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Review article

Bambusa arundinacea (vanshlochan): An overview

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ABSTRACT

Bamboo species are thought to be originally from Central China, but are now found in many temperate and semi-tropical regions around the world. There are approximately 75 species and 200 varieties of *Phyllostachys*. *Bambusa arundinacea* (Vanshlochan) belonging to family Poaceae, is a well known Ayurvedic and medicinal plant in Indian tradition. This plant is reported to possess antidiabetic, antifertility, antibacterial, anti inflammatory and antiulcer, protective, anthelmintic, insecticidal, antiarthritic, antioxidant, aphrodisiac, vessel protection and venotonic activities. It is found in North-West India and Bengal, Sri Lanka, Malaya, Peru and Myanmar (Burma). Many of the important chemical constituents are found in it. It is a common plant which is mostly used as a building material ranging from food containers, skewers, chopsticks, handicrafts, toys, furniture, flooring, pulp and paper, boats, charcoal, musical instruments and weapons. In addition to its more common applications, bamboo has other uses, from skyscraper scaffolding and phonograph needles to slide rules, skins of airplanes, and diesel fuels. Bamboo ashes are used to polish jewels and manufacture electrical batteries. It has been used in bicycles, dirigibles, windmills, scales, retaining walls, ropes, cables and filament in the first light bulb.

Key word: Bamboo, *Bambusa arundinacea*, Traditional medicinal use of bamboo.

INTRODUCTION

The term bamboo describes all tree- or bush like grasses having a durable woody or branched stem. The lignifying cell structure of the bamboo tissue and its technological properties are very similar to the wood tissue proper. Bamboo may therefore also be termed wood. Contrary to wood, the bamboo have a hard outer surface and is soft inside^[1]. Herbal medicines have great importance in maintaining the health of every person. Different parts of the plant have different active substances and these active substances may vary in their extent of activity and concentration. Most of active principles are present in leaves, flower, fruit, bark, root & seeds of the plant^[2]. Bamboos are members of the Graminae (Poaceae) family, as are corn, sugar cane and other grasses. Bamboos differ from the other members of the grass

family by the presence of branches at each node. A bamboo culm consists of an internode (which is 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^[3]. 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. 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

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over two billion people living in tropical and subtropical belts in Asia, Latin America and Africa^[4].

CLASSIFICATION

Bamboo is a perennial, giant, woody grass belonging to the group angiosperms and the order monocotyledon. The grass family Poaceae (or Gramineae) can be divided into one small subfamily, *Centothecoideae*, and five large subfamilies, *Arundinoideae*, *Pooideae*, *Chloridoideae*, *Panicoideae*, and *Bambusoideae*. In distinction to its name, bamboos are classified under the subfamily *Bambusoideae*. Wang and Shen stated that there are about 60 to 70 genera and over 1,200 – 1,500 species of bamboo in the world. About half of these species grow in Asia, most of them within the Indo-Burmese region, which is also considered to be their area of origin. Some examples of bamboo genera are *Bambusa*, *Chusquea*, *Dendrocalamus*, *Phyllostachys*, *Gigantochloa* and *Schizostachyum*^[5]. There are existing 500 different species of bamboo with partial some hundred subspecies, Characterised by the type of rhizome and the formation of upright canes there are three main groups of bamboo. The first group is called monopodial bamboos. They form long and thin extensions of the rhizome whose buds produce single shoots are regular intervals.

The sympodial bamboos constitute the second group. They have short, thick rootstocks the tips of which produce the canes. The third group is called climbing bamboos. They can grow very irregularly and may form.^[1]

Phyllum - Phaerogans (Angiosperm)

Subphyllum - Monocotyledons

Order - Graminales

Family - Gramineaceae (Poaceae)

Genus - *Bambusa*

Species - *arundinacea*^[6]

