The anthelmintic activity can be attributed to the presence of α -amyrin³¹.

Anti-diabetic Activity

Aqueous ethanol extract of *Bambusa bambos* seeds were tested for anti-diabetic activity using alloxan induced diabetic rats and compared with standard. The results demonstrated that the aqueous ethanol extract showed significant protection and maximum reduction in blood glucose levels in alloxan induced diabetic rats. The anti-diabetic activity was comparable with reference standard glibenclamide³². Ethanol extract of the roots significantly reduced blood glucose levels in normal and alloxan induced diabetic rats at dose levels 200 and 400 mg / kg p.o. The hypoglycaemic activity of extract was found to be in dose dependent manner and was comparable with reference standard glibenclamide³³. Aqueous extract of leaves showed hypoglycaemic action when administered orally at dose of 500 mg / kg to normal rats and 60 mg / kg i.v to streptozocin induced diabetic rats. The hypoglycaemic effect was comparable with standard anti-diabetic agent glibenclamide (0.9 mg / kg)³⁴. The anti-diabetic activity can be attributed to the presence of α -amyrin^{35,36}, Stigmast-5, 22-dien-3 β -ol and Stigmast-5-en-3 β -ol- β -D-glucopyranoside in the plant²¹.

Antibacterial Activity

Water-phase extract of bamboo shavings (WEBS) by supercritical carbon dioxide extraction was evaluated for its antimicrobial action against a range of food borne and food spoilage pathogens using agar disc diffusion assay in nutrient agar and CzapekDox agar media. The WEBS exhibited antimicrobial action against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Aspergillus niger*, *Penicillium citrinum* and *Saccharomyces cerevisiae* with a concentration-dependent relationship³⁷. The antibacterial activity can be attributed to the presence of α -amyrin³⁸ and phenolic compounds occurring in the plant²⁸.

Antifertility Activity

Ethanol extract of the *Bambusa bambos* tender shoots (BASE) caused a reduction in fertility of male rats. Administration of BASE for 7 days at a dose of 300 mg / kg per day the fertility index decreased to 15 % for control rats and to 23 % after a 7 day recovery period. The number of cohabited females being successfully inseminated was reduced especially after 4 days of treatment. Complete recovery of mating behaviour was evident 8 days after BASE withdrawal. The number of spermatozoa in the caput and cauda epididymis was decreased with concomitant decrease in the motility of spermatozoa collected from the cauda epididymis. The weights of testes, epididymis, vas deferens and prostrate were also significantly decreased. The serum profile of protein and oxaloacetate / pyruvate transaminase activity showed that the extract was relatively non-toxic³⁹.

Anti-arthritic Activity

Anti-arthritic activity of the plant in treating rheumatoid arthritis (RA) using Complete freund's adjuvant (CFA) induced arthritis animal model was investigated. The effect of methanol extract on arthritis was studied by analysing various markers of bone erosion like histological and radiological evaluation of the joints. Parameters such as paw volume, rheumatoid factor and erythrocyte sedimentation rate (ESR) and spleen histopathology were determined. The methanol extract showed significant decrease in bone erosion, spleen enlargement and rheumatoid factor etc. at dose levels 100, 200 and 300 mg / kg in a dose dependent manner, compared to control group but less compared to standard drug (Dexamethasone 5 mg / kg i.p.)⁴⁰.

Antioxidant Activity

Bambusa bambos contains phenolic compounds such as phenolic acids, flavonoids, tannins which contribute to the antioxidant activity of the plant⁴¹⁻⁴⁵. The antioxidant activity of flavonoids results from the combination of their iron chelating activity and their ability to scavenge ageing-induced free radical. Flavonoids can inhibit oxidases such as lipooxygenase, cyclooxygenase and xanthine oxidase, thus preventing the *in vivo* formation of reactive oxygen species (ROS) and organic hydro peroxidase. Flavonoids also inhibit enzymes indirectly involved in oxidative processes. These actions are responsible for anti-aging, photo protection and hair colour protection properties of flavonoids⁴⁶.

