

# Evaluation of Biochemical and Nutritional composition of Tray Dried Bamboo Shoot (*Bambusa balcooa*) Powder (BSP)

Anjana Bora<sup>1</sup>, Sasikala. S\*, Sandra Aveena Monis<sup>1</sup>, Vinothini K<sup>1</sup>

<sup>1</sup>Department of Food Process Engineering, SRM University, Kattankulathur, Chennai, India

**Abstract:** - This paper investigated the study of biochemical and nutritional content of tray dried edible bamboo shoot (*Bambusa balcooa*) powder (BSP). The biochemical and nutritional analysis of bamboo shoot powder of *Bambusa balcooa* results showed that it contained 90.78 % moisture, 0.88% ash, 0.28% fat, %2.96 protein, 5.28% carbohydrate. The colour analysis of bamboo shoot powder was performed using Hunter colorimeter. The present study indicated that the bamboo shoot powder (BSP) could significantly use as a food additive on the basis of its nutritional composition in different food applications.

**Keywords:** Bamboo shoot; bamboo shoot powder (BSP); *Bambusa balcooa*; biochemical and nutritional composition; color analysis.

## I. INTRODUCTION

Bamboo plant is basically a grass, belonging to family Poaceae and it is spread over 1,250 species under 75 genera in the world (1). Out of these, about 136 species under 23 genera are available only in India (2).

Bamboo shoots are young edible bamboo plant that have just emerged from the ground and constitute a range of traditional delicacies. Bamboo shoots are generally 20-30 cm long, tapering at one end and weigh almost one pound. The shooting period of bamboo varies from species to species. Broadly, the temperate climate bamboos are runners, which shoot in the spring, while the tropical and subtropical varieties are clumpers, they shoot in the late summer and fall. The freshly harvested bamboo shoot is cream yellow in color. When a newly harvested bamboo shoot is peeled, it gives a strong smell and bitter taste (3). All species of bamboo shoots available in the world are not edible. Out of 136 species available in India, the most commonly edible bamboo species are *Bambusa balcooa*, *Bambusa pallida*, *Bambusa tulda*, *Bambusa polymorpha*, *Dendrocalamus hamiltonii*, *Dendrocalamus giganteus* and *Melocanna bambusoides* (2).

Bamboo shoots are found in China, Japan, US, North East India, Thailand, Nepal, Bhutan, Korea, Australia, New Zealand, Malaysia and Indonesia. Bamboo shoots are very important constituent in stir fry and in some traditional items in the Asian countries. About 462.8 tonnes of bamboo shoots are harvested every year in the North eastern states of India. In India, use of bamboo shoots is still limited to North-East region and some other

hilly parts in south. The analysis of bamboo shoots to understand its nutritional values is already highlighted by many researchers (4, 5, 6, 7, 8, 9). The conclusions were proposed that bamboo shoots are highly nutritious and therapeutically rich. Bamboo shoots are low in fat and cholesterol content but very high in potassium, carbohydrates and dietary fibre. Many nutritious and active materials such as vitamins, amino acids and antioxidants such as flavones, phenols and sterols are present in bamboo shoot.

### Nutrient Value of Bamboo Shoots

Bamboo shoots are low in cholesterol and saturated fats contents (total fats 0.5%), are high in carbohydrates (5.70%), protein (3.9%), minerals (1.1%) and moisture (88.8%) (10). It is also a good source of Vitamin E ( $\alpha$ -Tocopherol), Vitamin C, B6, thiamin, riboflavin, niacin, and dietary fibers like hemicelluloses, cellulose, pectin, lignin (9). It has been reported that bamboo shoots can significantly decrease serum total and serum LDL cholesterol in rats and total liver lipids including liver cholesterol by 16.1 mg/dl. With 17 different types of amino acids, it contains over 10 kinds of mineral elements i.e., Cr, Zn, Mn, Mg, Ni, Co, Cu; Lysine.

Bamboo shoots have also been reported to be rich in both phenols and phytosterols. Eight phenolic compounds, viz., protocatechuic acid, hydroxybenzoic acid, catechin, caffeic acid, chlorogenic acid, syringic acid, p-coumaric acid and ferulic acid were identified from *P. pubescens* and *P. nigra* (10). Bamboo shoots, both fresh and fermented are good source of phytosterols. The level of total phytosterols in bamboo shoots ranges from 0.12% to 0.19 % on a dry weight basis in different species of bamboos (11).

Bamboo shoots are rich in both amino acids and antioxidants and taste fresh, crisp with aromatic quality, and are delicious. Therefore, they are usually called "the top grade vegetable" (12,13). Shoots also contain various flavonoids, phenols and phenolic acids (phytochemicals) which are potent anti-oxidants and may have anti-cancer, antibacterial and anti-fungal properties (14, 15).