COMMON NAMES

Bamboo, common name in English (Bamboo, Bamboo manna, Giant Thorny Bamboo); Hindi(Bans-lochana, Banskapur, Vanoo , Banz); consist of fresh leaves and dried fruits. Bamboo are thorny tree, 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. Leaves 17.5 – 20.5 X 2-2.5 cm, linear or linear – lanceolate, tip stiff, glabrous or puberulous beneath, margins scabrous, base cilliate, mid-rib narrow, leaf-sheath ending on a thick callus and shortly bristly auricle, characterized by woody, pointed stems. The thickness of the outer shell and the deposit of silica in outer cortical layer also make it very hard when cums are fresh green colour.^[3]

DISTRIBUTION

Most of the bamboos need a warm climate, abundant moisture, and productive soil, though some do grow in reasonably cold weather^[5]. Most bamboo species grow at temperatures from - 28°C to +50°C^[1]. According to Grosser and Liese, bamboos grow particularly well in the tropics and subtropics, but some taxa also thrive in the temperate climate of Japan, China, Chile and the USA. Lee et al. stated that the smaller bamboo species are mostly found in high elevations or temperate latitudes, and the larger ones are abundant in the tropic and subtropic areas.^[5] Bamboo grow at sea level and can be found at altitudes of up to 3800 m^[1]. Bamboo is quite adaptable.^[7] A common bamboo distributed throughout the moist parts of India, upto an altitude of 1250 m particularly near river banks in Central and South India ascending upto 1100 m on the Nilgiri, in many places in North-West India and Bengal, Sri Lanka, Malaya, Peru and Myanmar (Burma)^[3]. Bamboos grow mainly on sandy loam to loamy clay soils. They prefer well drained soils but grow also in wet and even marshy locations. They do not tolerate saline soils.^[1]

ROOT

Bamboo has durable rootstocks, the rhizomes. After a seedling has produced the first rhizome, the differentiated rhizome system will begin to develop. Its circumferential and longitudinal growth increases annually. It is only after twelve and more years that canes of full thickness and height will be produced. According to the type of branching of the rhizomes the main group of the bamboos is called monopodial, whereas the other group is called sympodial. The monopodial species grow horizontally over large distances. A rhizome stolon will grow in length by 1 - 6 m per annum with an average life span of ten years. At irregular intervals the lateral buds produce single cane stems from which new canes grow upwards.

These species can be found in subtropical regions with a temperate climate.

CANE

The basic form of the bamboo plant consists of a branch system of segmented axes. There is no main axis for a central stem; each axis branches off another. There is a regular succession of nodes and segments in rhizomes, canes and branches. The shapes of the canes vary between straight and exactly vertical, overhanging or zig-zagged, curved or creeping. Bamboo is distinguished by its longitudinal growth. There is no other plant which grows as fast as bamboo. Some species of bamboo grow 5cm per hour. The species "*Guadua angustifolia*" grow 12cm per day. The canes of bamboo consist of nodes, segments and diaphragms. At first the canes appear as small buds at the nodes of the rootstock. There they grow for several years until they emerge from the soil in the shape of short, thick, conical shoots surrounded by sheath leaves. From that point the bamboo shoot will develop into a cane at enormous speed. Within a year at the latest it will reach its full size and the sheath leaves dropped completely. The average length of the canes amount 8 -15 m with a diameter of 5 - 12 cm and a wall thickness of 10 mm. Also the cane diameter remains unchanged as long as the cane stands. For this reason the diameter of the cane does not indicate its age. The age is judged by the sound of the cane and the appearance of its surface. Each shoot pushing out of the soil contains already in miniature all the nodes, segments and diaphragms which the fully grown cane will possess later. The segment closest to the ground increases in size first, and the one at the top last. The numbers and lengths of the segments per cane differ according to species. Smaller species have canes consisting of 15 - 20 segments, whereas larger species can have up to 55 segments. The segmental length increases from the base of the cane to its middle and decreases again towards the top. Most bamboo species have an average segmental length of 35cm. In most cases the interior of the cane remains hollow. Species with a solid cross section are rare. Frequently the segments at the top become solid. Bamboo bud with sheath leaves the nodes provide the insertion points of the shed sheath leaves. As a form of reinforcement they increase the resistance of the cane against splitting and buckling. Bamboo canes have a circular cross-