Vessels Protection and Venotonic Activities

Flavonoids are vein active and vessel protective agents because they reduce the permeability and increase the resistance of blood capillaries. Flavonoids are used in treatment of blood vessel disorders such as varices, chronic venous insufficiency, low capillary resistance etc. Oral administration of flavonoids improves capillary resistance in animal models. *Bambusa bambos* contains flavonoids which may contribute to vessel protection and venotonic activities.⁴⁷

Effect of Bamboo Buds on Structural and Functional Changes in Epididymis of Rats

Epididymal structural and functional activity of adult male rats was accessed by administration of ethanol extract of tender shoots of *Bambusa bambos* at dose of 300 mg / kg per rat per day for 7 days. Sperm motility was found to be decreased in cauda epididymal fluid and sperm count decreased significantly in both caput and caudal segments of epididymis. Histologically there was a decrease in epithelial

and stereocilia height in both segments and lumen diameter in cauda along with increase in intertubularstroma. Epididymal weights, activities of acid phosphatase and total lactate dehydrogenase were found to be decreased in both epididymal segments along with increase in protein concentration in caudal segment. Extract therapy was found to impair the structural and functional integrity of the epididymis⁴⁸.

Diuretic Activity

The Suffof-e-SuzakQawi is a Unani polyherbal formulation which is an official monograph in National Formulary of Unani Medicine (NFUM). It is reported to possess anti-gonorrhoeal and diuretic properties. Aqueous suspension of formulation when administered at dose levels of 500, 750 and 1000 mg / kg to healthy rats showed an increase in urinary output and urinary sodium excretion which was comparable with the reference standard furosemide⁴⁹.

Anti-thyroid Activity

Shoots of *Bambusa bambos* contain cyanogenic glucosides, glucosinates and thiocyanate. Raw, boiled and cooked extract of *Bambusa bambos* shoot showed inhibition of thyroid peroxidase (TPO) which was reversed by iodide thus demonstrating *in vitro* anti-thyroid activity⁵⁰.

Ecbolic Activity

Fresh juice of the leaves was tested for its uterine activity on isolated human as well as rat uterus. It was found to possess weak ecbolic action at a dose of 1-10 mg / ml⁵¹. Hypothermic activity, Aqueous extract of the leaves when administered to mice at various dose levels were found to reduce the mean rectal temperature at dose of 80 mg / kg which returned to normal after 24 hours post administration. Since any agent with hypothermic activity acts as an anti-pyretic agent, the aqueous extract of *Bambusa bambos* leaves might be considered as potential anti-pyretic agent⁵².

Marketed Preparations of *Bambusa bambos***Suffof-e-SuzakQawi**

It is a unani polyherbal formulation which is an official monograph in National Formulary of Unani Medicine (NFUM). It is reported to possess anti-gonorrhoeal and diuretic properties⁵³.

Zuroor-e-Quala

It possesses anti-inflammatory and antimicrobial properties and is recommended in cases of stomatitis and gastric ulceration⁴⁹.

Sitopaladichurna

It is an Ayurvedic preparation which has anti-tussive, analgesic and anti-pyretic properties and is used for relieving coughs associated with various respiratory disorders⁵⁴.

CONCLUSION

Herbs are an integral part of nature. Herbal medicine is based upon the premise that plants contain natural substance that can promote health and alleviate diseases. To treat various ailments most of the local population depend on native medicinal plants. This paper reports ethno medicinal uses, phytochemical constituents and biological activities of *Bambusa bambos* that is commonly used in traditional system of medicines. The reported biological activities are the outcome of traditional claims. A number of studies of

bamboo have yielded information about the chemical constituents, but no systematic evaluation has been carried out, so it is difficult to determine which of the identified compounds might be the primary constituent responsible for the activity. The present literature supports the potential of *Bambusa bambos* as a medicinal tree for mankind and justifies the inclusion of these drugs in traditional preparation.

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