

Traditional uses, phytochemistry and pharmacological profile of *Bambusa arundinacea* Retz

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ABSTRACT

Bambusa arundinacea family Graminae, is one of the precious plant resources of the earth. It has played a significant role in human civilization since ancient times. It is tall sized tree growing throughout India, moist parts of India. It also occurs in Sri Lanka, Malaya, Peru and Myanmar. The different parts of this plant contain silica, cholin, betain, cynogenetic glycosides, albuminoids, oxalic acid, reducing sugar, resins, waxes, benzoic acid, arginine, cysteine, histidine, niacin, riboflavin, thiamine, protein, gluteline, contains lysine, methionine, betain, cholin, proteolytic enzyme, nuclease, urease. Various parts of this plant such as leaf, root, shoot and seed possess anti-inflammatory, antiulcer, anti-diabetic, anti-oxidant, anthelmintic, antifertility, antibacterial, insectisidal, antiarthritic, vessele protection etc. This review mainly focuses on the traditional, phytochemical and pharmacological information of *Bambusa arundinacea*.

Keywords *Bambusa arundinacea*, phytopharmacological properties, phytochemicals, traditional uses

INTRODUCTION

In recent years, focus on plant research has increased all over the world and evidence show immense potential of medicinal plants used in various traditional systems. Herbal drugs have got tremendous momentum in global health care system. Many plants have been found to have therapeutic potential and are being used since time immemorial. The beneficial therapeutic effect of these medicinal herbs is seen in their continued use and proven scientifically (Jarald et al, 2007). Bamboo is one of the precious plant resources of the earth. It has play a significant role in human civilization since ancient times, and is still contributing to the subsistence of over two billion people living in tropical and subtropical belts in Asia, Latin America and Africa (Kiruba et al, 2007). *B. arundinacea* (Poaceae) is commonly known as bans. A bamboo culm consists of internodes (which are hollow for most bamboo) and a node, which is solid and provides structural integrity for the plant. At the node are one or more buds (depending on the species) which produce side branches. Traditional use of bamboo is differing from region to region and people to people. Since time immemorial, bamboo is used in fuel, food, housing and shelter by indigenous community (Kumar, 2012). The leaves of *B. arundinacea* are emmenagogue and are used as a folk medicine for the treatment of cough, fever and leprosy. *B. arundinacea* (Poaceae) is commonly known as bans. A bamboo culm consists of internodes (which are hollow for most bamboo) and a node, which is solid and provides structural integrity for the plant (Rastogi and Mehrotra, 1993; Patrick, 2011)). The plants contain flavanoids, phenolics, amino acids, proteins

glucosides. The young shoot contains poisonous cynogenic glucosides (0.3%) and taxiphyllain. Bamboo-manna (Vanslochan) contains silica or silicon as hydrates of silicic acid potash, alumina, iron peroxide, and calcium carbonate (Gupta, 2008). It was reported that the extract of *B. arundinacea* showed anti-inflammatory, antiulcer, antifertility, antimicrobial and hypoglycemic activities. The hypoglycemic properties of extracts of bambusa leaves have also been established. A previous research on this plant has resulted in the isolation of flavones glycosides (Nazreen et al, 2011). The root (burnt root) is applied to ringworm, bleeding gums, painful joints. Seeds are acrid, laxative, said to be beneficial in strangury and urinary discharge. Bark is used for skin eruptions. Leaf is emmenagogue, antileprotic, febrifuge used in haemoptysis (Rathod et al, 2012). Bamboos, a group of arborescent grasses, have closely been associated with mankind since ancient time (Watt, 1972). They are used for a variety of purposes such as mat making, traditional instruments, furniture, musical instruments, flooring and construction materials, paper making, fencing, fodder, fuel wood, cooking utensils, floats for timber and rafts, sericulture industry, and waste water management (Nazreen et al, 2011; Rathod et al, 2012). However there is lack of information about the use of bamboo plant. Hence, an attempt has been made to explore the indigenous knowledge about the use of this plant.

