

Nutrient, Mineral and Bioactive Constituent Evaluation of Bamboo Shoots Grown in Masha area, South- West of Ethiopia

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Abstract

Bamboo shoots grown in Masha area, Ethiopia were studied for nutrient, mineral and bioactive compositions using standard analytical methods. The nutrient composition involves the Moisture content 2.98%, Ash content 14.41%, crude lipid 2.25%, crude fiber 18.81%, crude protein 8.04%, and Carbohydrate 73.14%. Besides to this, the mineral composition of bamboo shoots were potassium 6324.101mg/100g, sodium 19.164mg/100g, calcium 60.449mg/100g, magnesium 118.75mg/100g, copper 1.429mg/100g, zinc 5.647mg/100g, iron 13.594mg/100g and manganese 2.895mg/100g. The bioactive constituent analysis revealed the presence of saponins, flavonoids, alkanoids, terpenoids, quinons, tannins and phenols. In the present study, *bamboo shoots* contained essential nutrients which compare favorably well with those of wild edible leaves in literatures.

Keywords: Mineral composition; bioactive constituent; Bamboo; essential nutrients.

1. Introduction

Bamboo, the giant grass of the family Poaceae, is almost ubiquitous. One of the oldest plants on Earth, bamboo is grown throughout the world and has uses from cradle to coffin. More than 1250 species, belonging to 75 genera, are being reported worldwide [1]. Bamboos belonging to family Poaceae are considered as one of the most versatile multiutility forest tree grasses. Though distribution of bamboo is worldwide with over 1250 species, their presence is predominantly found in Southeast Asia [2, 3]. They are known to have more than 1500 uses and are considered as one of the most economically important plants in the world [4]. The applicability of bamboo is highly diverse as they are employed immensely in paper, handicraft industry, house construction, and making furniture, water pipes, storage vessels and other important household items [5]. People from different countries address bamboos in different names because of their highly multipurpose properties. The Chinese called bamboos as “Friends of the people,” Vietnamese as “My brother,” and Indians as

“Green Gold.” Bamboos in addition to their multiple applications have another important usage in utilizing their juvenile shoots as popular food items [6].

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. Freshly collected bamboo shoots have good amount of thiamine, niacin, vitamin A, vitamin B₆, and vitamin E [7, 8]. Also the bamboo shoot based diets are rich source of dietary fibres and phytosterols and less cholesterol contents which make them one of the popular natural health foods. The nutrient compositions of shoots of different edible bamboo species have been analysed by several workers [7, 9, 10, 11, 12, 13]. Bamboo shoots contain generally tyrosine, arginine, histidine, and leucine as amino acids. The presence of tyrosine facilitates biochemical metabolism of our body as it is a major constituent of adrenals which are precursors for adrenaline, necessary for active body metabolic activities. It also plays important role in function of thyroid and pituitary glands which are involved in producing and regulating hormones in human body. Presence of high fibre and phytosterols in bamboo shoot reduces fat and cholesterol levels of blood making them one of the most sought after health foods among patients with life style related disorders. The dietary fibre possesses number of health benefits as it controls blood pressure, hypertension, and obesity and also protects our body from coronary diseases and potential carcinogens [14,15]. The high dietary fibres and low fat in bamboo shoot help in reducing the thickening of arteries maintaining the blood pressure. Park and John [16] conducted a study to show that diet containing bamboo shoots had reducing effect on serum content of total cholesterol and low density lipoprotein. There was increase in the frequency of bowel movement and faecal volume indicating its role in cholesterol lowering and diabetes prevention in individuals provided with bamboo diets. There are instances of using bamboo shoots by Karbi Anglong tribes of India to control early stage of cancer [16]. The anticancer property of bamboo shoots might be attributed to the presence of lignans and phytosterols. The production of carcinogens, growth of cancer cells, cell invasion, and metastasis are inhibited by phytosterol. Regular intake of bamboo shoots reduces reproductive health related problems in female. Since there is very little or no information on the true chemical composition of *bamboo* shoots grown in Masha area, Ethiopia, the processing of the shoots for nutritional or therapeutic purposes may be misleading. The populations unaware of the high nutritional and nutraceutical values of this vegetable grow for house construction, agricultural implements to provide food and fodder. This work was therefore aimed at finding out the nutrient composition, mineral compositions and bioactive compound constituents of bamboo shoots in a bid to determining its suitability as an edible vegetable or not.