section and are axially slightly conically tapered. From the base to the top they taper very gradually. Shorter canes taper more strongly than the longer ones. For this reason the long canes are preferred for building purposes. Not only has the diameter of the bamboo canes decreased with increasing height but also the wall thickness. After about the first three years of growth the canes start lignifying and silicate slowly. It is only then that they become useful as structural timber. The bamboo skin contains a high proportion of silicate acid. Because of the hard silicate layer of the outer surface, bamboo is highly resistant against chemical, animal and mechanical exposure. The surface of the young cane is green, later becoming yellowish, sometimes brown to black and either of uniform colour. The surface is mat or shiny. Some species are distinguished by a longitudinal stripe pattern of different colours and widths^[1].

BRANCHES AND LEAVES

The cane remain free of branches for a period of not more than year until develops its full height. This branching process proceeds from the top downwards and, in few species, may extend to the base of the cane. The branch bases sprout from the nodal protuberances. They have a strong connection between the diaphragm and the nodal bead. The branch forks are suitable as supports for lighter structures. The branches carry stemmed grass leaves which can be of various widths. In general one can say that the taller the bamboo cane, the smaller the leaves. Like our leaf-bearing trees, the bamboo sheds its leaves every year but with the following difference: the new leaves start growing without delay. As infill for cavity flooring or walls they provide a good insulating material. Because of its low weight the load-bearing structural elements are only subjected to minimal addition loads. Long and broad bamboo leaves are also used for roofing.

BAMBOO FLOWER, FRUIT AND MATURITY

Usually bamboos flower only once in their lifetime and die after bearing fruit. Some species can also flower annually without dying. During the flowering period the canes shed their leaves. After this no new leaves are formed. The smaller species flower after approximately 3 to 4 years, whereas larger species

can flower after 20 to 80 and in certain cases after 120 years. The flowering pattern may be divided into sporadic and mass flowering. With sporadic flowering the flowers appear only in particular clusters and on isolated canes within that clusters. With mass flowering all the clusters are in flower simultaneously. This flowering can extend over large areas and even through entire countrys. The individual flowers are formed from ears and panicles and measure only a few millimeters. The bamboos normally flower in the last months of a year and seeds mature at the beginning of the next year. At the start of the rainy season, after the ripening of the seeds, the first new bamboo plants can be seen on the ground. These are 10 to 50 cm high tin canes which are thicker and longer than the previous ones are added. The reason for this growth in size is the strengthening of the rhizomes. The rhizomes are fully developed only after many years and can then produce canes of the full height and diameter.

FRUITS

All bamboo fruits are edible. The majority of bamboo species produce ripe fruits only rarely. Most fruits falls to the ground before ripening. The ability of the seeds to germinate is very low. To cultivate artificially the bamboo is surer and much quicker consequently. Bamboo can be cultivated by division, from cuttings or by layerings^[1].

LIFE SPAN

The canes die and fall to the ground only a few weeks after the production of flowers and fruits. Frequently their rhizomes are exhausted and also die. With the large species the life span is determined by the flowering period which can be up to 100 years. In the latter case the flowering period and the life span are not equal because the plant can flower frequently without dying^[1].

PHYTOCHEMICALS

The silicious substance found near the joint inside is a white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste. Shoot has active constituents are oxalic acid, reducing sugar, resins, waxes, HCN, benzoic acid, diferuloyl arabinoxylanhexasaccharide, diferuloyl oligo saccharide, (5,5'-di--(diferul-9, 9'-dioyl)-[α -L-arabino furanosyl-(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. Leaves mainly contain proteins like gluteline, lysine, methionine, betain, cholin, proteolytic enzymes like nuclease, urease^[3]. Ethanolic leaf extract of *Bambusa arundinacea* Retz. furnished 6 constituents, two of which represented new natural entities (1 & 2). Remaining four (3-6) compounds which are previously reported from the other plant sources have been isolated for the first time from the leaves of *Bambusa arundinacea* Retz. Spectroscopic structure elucidation of the new natural products (1& 2) is described. The new compounds are characterized as 17, 20, 20-tri demethyl-20 α -isopranyl oleanane (1) and eicosan-1, 20-dioic acid (2).

