



ORIGINAL ARTICLE

Bamboo (Bans) Species an Extra Ordinary Gift of Nature

Kumari Smita

J.N. College, Dhurwa, Ranchi, Jharkhand

Email: premendra.anupam@gmail.comReceived: 27th Nov. 2017, Revised: 18th Dec. 2017, Accepted: 24th Dec. 2017

ABSTRACT

Bamboo normally called Bans belongs to the family Poaceae is a natural component of forest ecosystem (Dannemann, et al., 2007). It is utilised in varied applications (furniture, paper, handicraft, construction etc), and has been called green gold in Japan, poor man's timber in India, brother in Vietnam and friend in China, and is almost ubiquitous in nature. Over 60% population of Bangladesh live in Bamboo houses. Jharkhand rural population has been using Bamboo for the construction of house in the form of pillars, walls, window frames, rafters, room separators, ceiling and roofs. A number of species exists in different state of India. It is the fastest growing woody grass having dramatic and far reaching consequences on the stability and productivity of forests. An energy efficient natural resource with short growth cycle and carbon sequestering efficiency has many fold medicinal property and sacred value. These properties have been compiled and described in the article.

Key words: Bamboo, Medicinal and Sacred

INTRODUCTION

Bamboo belongs to the subfamily Bambusoideae of the family Poaceae. Bamboo forest in India occupies approximately 10.03 million hectares, which constitutes almost 12.8% of the total forest area. Bamboo being a grass has great potential for conservation of soil erosion. It restores soil degradation and controls soil erosion (because of high density evenly distributed canopy & fibrous root system with soil binding capacity), acts as a natural water control barrier (due to the uniqueness of root and rhizome), maintains soil fertility (via nutrient cycling), can grow comfortably in varied range of temperature, produce greater biomass and 35% more oxygen than a hard wood of comparable size, reduce CO₂ gases (some species are capable of sequestering up to 12 tonnes of CO₂ per hectare and hence highly efficient), lowers light intensity & protects against, ultraviolet rays (climate buffer), regenerates without planting, resist drought and are frost hardy, is capable of mitigating water pollution (consume more nitrogen).

OBSERVATIONS AND DISCUSSION

Bamboo has been bestowed with high medicinal value. *B. vulgaris* is rich in *cholin, betain, nuclease, urease, oxalic acid, benzoic acid*.

In *Bamboo vulgaris* shoots Phenolic acids in (mg/g) are as under:

P- hydroxy benzoic acid	:	1.47
Salicylic acid	:	1.27
Tanic acid	:	1.27
Protocatechuic acid	:	0.35

Bamboo shoots are said to be anticancerous, antimicrobial, and effective in decreasing blood pressure, cholesterol and increasing appetite. Bamboo leaf has been used as medicine and food, also clears heat and toxins in traditional Chinese medicine. Leaf contains *flavones*, phenolic acids, *antraquinones*, bioactive polysacchrides.

Seki Maeda (2010) found bamboo shoots effective in cancer prevention, increase appetite, decrease blood pressure and cholesterol level.

High soluble fibre content of bamboo helps in eluding bad cholesterol (LDL)- Awasthi & Tiwari (2008). It is good for heart patients. Ogunjinmi, et al., (2003) – opines that all parts of Bamboo have medicinal value but leaves are most (93.1 %) utilised.

Tabl 1: Health Benefits species

Place	Species	Parts	Used for
China	<i>Phyllostachys glance</i>	Leaves	Cough & lung infection
China	<i>Indosasa pingbianensis</i>	Shoot	Common cold and headache
China	<i>P.heterocycla cv.subescens</i>	Sap of young culms	Cough & throat inflammation
India	<i>Bambusa tulda</i>	Plant	Tetanus
India	<i>Dendrocalmus strictus</i>	Plant	Production of steroid drugs
India	<i>D.endrocalmus strictus</i>	Leaf decoction	As arbortifacient
India	<i>Schizostachyum capitatum</i>	Leaf infusion	Antihelminthic, to relieve pain

CHEMICALS IN BAMBOO (Rathore & Rani, 2011)**PHYTOSTEROLS:**

Bamboo shoot contains beta-sitosterol, compestrol, ergosterol & stigmasterol can be converted into 17- ketosteriods for use as precursors of hormonal steroidal drugs. But these chemicals differ significantly depending on the species and harvest season.

