

RESEARCH PAPER

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Nutraceutical value of *Gigantochloa atter* and *Bambusa blumeana*

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ABSTRACT

This study investigates the chemical composition and secondary metabolite profile of bamboo shoots from *Gigantochloa atter* ("Kajali") and *Bambusa blumeana* ("Kajawan"). Findings reveal that "Kajali" contains a higher concentration of secondary metabolites, including saponins, flavonoids, alkaloids, and anthraquinones. The proximate analysis indicates that "Kajali" has a moisture content of 63.45%, ash content of 2.99%, water content of 0.936%, sodium content of 11.39%, total fat of 0.42%, and crude protein of 5.33%. These results highlight its potential health benefits, suggesting the need for further research, particularly on its pharmacological properties.

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INTRODUCTION

Bamboo is intricately associated with humans since times immemorial. Bamboo, a kind plant of Poaceae subfamily of Bambusoideae plants, is a tall, arborescent grass that is highly valued globally due to its ecological significance, versatility, and various human uses (Mudjanarko *et al.*, 2020) is an evergreen perennial herbaceous plant. Bamboo can grow on degraded and marginal lands or in combination with other crops in agro-forestry systems (Carvalho *et al.*, 2013; Bajwa *et al.*, 2021). Bamboo shoot is the young bamboo plant emerging from the ground with a height of 20–40 cm. The bamboo shoot is of abundant nutrition, and it is a kind of pollution-free food with good flavor and taste. Bamboo shoots have immense potential of being used as important health food as they contain high proteins, amino acids, carbohydrates, many important minerals, and vitamins (Shi and Yang, 1992). Meanwhile, the growing environment of most bamboo shoots is natural and without any pesticides. Bamboo shoot is the neonatal culm just sprouting from the earth in full-diameter, in which the nodes and internodes were densely-packaged. Fresh bamboo shoots own a crisp and crunchy texture as well as a sweet taste, imparting a unique flavor. However, not all bamboo shoots are edible and the main edible species The bamboo shoots can be also processed into canned food, fermented food, and soft drinks (Majumdar, 2006; Mudjanarko *et al.*, 2020). Bamboo shoot is also a kind of traditional Chinese medicine due to their unique factors such as hypolipidemic effect, anti-diabetic activity, and anti-aging activity (Chongtham and Bisht, 2020).

However, the composition and the biological functions of polysaccharides extracted from the bamboo shoot shells are far from being understood. The bamboo shoots also contribute to producing active polysaccharides that could have anti-diabetic effects similar to those of some herbal medicines (Bajwa *et al.*, 2021).

However, the food potential of Bamboo shoot per se remains unexploited. Literature on the nutritional and medicinal potential of bamboo shoots is scarce. This

paper therefore provides insight on bamboo shoot as a food resource. Various edible species and exotic food products (fermented shoots, pickle, etc.) and recipes of bamboo shoots (bamboo beer, bamboo cookies) are consumed worldwide. Changes in the nutritional composition of different species of bamboo shoots with processing have also been reviewed. Bamboo shoots possess high protein, moderate fiber, and less fat content. They are also endowed with essential amino acids, selenium, a potent antioxidant, and potassium, a healthy heart mineral. The occurrence of taxiphyllin, a cyanogenic glycoside in raw shoots, and its side effects on human health calls for the demand for innovative processing ways using scientific input to eliminate the toxic compound without disturbing the nutrient reserve. Further investigation is required by the researchers to make novel nutraceutical products that benefit society.

Plant secondary metabolites are rich sources of bioactive compounds that may promote good health and effective in the prevention of numerous health problems including cancer and heart diseases. Plant secondary metabolites are rich sources of bioactive compounds that may promote good health and be effective in the prevention of numerous health problems including cancer and heart diseases. Studies suggest that the health benefits of food rich in bioactive compounds are attributed to the interactions of various bioactive compounds and other nutrients (Chongtham and Bisht, 2020). The chemical content of bamboo shoots is being studied. According to Odunta and Olaleye (2012), the ash content is a measure of the amount of minerals present within a sample high ash content (21.86%) indicates that leaves are relatively rich in mineral elements, and may contain inorganic radicals like carbonates, phosphates, and silicates of sodium, potassium, calcium, magnesium.