Regional and other names

Gujarati (Toncor, Wans, Vanskapur, Vas-nu-mitha); English (Bamboo, Bamboo manna, Giant Thorny Bamboo); Hindi (Bans-lochana, Banskapur, Vanoo, Banz); Bengoli (Bans-Kapur, Baans, Baansh, Baroowa Bans); Sanskrit (Vanshalochana, Venulavanam); Arab (Tabashir); Marthi (Bansa, Baambii, Bansamitha); Tamil (Munga-luppa, Mullumangila, Mulmunkil, Mungil); Telugu (Veduruppu, Mulkas Veduru, Mullu Veduru); Malialam (Moleuppa); Kannad (Bidaruppu, Tavakshira); Burma (Vd-chha, Vathega-

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Fig.1. Digital photograph of *Bambusa arundinacea* (Retz.) plant taken from Jawer, Jhalawar district, Rajasthan, India.

kiyo, Vasan, Vathe gasu); Unani (Tabashir, Tawashir) (Rastogi and Mehrotra, 1993).

Botanical description

Thorny tree, stems many, tufted on a stout root-stock, grows upto 30 meter high; culms 15-18cm across; nodes prominent, the lower emitting horizontal almost naked shoots armed at the nodes with 2-3 stout recurved spines; internodes upto 45 cm. long (Santosh' 2010; Anonymous, 1996). Leaves 17.5 – 20.5 X 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, enormous panicles often occupying the whole stem. Caryopsis (grain) oblong, 5-8 mm long, grooved on one side. Flowering and Fruiting: Once in life time, often during September – May (Anonymous, 1998; Jia, 2011; Chopra et al, 1958).

Traditional medicinal uses

The extract of the plant *B. arundinacea* Retz. had been used in folk medicines to treat various inflammatory conditions. In Ayurveda, the leaves, the stem and roots are used as astringent, laxative and as diuretic. An ointment from the root is said to be a folk remedy for cirrhosis and hard tumor. Shoot of *B. arundinacea* Retz. is used for dislodgement of worms from ulcer. Leaf bud (decoction) of *B. arundinacea* Retz. is used to encourage the free discharge of menses. Leaves are useful in leprosy, hematenesis, fever and haemoptysis. Leaves are also used in cough paralytic complications and in snake bites. An ointment from the *B. arundinacea* Retz. root is said to be a folk remedy for cirrhosis and tumors, especially tumor of abdomen, liver, spleen and stomach. Tabasheer, a siliceous secretion of *B. arundinacea* Retz. (up to 97 % SiO₂), considered aphrodisiac, cooling, and tonic is used in asthma, cough. Leaves given to horse suffering from coughs and colds (Nandkarni, 2000). Tribal women around Salem in Tamilnadu chew leaves of *B. arundinacea* Retz. in the morning and evening for 1-3 days to induce abortion of an early conception (Bhaduri, 1968). The extracts of *B. arundinacea* have been used in Indian folk medicine to treat various inflammatory conditions. The plant has antiulcer activity also. It is thought that these two properties in the same extract are very useful in the treatment of inflammatory conditions. It is well known fact that the most of

the available anti-inflammatory drugs are ulcerogenic (Muniappan, 2003). Leaves decoction is used to stimulate menstruation and as an antispasmodic to help relieve menstrual pain, in dysmenorrhoea and amenorrhoea. A decoction of bamboo joints is said to increase the flow of lochia after delivery (Kirtikar, 1975). *Bambusa* leaf juice is given for strengthening the cartilage in osteoarthritis and osteoporosis. It plays a part in the integrity of the bones, arterial walls, skin, teeth, gums, hair and nails and has been used to alleviate eczema and psoriasis. It is used in diarrhoea, dyspepsia, flatulence and worm problems. Silicates of *Bambusa* are very useful in creation of the body's structural matrix for forming and repairing connective tissue (Vanithakumari, 1989). An ointment from the root is said to be a folk remedy for cirrhosis and hard tumors, especially tumors of the abdomen, liver, spleen and stomach. Tabasheer, a siliceous secretion (up to 97% SiO₂), considered aphrodisiac, cooling, and tonic, is used in asthma, cough and debilitating diseases (C.S.I.R., 1948 - 1976) (Atal, 1982). Seeds of *B. arundinacea* Willd., by the Kani tribes of Kanyakumari district, southern Western Ghats. Method of seed collection, storage and mode of consumption by indigenous people has been described. The indigenous community not only uses the seeds as a food, but also as commercial commodity to improve the economy. The Kani tribes believe that the seeds of *B. arundinacea* enhance the fertility, so that there is great demand of seeds of this species in pharmaceutical industry to manufacture drugs to improve fertility (Kiruba et al, 2007).

