Exploring the Anti –Oxidant and Antimicrobial Activities of Fermented *Bambusa Balcooa* Shoots

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Abstract

Being a multipurpose plant, bamboo offers several advantages to all the organisms that make up the ecosystem. It aids the environment by storing carbon dioxide from the atmosphere and turning it into plant fibre. It is also utilised in home tasks for support and construction. It also gives animals' food and edible shoots for humans. Additionally, specific plant parts, such the stem and leaves, have therapeutic qualities that have been examined and assessed by a number of investigations into their phytochemical, antioxidant, and antibacterial activities. The demand for this plant's production is growing daily because so many people profit monetarily from selling it. Hence, micropropagation is regarded as essential as it guarantees production all year round, regardless of the season or obstruction brought on by this plant's blossoming. There are numerous species of this plant belonging to the genus Bambusa, which is regarded as one of the more significant ones. Thus, this review is an attempt to examine studies carried out by numerous academics and researchers in this domain with the goal of shedding light on some of the outstanding work completed that ultimately benefits humanity.

INTRODUCTION

Bamboo and humans have a long and complex relationship. It is a member of the Poacea family, extensively dispersed, and grows wild in mountains and fields from temperate Japan to tropical India. Bamboo shoots are tender, young canes that typically grow to a length of 8 to 12 inches, tapering to one end and exhibiting remarkable growth. In Southeast Asia and China, bamboo shoots have long been utilised as a food source and medicinal (Bao,2006). (1)

Bamboo shoots are rich in minerals, proteins, carbs, and dietary fibre; they are also low in fat and sugar and low in calories. Many researchers have determined the nutritional content of edible shoots from various bamboo species (Tripathi, 1998; Chen et al., 1999; Sharma et al., 2004;Xu et al., 2005;Nirmala et al., 2008; Singh et al., 2011). Bamboo shoots have been linked to several health advantages, including enhanced appetite and digestion, weight loss, the treatment of cardiovascular illnesses, antioxidant activity, anti-inflammatory effects, and anti-cancer properties (Shi and Yang, 1992; Hu et al., 2000; Lu et al., 2005). Three kinds of bamboo—Phyllostachys bambusoides, P. nigra, and P.—are the source of pyrolysates. (2)

Bamboo grows quickly as a species. The rhizomes and culms of this enormous, woody grass make up its two segments. The underground portion of the plant, known as the rhizome, is what rises from the earth to generate individual stems or culms. The monsoon season, which lasts for 4-6 months, is when the culms reach their full height and diameter; however, the maturity period might last for 2–6 years. The culms that develop incredibly fast and typically taper at one end are called bamboo shoots. Typically, they are harvested right where they join to trhizome. In Southeast Asian nations, the shoots have been used as food and medicine. They are high in proteins, carbs, minerals, and dietary fibres yet low in fats and sweets. (3)The presence of the different nutrients in the fresh/ unfermented bamboo shoot of edible Dendrocalamus hamiltonii like the moisture, protein, fats, ash, fibres and total carbohydrates have been found. Similarly, nutrient composition and organoleptic evaluation have also been carried out for its edible products such as chutney, candy, chukh, nuggets and crackers. (4)

Due to maturity, Dendrocalamus Hamiltonii impacted by the fungi Fusarium proriferatum and Schizophyllum commune have been observed to lose weight and moisture.stated that the antibacterial and antilipolytic properties of fermented bamboo shoot paste, powder, and extract can be found in pig pickles. Therefore, the fermented bamboo shoot may be used in place of the chemical preservatives. Comparably, it has also been discovered that fermented bamboo shoot improves the quality and shelf life of nuggets made from Desi wasted hens. It has been discovered that the nuggets treated with fermented bamboo shoot are of higher grade than the ones left untreated (14). This study used a variety of methodologies to investigate the phytochemical composition and antibacterial properties of fermented Bambusa balcooa shoots that were gathered in Manipur (6).