Leaf contains flavones, procyanidins & betaglucan, phenolic acids, anthraquinones and bioactive polysaccharides. Flavone glycosides (functional factors of leaf) comprise C- glycosides. The four main C-glycosylflavones of leaf are:- *Orientin*, *Homorientin*, *Vitexin* and *Isoviextin*

These,

1. Reduce the levels of triglycerides, total cholesterol and low density lipoprotein (LDL) in humans and increase HDL (High density lipoprotien)
2. Inhibit lipid peroxidation,
3. Myocardial infarction, and,
4. Dilate coronary vessels.

Lagrada, *et al.*, (2006) has mentioned that in nature more than 200 types of sterols are found. Plat & Mensik (2001) opines that these phytosterols lowers the serum cholesterol in humans and thereby reduce the risk of cardio vascular diseases. These are anti inflammatory (Bouic, 2002, Navarro *et al.* 2001), antibacterial (Ovesna, *et al.*, 2004) and anticarcinogenic (Awad, *et al.*, 2000; Raichat, *et al.*, 1980).

Phenolic acid of bamboo shoots on hydrolysis with *Driselase* (fungal enzyme) results into the formation of *xyloglucan* and *arbinoxylan oligosacchrides* containing *ferulic* and *p- coumeric* acid. The phenolic acid component in the above are (1) O-40 trans feruloyl α d- xylopyranosyl - (1 \rightarrow 6) d glucopyranose & (2) O [(5-0 (trans- p - coumaroyl) α -1 arabinofuranosyl)]- (1 \rightarrow 3) o β d-xylopyrnosyl- (1 \rightarrow 4) xylopyronose - (Ishei & Hiroi, 1990). Kweon, *et al.*, (2001) opine that above compounds show antioxidant activity.

The xylan (an arbinogalactan) and α - glucan isolated from bamboo is water soluble polysaccharides.Xylan from shoot contains L- arbinose residues. Maekawa (1975) found non starchy glucan too. It has been found that glucan is of two types α & β - glucan. Bamboo shoots natural glucan is β -glucan having three glucosides bonds beta -1,3; beta- 1,4 & beta- 1,6 for treating cardiovascular and cerebro- vascular diseases due to hyperlipidemia.

ANTIDIABETIC:

It has been observed that in human patients with chronic hyper glycaemia the umbilical endothelial cell (HUVEC) undergoes oxidative stress and apoptosis (These are detrimental effects). These detrimental effects are due to the formation of PKC dependent peroxynitrite (ONOO). This peroxynitrite is formed due to the

1. Activation of NADPH oxidase;
2. Induction of nitric oxide synthase &
3. Heat shock protein.

The above three are essential for apoptotic oxidative stress in diabetic complications.

The patients treated with *Sasa borealis* water extract (SBWE) shows suppression in the above detrimental effects. (Choi, 2008), opines that the blockade of high glucose, induced the production of heat shock protein which in all probability reduce the severity of apoptosis. Experiments are needed with other varieties of Bamboo water extracts too.

Table 2: List of Bamboo species & where these are found: (Behra & Mishra, 2011)

Name of the species	Distribution in states/Union territory
<i>Bambusa arundinaecea</i>	Arunachal Pradesh, Karnataka, Odisha, Maharashtra, Himachal Pradesh, Andhra Pradesh, Gujarat
<i>B. balcosa</i> <i>B. bambos</i>	Arunachal Pradesh & Mizoram Jharkhand
<i>B. pallida</i> <i>B. atra</i>	Arunachal Pradesh, Nagaland, Mizoram, Tripura Andaman island of eastern ocean
<i>B. polymorpha</i> <i>B. tulda</i>	Tripura Jharkhand
<i>Dendrocalamus hamiltoni</i>	Arunachal Pradesh, Assam, Mizoram, Nagaland
<i>D. longispathus</i>	Mizoram
<i>D. strictus</i>	Andhra Pradesh, Assam, Gujarat, Maharashtra, Himachal Pradesh, M.P, Manipur, Odisha, Karnataka, Uttar Pradesh, Rajasthan, Bihar and Jharkhand
<i>Melocama bambusoides</i>	Assam, Mizoram, Nagaland, Tripura, Manipur, Meghalaya
<i>Neebenzia balcooa</i>	Nagaland
<i>Oxytenanthera migrociliata</i>	Tripura, Assam
<i>O. parviflora</i>	Assam
<i>Pseudostachyus polymorphium</i>	Arunachal Pradesh
<i>Polystachia pargraeile</i>	Odisha

