

Quality Evaluation of Different Species of Edible Bamboo Shoots

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Abstract: Bamboo shoots are having immense potential of being used as health foods because of their richness in nutritional value. Four varieties of Edible Bamboo shoots viz. *Phyllostachys pubescens* (V₁), *Dendrocalamus asper* (V₂), *Dendrocalamus hemilltoni* (V₃) and *Bambusa bambos* (V₄) were used for the estimation of Quality attributes by using standard methodology. Results of the study showed that moisture, ash and fat contents of the four varieties was varied from 88.82-92.06; 0.80-0.90 per cent 0.29-0.39 per cent in V₁, V₂, V₃ and V₄, respectively. Whereas, fiber content was established as 1.29, 1.20, 1.50 and 1.42 per cent in V₁, V₂, V₃ and V₄ respectively. The values for protein content were calculated as 3.70, 3.43, 3.50 and 3.72 for V₁, V₂, V₃ and V₄ respectively. Shoots are also good source of minerals. Values for selenium and magnesium were 6.80, 6.70, 6.80 and 1.10 and 3.40, 4.50, 3.90 and 3.50 mg/100g, respectively for V₁, V₂, V₃ and V₄.

Keywords: Bamboo shoots, Nutritional value, Fat and Fiber contents

1. INTRODUCTION

Bamboo shoots are the emerging shoots which are just 12cm above the ground. This part of the bamboo is edible for human beings. Bamboo is one kind of vegetable for its being pollution free, low in fat, high in edible fibre and rich in mineral elements and considerable proportion of poly-unsaturated fatty acids. Thus, indicating a potential use as a source of therapeutic values. Bamboos play an important role in daily life of rural people especially tribals in numerous ways. The edible part of Bamboo i.e. shoot has an immense medicinal values. Presence of high quality vitamins, carbohydrates, proteins and minerals in Bamboo shoot and their easy availability to common man may help in solving nutritional deficiency of rural poor (Tripathi 1998). Bamboo shoots are rich in various nutrients, therefore an effort was made to evaluate some varieties of bamboo shoots for their nutrient content.

2. MATERIALS AND METHODS

In the present study, four different varieties of Bamboo shoots viz. *Phyllostachys pubescens* (v₁), *Dendrocalamus asper* (v₂), *Dendrocalamus hemilltoni* (v₃) and *Bambusa bambos* (v₄) were used for Quality evaluation.

Bamboo shoots were procured from the Division of Biotechnology, Institute of Himalayan Bio-resource Technology (IHBT), Palampur. Sheaths were manually removed. The shoots were washed under running tap water to remove adhered hairs and dust particles.

Methods used for the estimation were standard methods suggested by AOAC,1990 and Ranganna 1995.

3. RESULTS AND DISCUSSION

To ascertain quality parameters of Bamboo shoots, physical and chemical parameters were tested. The results are depicted in pertinent tables.

1. Physical Evaluation

The physical parameters of Quality evaluation included length, weight of shoot, width of shoot, weight of edible portion, peel per cent and per cent edible proportion. The relevant data have been depicted in Table 1.

*Dendrocalamus asper**Dendrocalamus hemilltoni**Phyllostachys pubescens**Bambusa bambos***Plate 1:** Different varieties of Bamboo shoots used for Quality evaluation

As is evident from the table, the shoot length was calculated as 24.56, 24.30, 26.50; 25.66 cm for varieties V₁, V₂, V₃ and V₄, respectively, while width was estimated as 5.0, 4.5, 7.0 and 3.5 cm respectively with an average of 5.0cm for the four varieties. Average weight for V₁, V₂, V₃ and V₄ was calculated as 275, 200, 300 and 250g respectively. The weight of the shoots varies with the size of the shoots.

Table 1. Physical Parameters of Bamboo Shoots

| Varieties | Length (cms) | Width (cms) | Wt. of shoot (g) | Peel (%) | Edible portion (%) |
|----------------|--------------|-------------|------------------|----------|--------------------|
| V ₁ | 24.56 | 5.00 | 275 | 70.90 | 29.10 |
| V ₂ | 24.30 | 4.50 | 200 | 67.50 | 32.50 |
| V ₃ | 26.50 | 7.00 | 300 | 66.67 | 33.33 |
| V ₄ | 25.66 | 3.50 | 250 | 70.00 | 30.00 |
| Mean | 25.25 | 5.00 | 256 | 68.77 | 31.23 |
| CD | 0.25 | 0.04 | 1.17 | 0.17 | 0.81 |

Edible portion is obtained after subtracting the weight of the peel from the weight of the shoot and data is expressed in the same table. Per cent edible portion was recorded to be 29.10, 32.50, 33.33 and 30.00 for same set of shoots.

2. Chemical/Nutritional Evaluation

Quality evaluation of Bamboo shoots was also affirmed on the basis of chemical analysis of varietal constituents viz., pH, Total Soluble Solids (° Brix), Acidity (%), Ascorbic acid (mg/100 g), Sugars and proximate composition.

Moisture

Estimation of moisture is widely used in testing the quality of foods. As the dry matter in food materials is inversely related to the amount of moisture it contains and it is directly related to stability, eating quality, nutritive value and processing requirements.