Bamboo shoots are high moisture products (moisture content = 85.98–92.37% d.b.), so development of molds, fungi and other microorganisms is a common phenomenon during storage of bamboo shoots. Owing to such technological gap in the field of bamboo shoot

processing, there is hardly any product that has yet created its way into the national or international market. Despite availability of a variety of water-based criteria, which can give indications of stability of food, water activity is one of the most effective and useful measurements of water in food, with particular regard to microbial growth and enzyme activity. Moisture sorption isotherm of a food describes the equilibrium relationship between water activity and moisture content of a food at constant temperature and gives an insight into the moisture-binding characteristic of a food. Therefore, knowledge of moisture sorption characteristics of a food is quite essential for prediction of technological performance and quality of stored foods (Chirife and Buera, 1994, Nelson and Labuza, 1994, Palou *et al.*, 1997). Moisture sorption characteristics of raw bamboo shoot could be predicted agreeably with Caurie model. The equilibrium moisture content was found to decrease with increase in temperature at constant water activity; conversely, they were found to increase with increasing water activity at constant temperature. Hysteresis was observed over the entire range of water activity. The values of monolayer moisture content as estimated by the best fitted Caurie's models for desorption and adsorption. Adopting a nutritionally balanced diet with convenient use and cost is an authentic call among the human population to become health alert. Nowadays, the quality of life is becoming one of the concerns of people about its health. The steady increase in life expectancy accompanied by the growing cost of health care and the increasing rate of metabolic disorders (heart disease, obesity, diabetes, and arthritis) are the factors to be considered in terms of life quality. Due to the widely grown health concern and side effects of the allopathic system of medicine among people, natural foods rich in nutraceuticals are catching up very fast.

Modern research has revealed that bamboo shoots have several health benefits: improving appetite and digestion, weight loss, and curing cardiovascular diseases and cancer. The shoots are reported to have anticancer, antibacterial, and antiviral activity. Shoots have antioxidant capacity due to the presence of phenolic compounds (Chongtham *et al.*, 2011). Few

studies also revealed its richness in nutritive components like protein and fiber content and thus the bamboo shoot could help mitigate the problem of malnutrition (Santosh *et al.*, 2021). The increasing trends of health consciousness among consumers have stimulated the field of functional foods and bamboo shoots can be one of them.

Apart from being an excellent source of food, bamboo is used in traditional medicines in many Asian countries. Modern research has supported most of the medicinal properties such as antioxidant, antidiabetic, antimicrobial, antitumor, and prevention of cardiovascular and neurological disorders. Due to its nutritional and medicinal properties, the bamboo shoot is an ideal bioresource for the development of novel functional foods and nutraceuticals (Chongtham and Bisht, 2020). Bamboo comes in different varieties, hence, testing the nutraceutical value of each variety will lead to choosing which among them is best for the production coming from Bamboo shoots. Bamboo shoots possess high protein, moderate fiber, and less fat content. They are also endowed with essential amino acids, selenium, a potent antioxidant, and potassium, a healthy heart mineral. The focus of the study is on the secondary metabolites present in bamboo shoots.

MATERIALS AND METHODS

Research design

This study focuses on determining the nutraceutical value of Bamboo shoots coming from the two varieties of Bamboo available in the community particularly in the municipality of Madrid, Surigao del Sur through nutritional analysis. Descriptive and experimental research will be utilized to determine which Bamboo shoot products have higher nutraceutical value after they are produced.

Collection of samples

Bamboo shoot samples were collected within the municipalities of Cantilan and Madrid, Carmen, and Lanuza. Samples will then be prepared to be ready for nutritional analysis and production of sample Bamboo shoots products.

Phytochemical screening

Test for flavonoids

Addition of 1 ml of NaOH to 3 ml of extract will determine flavonoid presence when yellow coloration is observed.

Test for saponins

Addition of 2 mL distilled water to 2mL of extract then vigorous mixing will cause frothing indicating presence of saponins.

Test for tannins

Addition of 2 ml 5% ferric chloride to 1 ml of extract will produce greenish precipitates indicating presence of tannins.

Test for alkaloids

Filtrate is obtained by mixing 1 ml of 1% HCl and 3 ml of extract, then heat for 20 min, cool and filtered. 1 ml of filtrate is then mixed with 2 ml Meyer's reagent to produce creamy precipitates indicating presence of alkaloids.

Test for free anthraquinones aglycone

Filtrate is prepared by mixing 0.5 g of powdered samples to 5 ml chloroform for 5 minutes and filtered. The filtrate is then mixed with 10% ammonia to produce rose pink coloration indicating presence of anthraquinones aglycone.

Proximate analysis of bamboo shoots

Proximate analysis of bamboo *Gigantochloa atter* "Kajali" of shoots was done at DOST -Butuan. The following test involve moisture, ash and water activity. The bamboo shoots were further analyzed for the moisture (%) (AOAC, 2012), ash (%) (AOAC, 1990).

RESULTS AND DISCUSSION

Secondary metabolites in two varieties of bamboo shoots

Secondary plant metabolites are numerous chemical compounds produced by the plant cell through metabolic pathways derived from the primary metabolic pathways. According to Akao *et al.*, 2004; Quitain *et al.*, 2004, bamboo shoots are a rich source of antioxidant

compounds like flavonoids, phenols, and phenolic acids. In the present study, two varieties of bamboo were studied the *Gigantochloa atter* "Kajali" and *Bambusa blumeana* "Kajawan". The result shows that Kajali has a greater number of secondary metabolites like saponin, flavonoids, alkaloids, and anthraquinones compared to kajawan. It has been known that the bamboo shoot is one such plant which is a delicious vegetable, rich in nutrients, and has several health-promoting bioactive compounds. The young shoots are reported to be a good source of minerals such as K, P, Na, Mg, Ca, and Fe along with trace elements such as cadmium, cobalt, copper, nickel, manganese, selenium, and zinc (Oinam Santosha *et al.*, 2017) (Table 1).