2. Materials and Methods

2.1 Sample collection

Samples of fresh young shoots of bamboo were collected from Masha area. Their outer, hard and fibrous portions were removed and discarded, while the inner fresh, tender and edible portion was washed with deionized water to remove the impurities and sunlight dried. After drying, the shoots were ground into a fine powder using a mortar and pestle, and then sieved and stored in a well labeled air-tight container for analysis.

2.2 Bioactive constituent evaluation

The bioactive constituent analyses include the Phenol determination, determination of Saponin, determination of Alkaloids, Flavonoids, terpenoid, quinons and tannins. All of these were determined based on methods of analyses described by AOAC [17].

2.3 Nutrient Analysis

The nutrient analysis of the samples for moisture, crude protein, fat, ash, fiber and total carbohydrate contents were carried out in triplicates according to standard methods AOAC [17] in JIJE Analytical Testing Service Laboratory in Addis Ababa, Ethiopia. While nitrogen was determined by micro-Kjeldahl method as described by Pearson [18] and the percentage nitrogen was converted to crude protein by multiplying the value with 6.25. To determine the total carbohydrate, the method of James [19]) based on the difference was employed.

2.4 Mineral Analysis

The mineral was analyzed by using atomic Absorption spectrophotometer (AAS) for the following metals: Ca, Na, K, Cu, Fe, Zn, Mg and Mn while the Flame Photometer was used in the analyses of K & Na.

3. Results and Discussion

3.1 phytochemical Analysis

The bioactive constituent screening methods detected the presence of a particular bioactive chemical in the methanolic and water extracts. Natural products belonging to saponins, terpenoids, tannins, alkaloids, quinons and flavonoids were shown to be present in both the methanolic and aqueous extracts. However, phenol was only found in the aqueous extract (Table 1). Phenols are strong antioxidants and play a role in the prevention and management of chronic diseases such as cancer and cardiovascular disease [20]. It had been reported that plant phenols may interfere with all stages of the cancer process resulting to reduction of cancer risk. The presence of alkaloid in plants part serves as a feeding repellent and toxin to herbivores since it directly interacts with special molecules at target sites within the nervous system. Studies have shown that saponin which was also detected have been used for treatment of hyperglycemia and that dietary source of saponins offer preferential chemopreventive strategy in lowering the risk of human cancer. Sofowora [21] reported that saponins exhibit a wide range of biological activities like anti-fungal, anti-inflammatory, anti-viral, anti-parasitic and anti-tumor activities. Another constituent of bamboo shoots was tannin. It had been reported that tannins are known to react with proteins to provide the typical tanning effect which is important for the treatment of inflamed or ulcerated tissues. Flavonoids, another constituent of *bamboo shoots* exhibited a wide range of biological activities like antimicrobial, anti-inflammatory, analgesic, anti-allergic, cytostatic and antioxidant properties [22]. The reported health benefits of *bamboo shoots* may be attributed to the presence of these phytochemical which could have been responsible for their medicinal values as well as physiological activities.

Table 1: Results of the phytochemical screening of *Bamboo tree shoots*

Phytochemical constituents	Solvents used	
	<u>Water (H₂O)</u>	<u>Methanol (CH₃OH)</u>
Alkaloids	+	+
Flavonoids	+	+
Terpenoid	+	+
Saponins	+	+
Quinones	+	+
Phenol	+	-
Tannin	+	+
Amino acid and proteins	+	+

3.2 Nutrient Analysis

The nutrient constituent analysis of bamboo shoots revealed that it contains an appreciable amount of carbohydrate 73.14%.

This value is higher than the values reported for leaves of *ipomoea batatas* (69.62%) [23], *pterocarpus soyansii* 46.66% and *pterocarpus santalinoides* 51.37% [24], but compared favorably with 73.08% in *Aloe barbadensis leaves* [25]. Carbohydrate serves as stored forms of energy as glycogen in liver and muscles. It also provides major source of energy and responsible for breaking-down of fatty acids and preventing ketosis [26]. The plant is a good source of carbohydrate but to meets the Recommended Dietary Allowance (RDA) values e.g. children (40%), adults (40%), pregnant women (30%) and lactating mothers (25%) [22]. It should be taken in lower quantities.