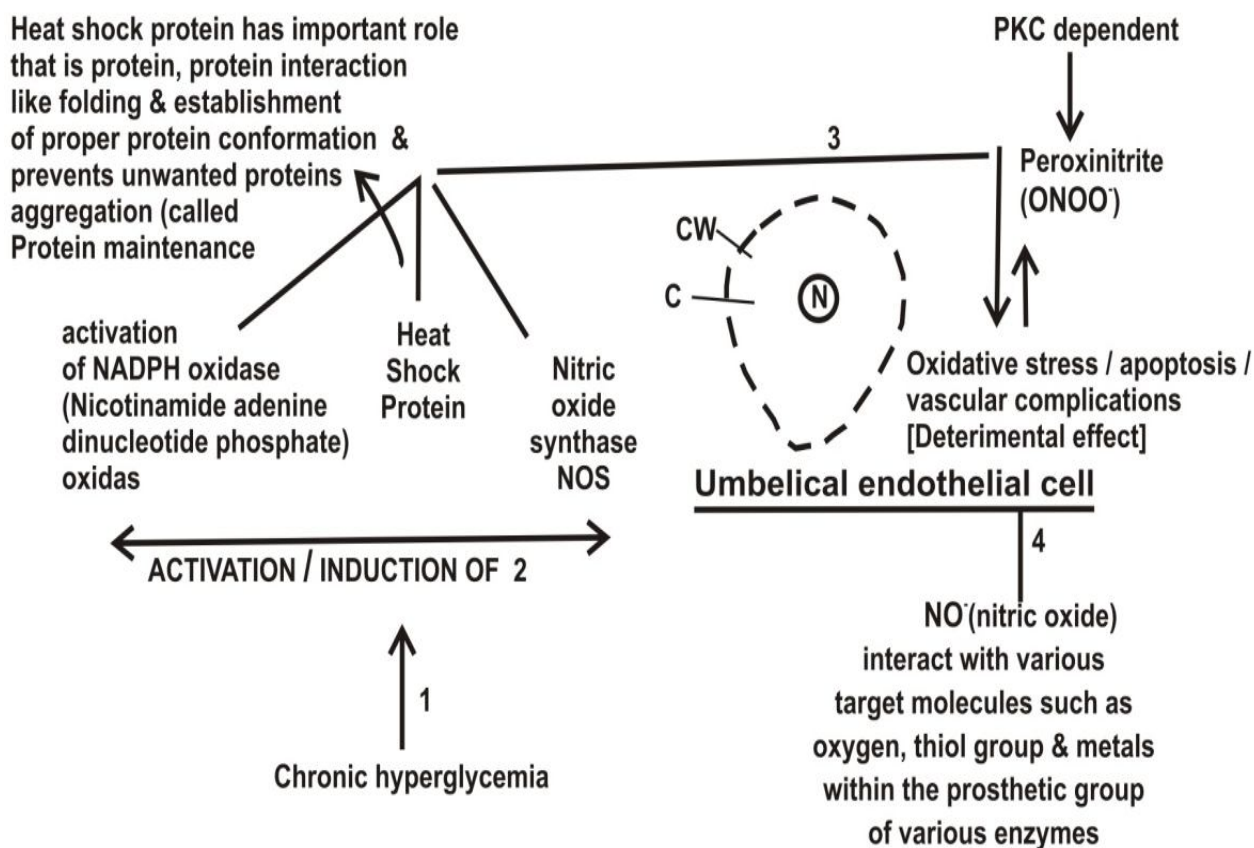


Fig. 1: Oxidative stress HUVEC & its Detrimental Effect

ANTIOXIDANT:

It has been shown that Hep G2 cells (immortal cell line from well differentiated hepatocellular carcinoma) undergo oxidative stress (Park, *et al.*, 2009) and that 1, 1- diphenyl-2 picrlhydrazyl radical is an oxidant which can cause oxidative damage in Hep G2 cells. The Bamboo extract is cytoprotective against such oxidative damage.

The phenolic compounds isolated from *Sasa borealis* whole plant showed inhibitory effects on P-glycoprotein in andramycin resistant human breast cancer cells (Jeong, 2007).

Anti oxidant activity of flavanoids in bamboo leaf is due to combination of their iron chelating activity and their ability to scavenge free radicals which cause aging. Flavanoids inhibit oxidases (Lipooxygenase, cyclooxygenase, mieloperoxidase, NADPH oxidase, xanthine oxidase) and thus prevents the formation of reactive oxygen species (ROS) in vivo experiments. Flavanoids also inhibit the activity of hydroperoxide.