Phytochemical constituents

Bamboo leaves have been used in traditional Chinese medicine for treating fever and detoxification for over 1000 years. Recently, some biologically active components in bamboo leaves and their potential health benefits have been widely studied. An ethanol/water extract of bamboo leaf mainly contains flavone glycosides, phenolic acids, coumarin lactones, anthraquinones and amino acids. Many papers have indicated that a flavonoid-rich bamboo leaf extract has multiple biological effects, such as anti-free radical, anti-oxidation, anti-aging, anti-fatigue, anti-bacteria, anti-virus, and prevention of cardiovascular diseases, and can be used as a pharmaceutical intermediate, dietary supplement, cosmetic ingredient, and food additive. Chemical investigation of this plant, triterpenes and



Fig. 2. *Bambusa arundinacea* (Retz.) root.



Fig. 3. *Bambusa arundinacea* (Retz.) leaves.

steroidal glycosides were the major phytoconstituents (Kiruba et al, 2007). In the course of phytochemical investigation of *Bambusa*, Stigmast-5, 22-dien-3 β -ol, Stigmast-5-en-3 β -ol- β -D-glucopyranoside were isolated in good quantities. The synergistic hypoglycemic effect of these two compounds has been well established. Along with the two new compounds i.e. 17, 20, 20-tri demethyl-20 α -isopranyl oleanane and a new acid, eicosanyl dicarboxylic acid, another two known compounds α -amyrin acetate and urs-12-en-3 β -ol- β -D-glucopyranosid have been isolated for the first time from this plant. The silicious substance found near the joint inside is white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste (Watt, 1972). Shoot has active constituents are Oxalic acid, reducing sugar, resins, waxes, HCN, benzoic acid, diferuloyl arabinoxylanhexasaccharide, diferuloyl oligosaccharide (Tadash, 1991), (5, 5'-di--(diferul-9, 9'-dioyl)-[α -L-arabinofuranosyl-(1 $\rightarrow$ 3)- O- β -D-xylopyranosyl-9 (1 $\rightarrow$ 4) - D xylopyranose] (taxiphyllin). Seed contain arginine, cysteine, histidine, isoleucine, leucine, lysine, methionine, phenylamine, threonine, valine, tyrosine, niacin, riboflavin, thiamine (Tai-Hung et al, 2009; Yeon Hee, 2010). Leaves mainly contain protein, gluteline, contains lysine, methionine, betain, cholin, proteolytic enzyme, nuclease, urease (Chatterjee and Pakrashi, 2001). The phytochemical investigation of an ethanolic leaf extract of *B. arundinacea* Retz. furnished 6 constituents, two of which represented new natural entities. Remaining four compounds which are previously reported from the other plant sources have been isolated for the first time from the leaves of *B. arundinacea* Retz. Spectroscopic structure elucidation of the new natural products is described. The new compounds are characterized as 17, 20, 20-tri demethyl-20 α -isopranyl oleanane and eicosan-1, 20-dioic acid (Kiruba, 2007). The bamboo leaves, obtained from the common tall bamboos (species of *Phyllostachys*, rather than the small *Lophatherum*) have recently been utilized as a source of flavonoids (e.g., vitexin and orientin), used as antioxidants. The flavonoids may reduce inflammation, promote circulation, and inhibit allergy reactions. A juice made from the leaves has been made into a bamboo flavored beer (Shastry, 2003). *B. arundinacea* extract contains Silicates (60% - 70%) which are responsible for its action in curative disease like diarrhoea, dyspepsia, flatulence and worm problems, inflammations, ulcers and wounds (Muniappan and Sundararaj, 2003). Nayak S & Rout GR analyzed the isolation

and characterization of microsatellites in *B. arundinacea* and cross species amplification in other bamboos (Nayak and Rout, 2005). Six microsatellites, three polymorphic and three monomorphic, were characterized in a bamboo species, *B. arundinacea* belonging to the family Poaceae (Tiwari et al., 1982).