MATERIALS AND METHODS

The production hub of Bambusa balcooa, situated approximately 25 km away from the laboratory, sold fermented shoots. After being collected, the samples were placed in 500 mL tagged PET bottles, transported, and kept in the lab refrigerator pending additional examination. The samples were dried, cleaned with distilled water, and then ground into a powder using a machine grinder before being kept in airtight receptacles. Ethyl acetate and methanol were used to remove the dried powered materials. A conical flask containing 10g of dry powder and 100mL of each solvent was filled with cotton wool, and the flask was rotated at 190–220 rpm for a full day. Following a 24-hour period, the supernatant was gathered and the solvent was reduced to ¼ of its initial volume using a rotary evaporator. The solvent was then sealed in an airtight container and kept at 5ºC for subsequent analysis. Using straightforward qualitative techniques, the extract was examined for the presence of carbohydrates, tannins, flavanoids, cardiac glycosides, saponins, alkaloids, steroids, and phenols (Trease and

Evans, 1989)(7). FT-IR analysis was performed with a Shimadzu FT-IR spectrometer (8400S model) in the 4000-400cm-1 range. 200 mg of FT- IR grade KBr was combined with 2 mg of the moisture-free, finely powdered sample, and the mixture was pressed onto a pellet. The pellet was placed in the sample holder right away, and an FT-IR spectra was captured. Using the agar well diffusion method, the antimicrobial activity of the methanolic extract was ascertained. In a petri dish, sterile nutrient agar and potato dextrose agar were added in equal amounts and set aside to solidify. Test bacteria such Escherichia coli, Staphylococcus aureus, Bacillus subtilis, and Pseudomonas aeruginosa, as well as fungi like Aspergillus niger, Candida albicans, and Fusariumoxysporum, were used to create an even dispersion of lawn culture using sterilised swabs. Following the diffusion of 100µL/well of the methanolic extract, the plates were incubated for 24 to 48 hours at room temperature. Following incubation, the growth inhibition was examined, and the findings were noted (8).

GROWTH AND MORPHOLOGY

Bamboo is divided into two main structural types: rhizomes and culms. The portion of the stem below ground is called the rhizome. In a single growing season that lasts three to four months, individual bamboo stems, or culms, emerge from the ground at their full diameter and reach their maximum height. The majority of the woody material is found in this section of the bamboo. The majority of bamboo culms are hollow and cylindrical, with diameters between
0.25 and 12 inches and heights between 1 and 120 feet. (9)
Bamboo is a fast growing species, with reported growth rates of 250 cm (98 in) in 24 hours and a high yield renewable resource. Bamboo growth depends on species, but generally all bamboo matures quickly. Bamboo has 40 to 50 stems inches one clump, which adds 10 to 20 culms yearly. Bamboo can reach its maximum height in 4 to 6 months with a daily increment of 15 to 18 cm (5 to 7 inches) Culms take 2 to 6 years to mature, which depends on the species. (10)

Common names and distribution in India

Bamboo, common name in English (Bamboo, Bamboo manna, Giant Thorny Bamboo); Hindi (Bans-lochana, Banskapur, Vanoo, Banz); Gujarati (Toncor, Wans, Vanskapur, Vas-numitha); 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); Maliyalam (Moleuppa); Kannad (Bidaruppu, Tavakshira) (11)

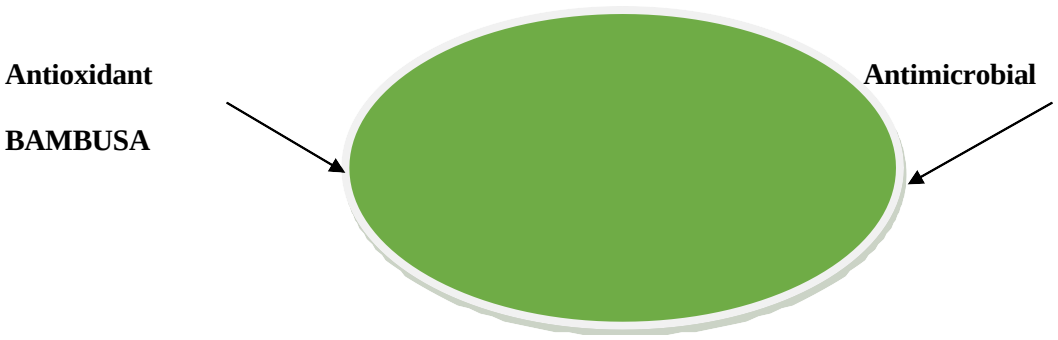

Fig -1 Representation of activity of Bambusa

The primary distribution regions of Bambusa arundinacea are Gujarat,Himachal Pradesh, Orissa, Maharashtra, Arunachal Pradesh, and Karnataka.Dendrocalamus strictus, which is found in Andhra Pradesh, Assam, Gujarat, Maharashtra, Himachal Pradesh, Madhya Pradesh, Manipur, Orissa, Karnataka, Uttar Pradesh, and Rajasthan, is the most commonly observed species. A few more species that are widely distributed in North Eastern India are Bambusa balcooa, Bambusa pallida, Bambusa tulda, Bambusa polymorpha, Dendrocalamus hamiltonii, Dendrocalamus longispathus, Melocanna bambusoides, and Oxytenanthera spp (12).