The key advantage of using dried bamboo shoot powder is its low moisture content which may allow its direct use into various dry food items, and preparing chutney and beverages. Other advantages of using dried

bamboo shoot based powder may include free-flowing, ease of handling and weighing, reduced storage space, ease of cleaning and sanitary aspects. In Japan, bamboo shoot-based powder is used as an essence in cookies and various other food items. Japanese use bamboo powder in standard bread flour and also recommends a 3–8% addition of the powder to any food products (16). In China, bamboo juice produced by pressure-cooking, is used to make beverages and specific liquors, apart from medicines (17). With a characteristic bamboo aroma and beer flavor, bamboo juice beers show a good number of health benefits by lowering blood lipids and fighting heart ailments (18, 19). Therefore, it is necessary to create more options in bamboo shoot processing. Unfortunately, the common people is unaware of their qualities as a food supplement and so till to date bamboos are mainly used for pulping for paper, fuel and fodder purposes. But in reality it can be used as a healthy food supplement. There is an urgent need to exploit the inherent values of bamboos which are rich in all the goodness of nature to be promoted as health foods as well as a food additive in various food applications.

The aim of this study was to evaluate the biochemical and nutritional contents of tray dried bamboo shoot powder (BSP) obtained from the *Bambusa balcooa*.

## II. MATERIALS AND METHODS

### A. Collection of Raw Materials

The edible bamboo shoot samples of *Bambusa balcooa* (Local name: Bhaluka) were collected from Guwahati, Assam, India. The samples were transported to the Department laboratory within 24 h and further studies had been carried out. In department laboratory the shoots were defoliated and washed properly. The unwanted parts were removed and the soft edible portions were used for preliminary studies. The shoots were stored at 4 °C till further processing.

### B. Preparation of Bamboo Shoot Powder (BSP)

The washed shoots were cut into smaller pieces and blanched for 30 min by changing the water after every 10 min. Then it was dried in tray dryer at 70°C (9) until it reached 5% equilibrium moisture content. Dried pieces of bamboo shoots were ground to get powder and sealed & stored in airtight food grade polyethylene terephthalate (PET) container. The BSP was further tested for nutritional analysis and antioxidant activity.

### C. Bio-Chemical and Nutritional Analysis of BSP

#### I. moisture content:

The moisture was determined by AOAC method (20). Briefly, 10 g of the sample was subjected to 105±3 °C in the oven for 5 hours and the moisture content determined gravimetrically.

$$\% \text{ moisture content} = \frac{(\text{initial weight} - \text{final weight})}{\text{initial weight}} \times 100$$

#### II. ash content:

The ash content was gravimetrically determined by incinerating the sample in a muffle furnace at 550±15°C for 24hours.(20)

Ash content was determined by using the following formula

$$\text{Ash content (g)} = \frac{M_2 - M_1}{M} \times 100$$

#### III. carbohydrate:

Carbohydrate was determined by using Anthrone reagent method.

#### IV. protein content :

The crude protein (N×6.25) was determined by using micro kjeldahl method.

#### V. fat content:

Fat content was determined gravimetrically after extraction with petroleum ether in soxhlet apparatus reported by AOAC (21).

Analysis of carbohydrate, protein, fat, ash, moisture, acidity, TSS were performed for three replicates. Methods used for the estimation were standard methods suggested by AOAC (21) and Ranganna (22).

#### D. Colour Analysis of BSP

The colour parameter of bamboo shoot powder was monitored by evaluating Hunter L\*, a\* and b\* values using Hunter Colori meter. L\* (lightness), a\* (redness) and b\* (yellowness) values were measured for bamboo shoot powder in three replicates.

## III. STATISTICAL ANALYSIS

Three independent experimental trials of the study were conducted. Mean values for various parameters were calculated and were analyzed by one-way ANOVA using the SPSS software for windows (version 20).The values were presented as mean along with standard error (Mean ± Standard error).