In this plant, triterpenes and steroidal glycosides were the major phytoconstituents. Stigmast-5, 22-dien-3 β -ol (4), Stigmast-5-en-3 β -ol- β -D gluco pyranoside (5) were isolated in good quantities. The synergistic hypoglycaemic 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 (1) and a new acid, eicosanyl dicarboxylic acid (2), another two known compounds α -amyrin acetate (3) and urs-12-en-3 β -ol- β -D-gluco pyranoside (6) have been isolated for the first time from this plant^[8].

PHARMACOLOGICAL STUDIES

Antidiabetic activity

Aqueous ethanolic solvent extracts of *Bambusa arundinacea* seeds 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 *Bambusa arundinacea* seed shown statistically significant Anti-Diabetic activity in comparison to the standard glibenclamide.^[9]

Antifertility effect

An ethanolic extract of *Bambusa 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 7day 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^[10].

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. The minimum inhibitory concentrations (MICs) of the WEBS against the tested bacterial strains were found in the range of 4.9 - 32 mg/ml using the two-fold dilution method. Different heat treatment conditions have no significant influence on the antibacterial activity. Emodin was taken as the standard sample to test for the content of total anthraquinone compound and preliminarily verify its antibacterial mechanism, so as to lay a theoretical foundation for development of its natural preservatives^[11].

Antiinflammatory and Antiulcer

The extracts of *Bambusa arundinacea* have been used in Indian folk medicine to treat various inflammatory conditions. The plant has got antiulcer activity also. It is thought that these two properties in the same extract are very much useful in the treatment of inflammatory conditions. It is well known fact that the most of the available antiinflammatory drugs are ulcerogenic. The antiinflammatory effect of the methanol extract of the leaves of *Bambusa arundinacea* against carrageen 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 Antiinflammatory Agent, NSAIA) has been studied and found to be the most potent antiinflammatory activity experimentally with least toxic (no ulcerogenic) activity. Thus, the combination of herbal product (methanol extract of *Bambusa arundinacea*) with modern medicine (NSAIAs) will produce the best antiinflammatory drug and will be useful for long-term treatment of chronic inflammatory conditions like rheumatoid arthritis with peptic ulcer, which are common.^[3]

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. Results: 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 anti-plasmin action in a FDP assay. It is of interest to note that pyrolyzates exhibited activities of NMDA-receptor antagonist and antifibrin (ogen), since a combination of NMDA receptor antagonists, glucocorticosteroids, GABAergic drugs and heparin are useful for treatment in delayed postischemic injury.^[3]

Anthelmintic Activity

Ethanollic extract of the root part of *Bambusa 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 Pipeazine citrate (15 mg/ml) and Albendazole (10 mg/ml).^[12]

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. 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).^[4]

Antiarthritic activity

Anti-arthritic activity of *Bambusa arundinacea* in treating Rheumatoid Arthritis (RA) using CFA-induced arthritis animal model was investigated. In the present study, the effect of *Bambusa 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 250gms. The methanolic extract of *Bambusa arundinacea* significantly (dose dependent) decreased the bone erosion, spleen enlargement & rheumatoid factor etc. at a dose (100mg/kg, 200mg/kg, 300mg/kg) compared to the control group but less compared to Standard drug (Dexamethasone 5 mg/kg i.p).

Antioxidant Activity

Flavonoids are present in Bamboo leaves, which is mainly responsible for the antioxidant activity, protection from cardiovascular diseases, cancer prevention.

- Presence of an O-hydroxyl structure in the B ring, which confers higher stability to the radical form and participates in electron delocalization.
- A double bond, in conjugation with the 4-oxo functional group in the C ring

- 3- and 5-OH groups with 4-oxo function in the A and C rings necessary to reach the maximum antioxidant power.