Protein is used for building and repairing of body tissues, regulation of body processes and formation of enzymes and hormones. Proteins also aid in the formation of antibodies that enable the body to fight infection. Proteins serve as a major energy supplier [27]. Proteins are responsible for the formation of bones, teeth, hair and the outer layer of skin and they help maintain the structure of blood vessels and other tissues. The protein content of bamboo tree shoot is 8.04%. The value is relatively lower compared to the 35.9% reported by [28] for calabash seed, 43.1% for luffa cylindrical kernel [29] and the 23.7-30.8% for gourd seed ([30]. The result revealed that the leaves of *bamboo* shoots are sources of protein.

The crude fat content of bamboo shoot was 2.25 %, which were low in amount when compared to those of groundnut (43%) [31], *alinum triangulare* (5.09%), *Amarantus hybridus* (4.80%) [32], leaves of *mucuna poggi* (9.45%) [33] and calabash seed (43%) [28]. Crude lipids are the principal sources of energy but should be

consumed with caution so as to avoid obesity and other related diseases. A diet providing 1-2% of its caloric energy as fat is sufficient in human beings as excessive consumption has been implicated in certain cardiovascular disorders such as atherosclerosis, cancer and aging [34]. The findings of this study showed that, the bamboo shoots are a poor source of plant fat (lipid), which is in good agreement with general observation that leafy vegetables are low lipid containing food, thus, advantages health use in avoiding obesity [35].

The crude fiber content of bamboo shoot was 18.81%. This value is higher than that of *Gnetum africanum* (4.60%), and *M. ureans* (4.00%) *Parinari polyandra* [36]. It is lower than leaves of *M. poggi* (30.38%) [33]. Bamboo shoots have been recognized as an excellent source of fiber, which is an important consideration for people who suffer from elevated cholesterol levels and in helping to cleanse the colon [37]. A number of studies have indicated that components of plants such as dietary fiber have beneficial effects in lowering blood cholesterol levels aside from the decreased intake of saturated fat and cholesterol that occurs with high intakes of plant foods [38]. Fibre cleanses the digestive tract, by removing potential carcinogens from the body and prevents the absorption of excess cholesterol [39]. Finally fiber binds to cancer-causing chemicals, keeping them away from the cells lining the colon, providing yet another line of protection from colon cancer [40]. The substantial amount of fiber in vegetables shows that they can help in keeping the digestive system healthy and functioning properly. Thus, the bamboo tree shoots could be valuable sources of dietary fiber.

The ash content of bamboo shoot was 14.41%. The value obtained is higher compared to 1.8% reported in sweet potato leaves [41], 10.83% in water spinach leaves and 5% in *Tribulus terrestris* leaves, but lower than 19.61% in *Amaranthus hybridus* leaves [42], and 18.00% Balsam apple leaves [26]. The value is compared favorably with 13.74±0.013% of *Ipomoea batatas* leaves [23]. The ash contents of the leaves are an indication that the leaves contain nutritionally important mineral elements. Therefore, the *bamboo* shoots contained a good amount of minerals.

The moisture content of bamboo shoot was 2.98%. It is lower than the values reported for *C. aconitifolius* leaves (5. 35%) [22]. The moisture content of food is used as a measure of stability and susceptibility to microbial contamination. The low moisture content of the leaves would hinder the growth of micro organisms and shelf life could be higher. This suggests that dried *bamboo shoot* will not promote microbial growth and enzyme activity since its water content is low.

3.3 Mineral Content Analysis

The mineral compositions of bamboo shoots were evaluated in the present study. Potassium is necessary for the function of all living cells and is thus present in all plant and animal tissues. Epidemiological studies and studies in animals subject to hypertension indicate that, diets high in potassium can reduce the risk of hypertension and possibly stroke. The present study revealed that the potassium content of bamboo shoots was 6324.101mg/100g. The value obtained is higher compared to 3608.854mg/100gm reported for *ipomoea batatas* leaves [23]. Thus, bamboo shoots could serve as a good source of potassium for the hypertensive patient especially pregnant women that are prone to high blood pressure toward the period of delivery.

Sodium is an essential element that is necessary for humans to maintain the balance of the physical fluids system. It is also required for nerve and muscle functioning. Sodium content of bamboo shoot was 19.164mg/100g. This value is lower than 805.60 ± 0.01 mg/100g and 196.80 ± 0.02 mg/100g reported for the leaves and stems of *Balanites aegyptiaca* ([43]). It is higher when compared to 17.95mg/100g in leaves of *M. areboeus* and 15.83mg/100g in *S. sparganophora* [20]. Sodium is associated with Potassium in the body in maintaining acid-base balance and nerve transmissions. High concentration of Sodium is disadvantageous because Potassium depresses blood pressure while Sodium raises blood pressure, thus the level of Sodium in this shoot would be suitable for health when consumed.