Proximate composition of bamboo shoots with a greater number of secondary metabolites present

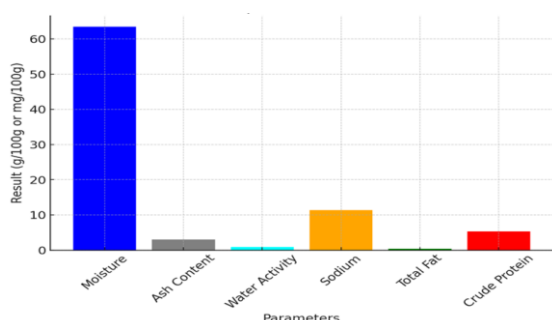
Based on the above result *Gigantochloa atter* "Kajali" has a greater number of secondary metabolites. The bamboo shoot of Kajali was subjected to proximate analysis. Results show that the moisture content is 63.45% which is lower than the study of Gonzales and Apostol (1968) having 75% moisture content. According to some studies, high moisture content leads to deterioration in terms of physical and chemical quality due to increased enzymatic activity and microbial degradation. The low moisture content would hinder the growth of microorganisms and shelf life could be higher. This suggests that dried bamboo shoot of Kajali will not promote microbial growth and enzyme activity since their water content is low (0.936).

On the other hand, Result in Fig. 1 show that the ash content of *G. atter* "Kajali" is 2.99% is higher than the Indian native bamboo samples ranged from 0.4% to 3.0% (Kumar and Chandrashekar, 2014). The values of the ash content were within the threshold prescribed in the EN standards EN 14775 is $\geq 3\%$. In the present study result showed that it is within the threshold. This result implies that it cannot cause any serious slagging, fouling, and corrosion to the conversion of plant during combustion, according to the guiding values for ashes related to the solid biofuels ISO 1171 (1997).

Table 1. Secondary metabolites present in bamboo shoot

Secondary metabolites	<i>Gigantochloa atter</i> “Kajali”			<i>Bambusa blumeana</i> “Kajawan”		
	T1	T2	T3	T1	T2	T3
Tannins	-	-	-	+	+	+
Saponin	+	+	+	+	+	+
Flavonoids	+	+	+	-	-	-
Alkaloids	+	+	+	-	-	-
Anthraquinones	+	+	+	-	-	-

Legend: ‘-’ = Negative, ‘+’ = Positive

**Fig. 1.** Chemical analysis of *Gigantochloa atter* “Kajali” based on identified parameters

Bamboo shoots are endowed with rich quantities of useful minerals such as potassium, phosphorus, sodium, calcium, magnesium, and iron. Minerals are required for the proper functioning of many useful metabolic activities of our body since they are rich in group B-vitamins. Bamboo shoots are very low in calorie (12 kcal/100g). The dietary fiber (4% DV) supports healthy bowel function and may protect against heart disease. In the present study the amount of sodium is 11.39 mg/100g which is higher than the dietary references intakes which is only 4 mg with 0% of daily value. Sodium is an essential nutrient and is needed by the body in relatively small amounts (provided that substantial sweating does not occur) to maintain a balance of body fluids and keep muscles and nerves running smoothly. Bamboo shoots are considered as one of the useful health foods because of their rich contents of proteins, carbohydrates, vitamins, fibers, and minerals and very low fat. In the present study result show in Fig. 1 that the total lipid is 0.42g/100g is a little higher than the total lipid (0.3 g) dietary reference. The high dietary fibers and low fat in bamboo shoot help in reducing the thickening of arteries maintaining the blood pressure. Park and John, 2009 conducted a study

to show that diet containing bamboo shoots had reducing effect on serum content of total cholesterol and low density lipoprotein.

CONCLUSION

Bamboo shoots are not only tasty and healthy, but they also contain bioactive chemicals that are good for health. Despite the numerous health benefits of bamboo shoots, limitations still exist, and future studies are needed to discover more potential uses. Additionally, more research is needed to investigate the pharmacological properties of specific bamboo species, including *Bambusa vulgaris*, which has shown to have antipyretic, analgesic, anti-inflammatory, antioxidant, antiviral, diuretic, hepatoprotective, anti-anxiety, and renoprotective properties.

Innovative techniques of preparation should also be widely publicized to increase the demand for bamboo shoots. The usefulness of bamboo shoots as health food is not largely known by general public due to ignorance of their high nutritional values. There is a greater necessity to create awareness among the people about their nutritional health benefits so that they are widely accepted.

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