Some of the enzymes such as Phospholipase A₂ which is indirectly involved in oxidative process are also inhibited by flavanoids.

Flavanoids also stimulate catalase and superoxide dismutase (SOD) (Perez-Trueba GLOS, 2003), increases the availability and activity of endogeneous antioxidants, inhibit enzymes involved in the formation of ROS (Perez-Trueba GLOS, 2003).

Procynidins (polyphenolic compounds) are polymers formed by different amounts of catechin, epicatechin and galic acid linked together. Procynidins scavenges oxygen free radicals, inhibits lipid peroxidation, protects blood vessels, inhibits atherosclerosis, helps in myocardial ischemia, platelet agglomeration, hypertension, etc – Liu & Wu, 2007).

Sasa species have found in Japan, Russia, parts of Kurl Island and southern part of Sakhakin island. Sakai & Saito (1964); Shibata, *et al.*, (1979), Chuyen, Kato (1982) opines that *Sasa albomarginata* shows antibacterial & anticancer activity whereas Murakani and Yamaguchi (1968) found bamboo leaves to have anticancer effect.

Suzuki and Saito (1988) found that polysaccharide of *Sasa* species have anti tumour effect.

Sasa kurilensis leaves polysaccharides GK₁ and GK₂ negatively affect growth of sarcoma 180 of mice with absolutely no side effect (Raidaru, *et al.*, 1997).

Chemicals like benzopyrene (BP) and 4- nitroquinoline-1-oxide (4 NQO) creates spontaneous tumour in mice. Bamboo leaf extract and bamboo leaf lignin are supposed to have antitumour activity (Kuboyama, *et al.*, 1981).

ANTI INFLAMMATORY:

Methanolic extract of *Bamboo vulgaris* produces no mortality in doses up to 2000 mg/kg.p.d clearly indicate anti inflammatory activity (William, *et al.*, 2009).

ANTI HYPERLIPIDEMIC ACTIVITY:

It has been observed that SD rats showing high blood lipid when treated with the extracts of bamboo leaves (Ebl) lowered concentration of blood triglyceride and cholesterol to a great extent. Not only that, it increased the HDL cholesterol and decreased LDL cholesterol in a dose dependent manner. Ebl is a flavanoid nutrient.

Young and Mc Eneny, 2001 found that Ebl and Eb showed equal effect at the same dose.

EFFECT OF TRITERPENOID- RICH EXTRACT FROM BAMBOO SHAVINGS (EBS)

Reduces serum total cholesterol and total triglyceride (TG) levels in hyperlipidemic rats, These (cholesterol and triglycerides) are responsible for bringing pathological changes in cardio vascular diseases.

A chemical Friedlin (triterpenoid compound) from EBS serves as vasodilator in thoracic aorta of rat subjected to vasoconstriction in thoracic aorta with phenyl phrine. It seems that EBS has an impact on lipid metabolism (Jiao, *et al.*, 2007).

It has been seen that bamboo shoot diet feeding brings bowel movement. Park and Jhon (2009), opines that bamboo shoot as dietary fibre source has beneficial effect on lipid profile and bowel movement.

NEUROTRANSMITTER

Horuchi, 2003 found Ach synthesis in bamboo shoots. Ach is called Acetylcholine [An acetic acid ester of choline $\text{CH}_3\text{-CO-O-CH}_2\text{-N(CH}_3\text{)}_3\text{.OH}$ normally present in many tissues, used as parasympathomimetic] which is a neurotransmitter in vertebrates. Expression of Ach was detected by assaying Ach content and synthesis. Choline acetyltransferase (Chat) and caritine [A vitamin of B-complex presents in meat extract] acetyltransferase [enzyme that bring about synthesis of acetylcholine] (Car AT) was detected in bamboo shoot by specific radio immunoassay [Using a radioactive labelled substance that reacts with the substance under test].

The levels of these enzymes were comparatively higher in upper portion of the bamboo shoots.

Bambusa concretio salicea (BCS) has been used in Korea for the treatment of hypertension and cerebro-vascular diseases. It protects against-

Oxidative glutamate [A salt of glutamic acid] toxicity in murine neuroblastoma [Sarcoma of nervous system origin] cells as well as in human neuroblastoma.