Magnesium is an important mineral element in connection with circulatory diseases such as ischemic heart disease and calcium metabolism in bone [26, 45]. The magnesium content of bamboo shoot was 390.mg/100g, which is higher compared with 2.56mg/100g in *Diospyros mespiliformis* [46], 23.18mg/100g of *Amaranthus hybridus* leaves [42] but, lower than 400.00 mg/100g in *Cassia siamea* leaves [47].

Calcium is an important component of a healthy diet and a mineral necessary for life. It plays an important role in building strong and dense as well as in the keeping of healthy bones and teeth both early and later in life. Calcium contents of bamboo shoots were 60.449mg/100g. It is higher than the values obtained for spinach 14.55mg/100g, okra 50.8mg/100g but, less than soybean 480mg/100g [48]. Therefore, it is possible for bamboo shoots to serve as a rich source of minerals involved in bone formation.

Copper has a number of important functions in the human body. It helps to produce red and white blood cells and triggers the release of iron to form hemoglobin (the substance that carries oxygen around the body). Copper content of bamboo shoot was 1.429mg/100g. The result of the present study shows that, the bamboo shoots are good sources of copper relative to its recommended dietary allowance (RDA) of 1.5-3 mg/day for adult male and female, pregnant and lactating mothers and 1-3 mg/day for children 7-10 years [49].

Iron is required for hemoglobin formation and its deficiency leads to anemia [50]. The iron content of bamboo shoot was found to be 13.594mg/100g which is higher than 2.80mg/100g in *T. terrestris*, in some cultivated vegetables such as spinach (1.6mg/100g) lettuce (0.7mg/100g) and cabbage (0.3mg/100g) [50], but lower than 84.4mg/100g in *Helminthostachys sp.* The bamboo shoots are rich sources of iron, and could be of good use to pregnant women and lactating mothers. Generally for women since they loss some quantity of blood during monthly menstruation, it could help in the nourishing of their bodies.

Manganese plays an important role in number of physiologic processes as a constituent of some enzymes and an activator of other enzymes. Concentration of manganese in bamboo shoots was found to be 2.895mg/100g which is lower than 5.82mg/100gm of launaea leaves [51], but higher than 0.43% of *I. astragalina* leaves [52]. When compared to the RDA for manganese which are 2-5 mg/day for adult male and female, pregnant and lactating mothers and 2-3mg/day for children (7-10 years) (NRC, 1989), the bamboo shoots of this plant can serve as a manganese supplement because amount of manganese in the shoots of bamboo is an indication that it could serve as a good source of manganese, since the result compared favorably with the daily requirements recommended by RDA for children and adult male and female.

As an essential element in the nutrition of man, zinc functions as an integral part of numerous enzymes or as a stabilizer of the molecular structure of sub-cellular constituents of membrane as well participates in the synthesis and degradation of carbohydrates, lipids, proteins, nucleic acids and has shown to play an essential role in polynucleotide transcription and translation and thus in the process of genetic expression [33]. Zinc concentration in the bamboo shoot was found to be 9.965mg/100g which is higher than *C. aconitifolius* leaves (0.02mg/100g) [22]. It is lower than *P. biglobosa* flower (17.8mg/100gm) [53]. Zinc content of this plant can serve as a zinc supplement when compared to the zinc RDA of 10 mg/day for children (7-10 years), 12 mg/day for adult female, thus, bamboo shoots could be beneficial for children and adult females, but cannot serve as a zinc supplement when compared to the zinc RDA of 15 mg/day for adult male and 19 mg/day for pregnant and lactating mothers [49], to meet the recommended requirements more quantities should be taken.

4. Conclusion:

The bamboo shoots revealed that the plants contain an appreciable amount of proteins, crude fibre, lipid, carbohydrate and minerals. Bioactive constituents such as saponins, tannins, flavonoids, alkaloids, quinons and phenol were also found in the plants whose presence serve for different therapeutic uses. Since it contains substantial amount of nutrients and bioactive constituents, it can therefore be concluded that *bamboo shoots* can contribute significantly to the human nutrient requirements and could be used as a good source of nutrients supplement and as medicine.

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