Consumption of Bamboo

A traditional delicacy in several nations, including India, is bamboo shoot. Bamboo shoots are eaten raw, canned, cooked, marinated, fermented, frozen, liquefied, and medicinally because they are low in fat and high in potassium, carbohydrate, dietary fibre, vitamins, and active elements. Since most nations have a traditional, erratic, seasonal, and regional consumption pattern for bamboo shoots. (13)

Chemical composition

Bamboo's chemical makeup is comparable to that of wood. At about 90% of the total mass, cellulose, hemicellulose, and lignin are the major components of bamboo culms. Inorganic salts, waxes, tannins, and resins are among bamboo's minor ingredients. Bamboo, however, contains more silica, ash, and alkaline extractives than wood [14]. Bamboo has more organic materials besides cellulose and lignin. It has 0.8–6% protein, 2-4% fat, 2% deoxidised saccharide, and roughly 2-6% starch. (15)

Phytochemical Screening

The greatest source of pharmaceuticals used in conventional medicine, contemporary medicine, nutraceuticals, food supplements, traditional remedies, pharmaceutical intermediates, and chemical entities for synthesised medications is found in plants [16]. Plants can synthesise a vast array of chemical compounds that carry out crucial biological tasks. These compounds are also employed by plants to fend off attacks from herbivorous animals, fungi, and insects. The term "photochemical" refers to the non-nutritive chemical substances that naturally exist in plants; the Greek word "phyto" means "plant." Certain medications with high activity profiles have been developed as a result of the extraction and characterisation of numerous active phytocompounds from Plants. (17) Numerous phytochemicals and plant extracts have the ability to scavenge free radicals or serve as antioxidants (18). There are two categories for these phytochemicals: primary and secondary metabolites. Primary metabolites, which include sugars, lipids, and secondary metabolites, are necessary for all plants. Phytochemicals, on the other hand, are found in a narrower variety of plants and have a specific function because they are protective. Numerous studies have been conducted in the past on the investigation of phytochemicals on a variety of medicinal plants. On the other hand, the investigation of these phytochemicals on bamboo leaves can be seen as a novel method, and interest in it is growing every day. Because bamboo leaves are both nutritious and medicinal, they are an excellent source of food for animals. Three bamboo species—B. vulgaris Schrad. ex J. C. Wendl., B. ventricosa McClure, and O.— were the subject of phytochemical analysis. A. Rich. abyssinica by Coffie et al., 2014 to ensure that it is safe to consume in the ethanol that was extracted, both wet and dry sampling of leaves. (19) It was discovered that every leaf extract contained cyanogenic glycoside, general glycoside, coumarin, and saponin. Additionally, the extracts of B. ventricosa and O. abyssinica had flavonoids and

polyphenols. None of the species contained any evidence of steroids, anthraquinones, carotenoid, triterpenoid, or anthracene glycoside. Because B. vulgaris included four classes of phytochemicals and comparatively less saponin—which can lyse the red blood cells of larger herbivores—plant extracts are not injected directly into humans, making it the safest of these three species.

(20) Additionally, their investigation revealed that air drying of the leaves did not significantly alter the phytochemicals present in the leaf extract, meaning that the leaves may be fed to cattle as hay in either a fresh or dried form. Lack of cattle feed during the dry season, when there is little rainfall, remains a major issue in developing nations. When considering fodder, bamboos may be a better option because their leaves are higher in carbohydrates than the parts of the leaves of many other vegetables. (21) Plant extracts were a good source of various bioactive chemical groups. Because the crude extracts significantly suppressed the growth of the fungus A. niger, these phytochemicals have thus shown good potential for the expansion of contemporary chemotherapies against microbial infections. Not only are leaves and stems of certain species of bamboo significant, but their substantial contents of proteins, carbs, vitamins, fibres, minerals, and very little fat make the bamboo shoots of certain species even more beneficial to human health. Numerous minerals, including potassium, calcium, zinc, manganese, copper, iron, and trace levels of phosphorus and selenium, are found in bamboo shoots (22). Compared to ethyl acetate, methanol solvent revealed more phytochemical components. According to Srivastava's 1990 study, colorimetric analysis revealed that the total phytosterol concentration in dried samples of fresh shoots from B. tulda and D. giganteus was 0.21–0.39% and 1.6-2.8% in samples of fermented shoots [23]. As the organic matter is broken down by anaerobic digestion, the amount of phytosterols in fermented shoots increases. As a result, fermented bamboo shoots may be utilised as a raw material to make steroidal medications that lessen discomfort and inflammation (24).