In Alzheimer disease, the neuro secretion of β -amyloid peptide (a neurodegenerative peptide) takes place. The above salicea has inhibiting effect on such an activity.

A β 25-35 peptide induces neuronal death which is protected by its water extract. It has been observed that BCS has protective value on $\text{A}\beta$ -induced neural death of cultured rat neural astrocytes as it inhibits lipid peroxidation and protection of anti oxidative enzyme (Cheon, *et al.*, 2005).

SACRED ASPECTS:

Bamboo grows in clusters and therefore, regarded symbolic of large family. Green bamboo is considered sacred to Lord Shiva and Vishnu. It is also sacred to Buddhists and has been shown in stupas and Buddhist sculptures (Watt, 1885).

The tribals of Alwar & Chittorgarh districts of Rajasthan, keep the new born child on a winnowing fan (called sup/chhajala) made from bamboo, believing that child will be blessed for prosperous life (Bahra & Mishra, 2011). The culms of bamboo are installed in the ground and a flag is hosted on it during magh purnima at the place where Holi is set on fire by tribals of Banswara (Singh & Pandey, 1982). Lakshmana (brother of Lord Rama) is supposed to have constructed cottage when Lord Rama and his wife Sita were in exile.

In Mahabharata (1.63), in order to please Indra (the rain god), bamboo poles were planted every year and decorated. There after Uparichara the king of Chedi (of Puru dynasty) offered prayer for expansion of the kingdom.

Kaavadi (Kawar) is a type of old balance which is carried by pilgrims during many puja specially to Babadham at Deogarh and this is also performed at various places of the country, particularly at the places where the Joyotilingas are present. The kaavadi is made by bamboo pole and symbolize a balance between happiness and unhappiness, wealth and poverty, extreme joy and depression.

It is said that kavaadi was used by sage Agaastya to lift two hillocks balanced on his shoulders on a bamboo pole to be installed in south India. But he failed and therefore diverted his disciple Indumbhan to do so. He too could not complete the work and left the hillocks near Palani (home of Kartikeya, the son of Lord Shiva).

He again tried to lift the hillocks to be taken to the destination as directed by Indumbhan but could not lift the hillocks.

Indumbhan sought the help of a boy but the boy instead of helping claimed that the hillocks belong to him and therefore both entered into fight. Indumbhan was defeated and later found that the boy was no one else but Lord Kartikeya. After apologizing he was blessed by Lord- that anybody carrying the kavaadi shall be in the heart of Lord.

Another story is that on one occasion (killing of monkeys on a mango tree by the soldiers of Kashi king) Lord Buddha saved the monkeys by making a bridge of his body over the river into a bamboo grove but lost his life. So, for Buddhist, the bamboo is sacred tree (Gandhi & Singh, 1989).

Lord Krishna played flute to call cows. The divine music (sweet notes and melodies) attracted many disciples too.

In Bihar and Uttar Pradesh the married couples when enter the husband's home has to place their feet in bamboo baskets moving slowly and then reach the destination. Such an act is symbolic of

large family and considered auspicious. It is a tradition which has come into effect since long and is linked to good of the family.

In aghora puja- a branch of bamboo is erected in the ground near a pandal, decorated by the flowers of mango tree and banana tree with flowers and then puja of Lord Shiva and Parvati is performed.

The Lord of Bamboo tree (Venu Vana natha) temple at Tiruvetkalam (Tamilnadu) it is said that sage Kanva performed penance for many years and while doing so was covered by termite mound where bamboo plant started growing. Sage Kanve got almost covered by mound. Lord Brahma then split the bamboo grove into three bows and named Paasupta, Sharanga & Gandiv and gave one each to Lord Shiva, Vishnu and Chandra. Later Indra asked Arjun to worship Venu Vana Nath and procured Paasupta. In order to procure paasupta Arjun started his penance. In order to test the devotion of Arjuna Lord Shiva changed his swarupa and became a boy who disturbed the penance of Arjuna. Being disturbed by the boy Arjuna fought with him until shiva appeared before him and gave Arjun Passupata. The battle of Shiva & boy and Arjuna is normally depicted in the mandap in front of shrine.

It is said that Indra became Bamboo himself and worshipped Lord Shiva at Sirkali.

CONCLUSION

There is an urgent need to study the chemical components of each species of bamboo and their effects in controlling various diseases. As regards sacredness many other stories prevail at different places of the country. But in the opinion of the author all this has been done to conserve bamboo species because of its multi functional aspect (i.e, uses and medicinal properties).

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