Vessel-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 the treatment of blood vessels disorders such as varices, chronic venous insufficiency (CVI), low capillary resistance, etc. Their protective effect is due to their high affinity for proline-rich proteins, such as collagen and elastin. Since these proteins are structural components of veins, their degradation weakens the blood vessels, inducing edema and swelling of the lower limbs.^[12]

Aphrodisiac^[13]

Vanshlochan had been reported of having aphrodisiac activity along with Kunch, Safed musali, Kesar and Jivanti.

TRADITIONAL MEDICINAL USES

The extract of the plant *Bambusa arundinacea* Retz. has 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 *Bambusa arundinacea* Retz. is used for dislodgement of worms from ulcer. Extractives from various parts of the plant have been used for hair and skin ointment, medicine for asthma, eyewash, potions for lovers and poison for rivals. Leaf bud (decoction) of *Bambusa arundinacea* Retz. is used to encourage the free discharge of menses. Leaves are useful in leprosy, hematemesis, fever and haemoptysis. Leaves are also used in cough paralytic complications and in snake bites. An ointment from the *Bambusa 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 *Bambusa arundinacea* Retz. (upto 97 % SiO₂), considered aphrodisiac, cooling, and tonic is used in asthma, cough. Leaves given to horse suffering from coughs and colds. Tribal women around Salem in Tamil nadu chew leaves of *Bambusa arundinacea* Retz. in the

morning and evening for 1-3 days to induce abortion of an early conception. The extracts of *Bambusa 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. 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. *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. 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. Seeds of *Bambusa 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 *Bambusa arundinacea* enhance the fertility, so that there is great demand of seeds of this species in pharmaceutical industry to manufacture drugs to improve fertility.^[4]

BAMBOO AS A BUILDING MATERIAL

Bamboo is one of the oldest building materials used by mankind. The bamboo culm, or stem, has been made into an extended diversity of products ranging from domestic household products to industrial applications. Examples of bamboo products are food containers, skewers, chopsticks, handicrafts, toys, furniture, flooring, pulp and paper, boats, charcoal, musical instruments and weapons. In Asia, bamboo is quite common for bridges, scaffolding and housing,

but it is usually a temporary exterior structural material. In many overly populated regions of the tropics, certain bamboos supply the one suitable material that is sufficiently cheap and plentiful to meet the extensive need for economical housing. Bamboo shoots are an important source of food, and a delicacy in Asia. In addition to its more common applications, bamboo has other uses, from skyscraper scaffolding and phonograph needles to slide rules, skins of airplanes, and diesel fuels. Bamboo ashes are used to polish jewels and manufacture electrical batteries. It has been used in bicycles, dirigibles, windmills, scales, retaining walls, ropes, cables and filament in the first light bulb. Indeed, bamboo has many applications beyond imagination. Its uses are broad and plentiful^[5]. Bamboo is one of the oldest construction materials. Bamboo houses are without exception skeletal buildings having raised floors with main posts which are anchored in the ground. Typical bamboo elements are canes, halved canes, laths, beading, bamboo boards and rope ties. This way of construction offers the following advantages: pre-fabrication, simple assembly, simple replacement of structural parts; the bamboo elements can be easily dismantled and reused. Posts, battens, rails, purlins and rafters from the longitudinal and transversal bamboo framework. Normal cane diameters are 5-10 cm. Walls, floors and roof are linings rather than stiffening elements of the non-rigid framework because braces and diagonal stays are absent in those planes. The structural safety of the skeletal structure is almost exclusively provided by the posts anchored in the ground. The only vertical and horizontal forces acting on the structure are wind pressure, roof moisture, liveloads and deadweight. The framing is connected by articulated joints. All the framing bars can slightly move in relation to one another. Although each part is able to transfer all axial and transversal forces. Rigid connections or joints are very rarely used. Above all the structure must be able to withstand dynamic loads, for example wind gusts. The building materials as well as the structure have a high elasticity and low mass. This is the reason, why this houses are secure from an earthquake.^[1]

CONCLUSION

Numerous phyto chemical and pharmacological studies have been conducted on different parts of *Bambusa arundinacea*. The present literature

supports the potential of *Bambusa arundinacea* as a medicinal tree. In view of the nature of the plant,

more research can be done to investigate the unexplored and unexploited potential of this plant.

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