## IV. RESULTS AND DISCUSSION

### A. Bio-chemical and Nutritional Analysis of Bamboo Shoot Powder (*Bambusa balcooa*)

Quality evaluation of bamboo shoot powder was affirmed in terms of chemical and nutritional analyses of constituents such as percent moisture, ash, carbohydrate, protein, fat, TSS and pH. In **Table I** the values for nutritional and chemical constituents of BSP are shown. Bamboo shoot powder of *Bambusa balcooa* has 90.78 per cent moisture, ash 0.88 %, carbohydrate 5.28%, protein 2.96%, fat 0.28 percent. Hence earlier studies by Bhatt *et al.*(4) had reported 94.70 per cent moisture content which was on the higher side when compared with present values of this study. The results of the present study are close to the values reported by Kumbhare & Bhargava, (6) who reported 0.90 per cent ash in *Bambusa nutans* and

0.80 per cent in *Dendrocalamus asper* and *Bambusa vulgaris*. Qui (24); Ferreira et al.(25) had reported that the protein constituent present in different bamboo shoot species were in the range of (1.49) to (4.04) percent. The results are in close agreement with Sharma et al.(26) who reported the fat content to be 0.20 percent whereas, Anonymous, (27) reported 0.50 percent fat content which is considerably on higher side of the present study. Whereas the study performed by Gopalan et al. (28) had reported that the carbohydrate constituent ranged from (4.32) to (6.92)% in different bamboo shoot species. TSS was calculated as 0.90° Brix in the bamboo shoot powder and pH was calculated as 5.07. The nutritional evaluation of bamboo shoot powder from *Bambusa balcooa* showed since it is rich in carbohydrate and low in fat it can be recommended for eating purposes and can be useful for diabetic and cardiac patients. Moreover, it showed that the BSP can be used as a food supplement in various food applications too.

#### B. Colour Measurement of BSP by Hunter Colorimeter

In **Table II** the values for lightness (L\*), redness (a\*) and yellowness (b\*) obtained from colour measurement of BSP by Hunter colorimeter were mentioned. The BSP has a rich yellowness as the powder naturally appears as bright yellowish brown colour. The rich yellowish brown colour of the bamboo shoot powder could significantly enhance colour of other food stuffs by its addition to them.

#### V. CONCLUSION

The results of the present study indicated that the bamboo shoot powder (*Bambusa balcooa*) is a rich source of carbohydrate, good source of protein, less in fat content and also possesses mineral nutrients. It has a good bright yellow colour that could be used as additive to other food matrices for enhancement of colour. The high nutritive value with good source of mineral and fiber content of fresh bamboo shoots need to be explored for their potential for edible purposes. This is the initial study for the development of bamboo shoot powder of *Bambusa balcooa* and its biochemical and nutritional analyses. But it has a vast potential to be developed as a novel, innovative and promising healthy food additive or supplement in food industry. In very near future, Bamboo shoots are getting more popular as healthy and nutritionally supplemented edibles among the communities both rural and urban. Many different food products can also be made with the incorporation of nutritious bamboo shoot powder (BSP).

#### ACKNOWLEDGMENT

The authors are thankful to the HOD, Food Process Engineering Department and the Dean, School of Bioengineering, SRM University, for providing necessary facilities and continuous support to carry out the research work.