Pharmacology

Anti-inflammatory and antiulcer activity

The antiinflammatory effect of the methanol extract of the leaves of *B. arundinacea* against carrageenin-induced as well as immunologically induced paw oedema and also its antiulcer activity in albino rats have been studied and found to be significant when compared to the standard drugs. The combination of methanol extract and phenylbutazone (Non-Steroidal Anti-inflammatory Agent, NSAIA) has been studied and found to be the most potent anti-inflammatory activity experimentally with least toxic (no ulcerogenic) activity. Thus, the combination of herbal product (methanol extract of *B. arundinacea*) with modern medicine (NSAIA) will produce the best anti-inflammatory drug and will be useful for long-term treatment of chronic inflammatory conditions like rheumatoid arthritis with peptic ulcer, which are common (Muniappan and Sundararaj, 2003).

Anthelmintic activity

Ethanolic extract of the root part of *B. arundinacea* was investigated for their anthelmintic activity against *Pheritima posthuma*. The study involves the determination of paralysis time and death time of the worms in the different doses of the extracts (10, 20 and 50 mg/ml). The extract exhibited significant anthelmintic activity in a dose dependent manner compared to the control. Activity was comparable with the reference standard Piperazine citrate (15 mg/ml) and Albendazole (10 mg/ml) (Kumar, 2012).

Antidiabetic activity

Aqueous ethanolic solvent extracts of *B. arundinacea* seed were tested for anti-diabetic activity using alloxan induced diabetic rats and compared with standard. The result expressed that aqueous ethanolic extracts had shown significant protection and maximum reduction in blood glucose was observed in alloxan induced diabetic rats. The results of this comprehensive study reveal that *B. arundinacea* seed shown statistically significant Anti-diabetic activity in comparison to the standard glibenclamide (Macharla, 2011).

Antibacterial activity

Water-phase extract of bamboo shavings (WEBS), by supercritical carbon dioxide extraction, was evaluated for its antimicrobial action against the range of food borne and food spoilage pathogens using agar disc diffusion assay in nutrient agar and Czapek Dox Agar media. The WEBS exhibited antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Aspergillus niger*, *Penicillium citrinum* and *Saccharomyces cerevisiae* with a concentration-dependent relationship (Zhang, 2010).

Protective effects

Two biological activities of bamboo-derived pyrolyzates were investigated; the protective effects against N-methyl-daspartate (NMDA)-induced cell death in primary cultured cortical neuron and the anti-plasmin effects determined by using fibrin and fibrinogen degradation products (FDPs) assay. Treatment of neuronal cells with pyrolyzates of *Phyllostachys pubescens*, *Phyllostachys nigra* and *Phyllostachys bambusoides* resulted in restored cell viability when compared to untreated cells in an NMDA-induced neuronal cell death assay. In addition, cortical neurons treated with *Phyllostachys pubescens* and *Phyllostachys nigra* showed a reduction of apoptosis following

exposure to NMDA, as determined by Hoechst 33342 staining. In addition, *Phyllostachys nigra* pyrolyzates also exhibited antiplasmin action in a FDP assay. It is of interest to note that pyrolyzates exhibited activities of NMDA-receptor antagonist and antifebrin (ogen), since a combination of NMDA receptor antagonists, glucocorticosteroids, GABAergic drugs and heparin are useful for treatment in delayed postischemic injury. Results indicate that the pyrolyzates derived from bamboo may have antiapoptotic effects, and can be useful as a supplement for ischemic injury treatment (Rathod, 2012).