Proximate analysis

Buho (Schizostachyum lumampao), which has the potential to be utilised as herbal tea, has a high ash, crude fibre, and crude protein content, according to proximate analysis. Saponins, diterpenes, triterpenes, phenols, tannins, and flavonoids were found in both the ethanolic and aqueous leaf extracts, while phytosterols were only found in the ethanolic extract, according to qualitative phytochemical screening . About 30% of the material is made up of ash, which is the same as the quantity of inorganic matter in the leaves. The following are the results of the proximate analysis of the leaves (given as mean ± standard deviation, n=3): Measuring 9.99 ± 0.056% moisture, 30.49 ± 0.58 % ash, 22.10
± 1.26 % crude protein, 1.56 ± 0.97 % crude fat, 28.65 ± 0.09 % crude fibre, and 7.21 ± 0.79 % total sugar (25).

Ethanomedical uses

Bamboo sap is particularly useful in treating children's feverish illnesses and epilepsy. It also heals colds and clears up phlegm, fever, or loss of consciousness connected with phlegm-heat. Pleioblastus amarus is a tall bamboo plant found in Southern China. Its leaves are used to cure lung inflammation, fever, and fidgeting. The leaves have a little bitter and pungent taste (26).

ANTIOXIDANT ACTIVITIES

Any material that traps free radicals to prevent or postpone oxidative damage to a target molecule is considered an antioxidant. Although the exact composition of the antioxidant chemicals found in bamboo leaves is unknown, academics and researchers throughout the world are becoming more and more interested in the antioxidant activity of different bamboo leaves. Antioxidants may be vital in reducing the cellular damage caused by free radicals, which is also a major cause of many age-related human diseases (27).

Therefore, research on phytochemicals and plant extracts' possible antioxidant properties is crucial for the medical field as well. With over 6,000 different varieties, flavonoids are a broad set of phytonutrients that can be found in almost all fruits, vegetables, cereals, bark, roots, stems, flowers, tea, and wine. They also supply carotenoids, which are what give fruits and vegetables their brilliant colours. Because of their ability to scavenge and prevent the generation of free radicals, flavonoids and antioxidant activity are being studied more and more, especially for their potential health advantages. Additionally, it has been observed that certain flavonoids have far greater antioxidant capabilities than do vitamins C and E. (28). Numerous flavonoid families have also been employed in the management of medical conditions in humans. Procházková et. al. 2011 address both the prooxidant and antioxidant properties of flavonoids in their review work. Flavonoids can also have prooxidant activity, which encourages the oxidation of other chemicals, under specific reaction conditions, therefore they cannot only be considered antioxidants. However, a certain flavonoid's prooxidant or antioxidant qualities primarily rely on its concentration. Because flavonoids naturally modify the body's response to allergens, viruses, and carcinogens, they have also been referred to as "nature's biological response modifiers." (29). Wang et al. (2007) studied the antioxidant activity of fifteen distinct species of bamboo, eight of which were Bambusa species. Out of the fifteen bamboo species that were chosen, their findings showed that the methanolic extract of B. textilis McClure had the highest antioxidant activity. In order to find antioxidant components, the extract was further analysed using HPLC-UV and HPLC-micro-fractionation. Three antioxidant fractions, namely isoorientin 4"-O-β-D-xylopyranoside, isoorientin 2"-O-α-L-rhamnoside, and isoorientin, were isolated. Tripathi et al. (2015) evaluated the total polyphenol and antioxidant activity of B. vulgaris and B. nutans leaf extracts. Total phenolic content of the extracts was calculated spectrophotometrically using a modified Folin-Ciocalteu method, and antioxidant activity was evaluated using the DPPH (2, 2-diphenyl- 1-picrylhydrazyl) radical scavenging assay (30). Three CGA derivatives, 3-O- (3′-methylcaffeoyl) quinic acid, 5-O-caffeoyl-4-methoxylquinic acid, and 3-O- caffeoyl-1-methoxylquinic acid, were extracted and identified from the leaves of bamboo P. edulis in their investigation. CGA is an ester of caffeic acid with quinic acid found naturally in numerous plants such as coffee beans, apples and blueberries. Goyal et al. (2010) evaluated and analysed the DPPH radical scavenging activity, total phenols, and antioxidant activities in an Indian wild B. vulgaris "Vittata" methanolic leaf extract (31). Carbohydrates, reducing sugars, steroids, flavonoids, saponins, alkaloids, tannins, anthraquinones, and glycosides were discovered to be present. The elevated levels of total flavonoids and total phenolic compounds suggested that the antioxidative activity was facilitated by these chemicals. The phytochemical In particular, flavonoids are accountable for antioxidant capacity and several species of Bambusa are examples of this trait. Additionally Further study is still required. A qualitative and quantitative examination of these substances to determine possible uses for bamboo leaves in the field of medicine (32).