#### REFERENCES

- [1] Upreti TC, Sundriyal RC. Indigenous resources and community dependence: a case study from Arunachal Pradesh, India. *Grassroots Voices - A J Resour Dev.* 2001, 6(1-2):28-39
- [2] Sharma.L (1980). Bamboos in the Asia-Pacific region. In: Lessard G, Chouinard A (ed) *Bamboo research in Asia. Proceedings of a workshop held in Singapore.* International Development Research Centre, Ottawa, Canada. pp. 99-120
- [3] Sharma.L(1987) Inventory and resource of bamboos. In: Rao AN, Dhanarajan G, Sastry CB (eds) *Recent research on bamboo.* Proceedings of the International Bamboo Workshop, Hangzhou, China, 6th-14th October, 1985. Chinese Academy of Forestry, Beijing, China; International Development Research Centre, Ottawa, Canada. pp. 1-17.
- [4] Bhatt B.P., Singh K. and Singh A., Nutritional values of some commercial edible bamboospecies of North Eastern Himalayan region,India. *Journal of Bamboo and Rattan.* 4, 896-898 (2005).
- [5] Chen Y, Quin W, Li X, Gong J, Ni M. 1985. Study on chemical composition of ten species of bamboo. *Chem Ind For Prod* 5:39-46.
- [6] Kumbhare V. and Bhargava A., Effect of processing on nutritional value of central Indian Bamboo shoots. Part-1. *J. Food Sci.Tech.* 44, 29-31 (2007).
- [7] . Nirmala C., David E. and Sharma M.L., Changes in nutrient components during aging of emerging juvenile Bamboo shoots.*Int. J. Food Sci. Nut.* 53, 1-7 (2007).
- [8] Nirmala C., Sharma M.L. and David E., A comparative study of nutrients components of freshly harvested, fermented and canned Bamboo shoots of *Dendrocalamus giganteus* Munro. *J. Amer. Bamboo Soc.* 21, 33-39 (2008).
- [9] Satya S., Bal L.M., Singhal P. and Naik S. N.,Bamboo shoot processing: food quality and safety aspect (a review). *Trends in Food Science & Technology,* 21(4), 181-189(2010).
- [10] Park EJ, Jhon DY. 2010. The antioxidant, angiotensin converting enzyme inhibition activity, and phenolic compounds of bamboo shoot extracts. *Food Sci Techn* 43:655-9.
- [11] Sarangthem K, Singh TN. 2003c. Transformation of fermented bamboo (*Dendrocalamus asper*) shoots into phytosterols by microorganisms. *J Food Sci Tech* 40:622-5.
- [12] Xu S, Cao W, Song Y, Fang L. 2005. Analysis and evaluation of protein and
- [13] amino acid nutritional components of different species of bamboo shoots. *Food Sci* 26:222-7.
- [14] Zheng LW, Kai HH, Qi XS, Zhen HP. Bamboo resources, utilization and ex-situ conservation in Xishuangbanna, south-eastern China. *J Forest Res.* 2008;19(1):79-83
- [15] . Pandey A.K., OjhaV., Yadav S. and Sahu S.K., Phytochemical evaluation and radical scavenging activity of *Bauhinia variegata*, *Saraca asoka* and *Terminalia arjuna* barks. *Res. J. Phytochem.* 2, 89-97 (2011).
- [16] Gupta V.K., Kumria R., Garg M. and Gupta M., Recent updates on free radicals scavenging flavonoids: An overview. *Asian J. Plant Sci.* 9, 108-117 (2010).
- [17] Hua X (1987) Bamboo shoot cultivation and management in Japan. In: Symposium on bamboo professional commission of zhaihang forestry society, pp. 16
- [18] Qing BD, Zheng LW, Kai HH, Qi XS, Zhen HP. Bamboo resources, utilization and ex-situ conservation in Xishuangbanna, south-eastern China. *J Forest Res.* 2008;19(1):79-83.
- [19] Shi Q.T. and Yang K.S., Study on relationship between nutrients in bamboo shoots and human health. Proceedings of the International Symposium on Industrial Use of Bamboo, December 7-11, 1992,International Tropical Timber Organization and Chinese Academy, Beijing, China pp:338-346 (1992).
- [20] Satya.S,chal P, Prabhu VG, Bal LM, Sudhakar P (2009b).Exploring the nutraceutical potential and food safety aspect of bamboo shoot of some Indian species. VIII World Bamboo Conference, Bangkok, Thailand.
- [21] AOAC., Official Methods of Analysis.Association of Official Analytical Chemists. 11th edition Washington D C USA. P-240(2005).

- [22] AOAC., Official Methods of Analysis. Association of Official Analytical Chemists. 11th edition Washington D C USA. P-240(1990).
- [23] . Ranganna S., Handbook of analysis and quality control for fruit and vegetables products. 3rd edition. Tata McGraw-Hill (1995).
- [24] Blois, M.S. Antioxidant determinations by the use of a stable free radical. *Nature* 1958, *181*, 1199–1200.
- [25] Qiu FG. 1992. The recent development of bamboo foods. Proceedings of the International Symposium on Industrial Use of Bamboo. International Timber Organization and Chinese Academy of Forestry, Beijing, China: Bamboo and its Use. p 333–7.
- [26] Ferreira VLP, Azzini A, de Figueriredo IB, Salgado ALB, Barbieri MK. 1995. Evaluation of bamboo shoots for human consumption. *Coletanea do Instituto de Tecnologia de Alimento, Brazil* 16:23–36.
- [27] Sharma M.L., Nirmala C. and David R.E., Variations in nutrient and nutritional components of juvenile bamboo shoots. *Panjab Univ. Res. J.* 54: 101-104 (2004).
- [28] Anonymous., Cyanogenic glycosides in cassava and bamboo shoots, a human health risk assessment. Technical report series no. 28. Food Standards Australia New Zealand. (2004).
- [29] Gopalan C, Rmasastri BV, Balasubramanian SC. 1971. Nutritive value of Indian foods. *Hyderabad, India: Natl. Inst. of Nutrition.*

Table II

Colour Measurement of BSP by Hunter Colorimeter

Parameter	Value
Lightness; L	64.62±0.01
Redness; a	7.50±0.08
Yellowness; b	23.5±0.07

Table I

Bio-Chemical and Nutritional Composition of BSP (*Bambusa balcooa*)

Parameter	Value
Moisture%	90.78±0.01
Ash%	.88±0.005
Carbohydrate%	5.28±0.01
Protein%	2.96±0.08
Fat%	.28±0.005
pH	5.07±0.03
TSS(°Brix)	.90±0.06

All values are in Mean ± SD