Antifertility activity

An ethanolic extract of *B. arundinacea* tender shoots (BASE) caused a reduction in fertility of male rats. After administration of 300 mg/kg per day of BASE for 7 days, the fertility index decreased to 15% for control rats and to 23% after a 7-day recovery period, respectively. The number of cohabited females being successfully inseminated was reduced especially after 4 days of treatment. Complete recovery of mating behavior was evident 8 days after BASE withdrawal. The number of spermatozoa in the caput and cauda epididymis were decreased concomitant with a decrease in the motility of spermatozoa collected from the cauda epididymis. The weights of testes, epididymides, vas deferens and prostate were also significantly decreased. The serum profile of protein and oxaloacetic/pyruvic transaminase activity show the extract to be relatively non-toxic (Brandis, 1972).

Insecticidal activity

Asian Centers of Diversity, bamboos are reported to tolerate insects, laterites, low pH, slope, and weeds ($2n = 72, 70$). Eight grams of raw shoots or slightly more improperly cooked shoots can cause death. Young shoots contain 0.03% HCN (C.S.I.R., 1948–1976). Hairs on various bamboos, and fungi which live thereon, may cause dermatitis. Benzoic acid and traces of cyanogenic glucoside present in shoots have lethal effect on mosquito larvae (has antiseptic and larval properties) (Anonymous 1996).

Antiarthritic activity

Anti-arthritic activity of *B. arundinacea* in treating rheumatoid Arthritis (RA) using CFA-induced arthritis animal model was investigated. The effect of *B. arundinacea* methanolic extract on the arthritis was studied by analyzing various markers of Bone erosion like histological, radiological analysis of the joints. For evaluation of anti-arthritic activity other parameters analyzed are Paw volume, Arthritic index, Rheumatoid Factor, Erythrocyte Sedimentation Rate (ESR) and Spleen histopathology. The powdered leaves are used for hot extraction by using methanol as solvent. The anti-arthritic activity of the dry extracts was performed using female rats of about 200 to 250 gms. The methanolic extract of *B. arundinacea* significantly (dose dependent) decreased the bone erosion, spleen enlargement & rheumatoid factor etc. at a dose (100 mg/kg, 200 mg/kg, 300 mg/kg) compared to the control group but less compared to Standard drug (Dexamethasone 5 mg/kg i.p) (Rathod et al, 2012).

In cosmetics

Antioxidant activity of flavanoids

The antioxidant activity of flavanoids results from the combination of their iron chelating activity and their ability to scavenge ageing- induced free radical. Flavanoid can inhibit oxidases such as lipooxygenase, cyclooxygenase and xanthine oxidase, thus preventing the *in vivo* formation of reactive oxygen species and organic hydroperoxidase. Additionally, it has been found that flavanoid inhibit enzymes indirectly involved in oxidative processes. Flavanoids shows antiaging, photoprotection and hair color protection (Macwan et al, 2010).

Vessels protection and venotonic activities

Flavanoids are vein active and vessel-protective agents because they reduce the permeability and increase the resistance of blood capillaries. Flavanoids are used in the treatment of blood vessel disorders such as varices, chronic venous insufficiency, low capillary resistance etc. Oral administration of flavanoid s has been observed to effectively improve the capillary resistance in animal models (Mukesh et al., 2005).

Acute and subchronic toxicity studies on anti-oxidant of bamboo leaves.

The anti-oxidant of bamboo leaves (AOB) has recently been certificated as a novel kind of natural anti-oxidant by the Ministry of Health of the Peoples Republic of China, and has been used in various food systems. Here, AOB was subjected to a series of acute and subchronic toxicological tests to evaluate its safety. The results showed that the maximum tolerated dose (MTD) of AOB was >10 g/kg body weight in both rats and in mice, which can be regarded as virtually non-toxic. No mutagenicity evidence was detected in any of the three mutagenic tests. Administration at levels of 1.43, 2.87 and 4.30 g/kg per day to the rats for 90 days did not induce significant hematological, clinic, chemical and histopathological changes, and suggested a no-observed adverse- effect level (NOAEL) of 4.30 g/kg per day. These results indicate that AOB can be generally regarded as safe for use as a food additive (Baiyi et al, 2005; Nazreen et al 2011; Christine and Martyn, 2000).