Fig -2 Representation of Bambo

ANTIMICROBIAL ACTIVITIES

One of the most significant and effective developments in contemporary science and technology for the purpose of controlling infectious diseases is the discovery and development of antibiotics. Pathogen resistance to conventional antimicrobial drugs is on the rise. Due to their resistance, microorganisms that are less vulnerable to conventional antibiotics must be isolated. This will enable resistant isolates to reappear during antibacterial therapy. Despite significant progress in the medical field, it is imperative to manage antimicrobial resistance by increased antibiotic usage to minimise hospital-associated cross-infection
(31). There are medicinal plants with antimicrobial action all over the world, and numerous attempts have been made to find new, potent antimicrobial chemicals. To determine whether a plant contains an antibiotic molecule that protects against bacteria and pathogens, antimicrobial screening is carried out.

All examined strains of E. coli were effectively inhibited by the ethanolic extract of D. asper leaves, as demonstrated by the micro dilution experiment. The primary constituents of the ethanolic extract were found to be fatty acids, esters, long-chain alcohols, and aldehydes, according to the chemical identification performed using pyrolysis GC/MS. Additionally, D. asper leaf extract could be used to make an antidiarrheal drug. In a related study, B. arundinaceae's antibacterial activity was evaluated against strains of Bacillus, P. aureus, E. coli, and S. aureus. The effectiveness of ethanolic extract was mediocre. in opposition to all four organisms, in an aqueous extract had a mediocre impact on E. S. aureus and E. Coli. Bamboo is regarded as a healthy supply of phytosterols, which are the precursors to different pharmaceutical plants' active steroids, and these also function as supplements. Within the research, carried out in 2014 by Wasnik and Tumane, The ethanolic and

methanolic groups were discovered. An extract of B. bambose L. leaves revealed outstanding blocking efficacy against every test Ten germs resistant to numerous drugs, and they each one was a clinical isolation from a wound infection (33). Similar to earlier research, the ethanol solvent in this instance also produced better outcomes overall. In each study, the zone of inhibition (ZOI) was measured to assess the plant extract's efficacy against different microbial strains. The gramme positive and gramme negative bacteria were more inhibited by the ethanolic extracts of B. arundinacea and M. indica, suggesting that they are both possible sources of natural antioxidants, phytochemicals, and antibacterials. M. indica had a greater potential for healing. Ethanolic and methanolic extracts from the two plants under test performed better in this investigation than aqueous extracts did. The n-hexane, chloroform,

And ethyl acetate extracts of B. vulgaris were subjected to antimicrobial screening, which revealed that the crude extracts inhibited the growth of A. niger mushrooms. This validates the traditional medical application of this species' aqueous extracts for the treatment of wounds and sexually transmitted infections Despite the fact that bamboo leaves have antibacterial properties, not much study has been done to date to determine the effectiveness and utility of bamboo leaves. To determine the essential elements required for their successful role as a medicinal plant for those extracts that have already been researched, more research is still required. Furthermore, more work needs to be done to fractionate the extracts in order to better understand the mechanisms underlying the antimicrobial activity of those antioxidants (34).

Conclusions

Bamboo, a plant in the Poaceae family, has enormous In Meghalaya, Dendrocalamus hamiltonii is one of the bamboo species that is commonly found. The first step in the investigation of the antioxidant and antibacterial qualities of fermented D. hamiltonii shoots is to extract the phytochemicals from the bamboo stalk by employing Soxhlet extraction techniques. Two solvents were employed in the extraction process. They are methanol and acetone, with extraction yields of 31.08% and 25.78%, respectively. To sum up, bamboo is a little-studied plant with a lot of therapeutic potential. Beyond being used for food and crafts, bamboo has to be thoroughly studied.Strong scientific studies are required to support bamboo's ethnopharmacological uses before it can be widely used in a variety of therapeutic applications.

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