Effects of bamboo buds: structural and functional changes in the epididymis of rats.

An ethanolic extract of the tender shoots of *B. arundinacea* was administered at 300 mg/kg per rat per day for 7 days to adult male rats to assess epididymal structural and functional activity. Sperm motility decreased markedly in the cauda epididymal fluid and sperm count decreased significantly in both caput and caudal segments of the epididymis. Histologically, a reduction in epithelial and stereocilia height (in both segments) and lumen diameter (in cauda) was noted. An increase in intertubular stroma was also evident. Epididymal weights, activities of acid phosphatase and total LDH were reduced in both epididymal segments. Protein concentration was appreciably increased only in the caudal segment. Extract therapy impaired the structural and functional integrity of the epididymis (Joshi et al, 2009; Sharma, 1996).

Misllaneous

- Bamboo is the main food of the Giant Panda; it makes up 99% of the Panda's diet. Soft bamboo shoots, stems, and leaves are the major food source of the Giant Panda of China.
- Bamboo is used in Chinese medicine for treating infections and healing. It is a low-calorie source of potassium. It is known for its sweet taste and as a good source of nutrients and protein.
- When bamboo is heated at very high temperature in an airless vessel, it becomes charcoal, which is used like other charcoal products, as a fuel component, a deodorizer, or an absorbent. The vapor that comes off the heated bamboo can be condensed to produce a liquid known as bamboo vinegar. Bamboo vinegar has been produced in Japan (where it is called *chikusaku-eki*) for many years and is used medicinally to treat eczema, atopic dermatitis, and other skin diseases; it is most commonly applied by adding to bath water. Bamboo vinegar is recognized as an anti-inflammatory and anti-fungal.
- Pickled bamboo, used as a condiment, may also be made from the pith of the young shoots.
- In addition, bamboo is frequently used for cooking utensils within many cultures. In modern times, some see

bamboo tools as an eco-friendly alternative to other manufactured utensils

➤ In Ayurveda, the Indian system of traditional medicine, the silicious concretion found in the culms of the bamboo stem is called *banslochan*. It is known as *tabashir* or *tawashir* in *Unani-Tibb* the Indo-Persian system of medicine. In English it is called "bamboo manna". This concretion is said to be a tonic for the respiratory diseases.

➤ In addition, the fiber of bamboo has been used to make paper in China since early times. A high quality hand-made paper is still produced in small quantities. Coarse bamboo paper is still used to make spirit money in many Chinese communities. Bamboo's natural hollow form makes it an obvious choice for many instruments, particularly wind and percussion. There are numerous types of bamboo flute made all over the world, such as the dizi, xiao, shakuhachi, palendag, jinghu, angklung, ities

➤ Bamboo was in widespread use in early China as a medium for written documents. The earliest surviving examples of such documents, written in ink on string-bound bundles of bamboo strips (or "slips"), date from the 5th c. BC during the Warring States period.

Important formulations

- Sitopaladi churna
- Talisadi churna

Genuine Bamboo-manna is difficult to procure. *Curcuma angustifolia* is in use as a substitute. Its original name, *Tabashiri*, was equated in due course the *Tabasheer* of Unani medicines (Gupta, 2008).

Possible Combinations: *B. arundinacea* + *Piper longum* + *Cinnamomum camphora* (curing lung disease)

Recommended dose: The recommended dose is between 0.5% and 5.0%.

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 local population depends on native medicinal plants. This paper reports ethnomedical uses phytochemicals present and biological activities of *B. arundinacea* that is commonly used in traditional system of medicines. The reported biological activities are the outcome of the traditional claims. The present literature supports the potential of *Bambusa arundinacea* as a medicinal tree mankind and justifies the inclusion of these drugs in traditional preparation.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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