A perusal of data in Table 2 illustrates that four varieties of Bamboo shoots viz. *Phyllostachys pubescens*, *Dendrocalamus asper*, *Dendrocalamus hemilltoni* and *Bambusa bambos* contain 92.06, 88.82, 91.06 and 89.05 per cent moisture respectively.

Table 2. Chemical Parameters of Bamboo Shoots

| Varieties | Moisture (%) | Ash (%) | Protein (%) | Fat (%) | Fibre (%) | NDF (%) | ADF (%) | Lignin (%) | TFFA* |
|----------------|--------------|---------|-------------|---------|-----------|---------|---------|------------|-------|
| V ₁ | 92.06 | 0.90 | 3.70 | 0.39 | 1.29 | 2.62 | 2.17 | 0.56 | 0.13 |
| V ₂ | 88.82 | 0.80 | 3.43 | 0.30 | 1.20 | 2.18 | 1.81 | 0.47 | 0.12 |
| V ₃ | 91.06 | 0.81 | 3.50 | 0.29 | 1.50 | 2.54 | 2.08 | 0.49 | 0.11 |
| V ₄ | 89.05 | 0.85 | 3.72 | 0.25 | 1.42 | 2.32 | 2.03 | 0.53 | 0.11 |
| CD | 0.16 | 0.08 | 0.01 | 0.01 | 0.18 | 0.03 | 0.01 | 0.02 | NS |

*TFFA=Total Free Amino Acids

The variations in moisture content of four different varieties may be because of various factors like stage of maturity, time of harvesting, agro-climatic conditions and the varietal differences. Bhatt *et al.* (2005) reported 94.70 per cent moisture which is on the higher side when compared with the present values. Later on, Nirmala *et al.* (2007) reported the values in *Dendrocalamus asper* to be 89.40 per cent, close to the present result. A bit variation could be due to the maturity of samples coupled with the agro-climatic and varietal variations.

Ash

Ash content gives an index to the mineral matter in food materials. From the Table 5 it is clear that ash content obtained in four different varieties viz. *Phyllostachys pubescens*, *Dendrocalamus asper*, *Dendrocalamus hemilltoni* and *Bambusa bambos* was recorded in terms of 0.90, 0.80, 0.81 and 0.85 per cent. This shows that the varieties of V₂ and V₃ attain almost close value for ash content, whereas, V₁ and V₄ had slightly on higher side. The results of present study are close to the values reported by Kumbhare and Bhargava (2007) who reported 0.90 per cent ash in *Bambusa nutans* and 0.80 per cent in *Dendrocalamus asper* and *Bambusa vulgaris*. The results are in line with present study. It can be safely concluded that the ash content is the inherited quality of Bamboo and least affected by varietal variations, topography and cultural practices.

Protein

The estimation of crude protein reflects that total nitrogenous and non-nitrogenous proteins present in the sample. The values for protein in four different varieties were ranged as 3.43-3.72 per cent.

Later on in 2009, Satya *et al.* reported the values on the higher side i.e. 3.90 per cent. Bhatt *et al.* (1996) had also attained higher value (4.16) per cent in *Bambusa vulgaris*. This variation could be due to genetic variation of the varieties or because of the use of different conversion factor.

Fat

Table 2 depicts the per cent fat in four varieties of Bamboo shoots. The variety (V₁) attained the maximum (0.39) and V₄ minimum (0.25) per cent. Whereas V₂ and V₃ had the intermediate values i.e. 0.30 and 0.29 per cent. The results are in close agreement with Sharma *et al* 1998 who reported the fat content to be 0.20 per cent. Anonymous (2004) reported 0.50 per cent at content which is considerably on higher side of the present study.

This significant variation might be due to the basic genetic make-up of the Bamboos. The light falling on the surface also affects the composition and its quality characteristics.

Crude fibre

Crude fibre includes all materials which are indigestible in humans and non-remnants and also used as an index of maturity. Table 2 illustrate that the values for four different varieties as 1.29, 1.20, 1.50 and 1.42 per cent, respectively. Whereas, Kumbhare and Bhargava (2007) reported 0.76 per cent crude fibre which is on lower ebb. The variation might be due to varietal difference as well as the stage of maturity. The values for parameters under test are in line to the cited ones. This gives credence to the present findings.

NDF, ADF, Lignin and total free amino acid

Fractions of fibre i.e. NDF, ADF and Lignin were estimated in four varieties of Bamboo shoots. The values for NDF were reported as 2.62, 2.18, 2.54 and 2.32 per cent, respectively for V₁, V₂, V₃ and V₄ while the values for ADF were 2.17, 1.18, 2.08 and 2.03 for the same set of Bamboo shoots. The values for Lignin were estimated as 0.56, 0.47, 0.49 and 0.53 per cent. The results are in line to Nirmala *et al* (2008) who reported 2.65 per cent NDF, 2.15 per cent ADF and 0.56 per cent Lignin in Bamboo shoots. The values for parameters under reference are in agreement to the cited ones. Thus this gives credence to the present findings. Total free amino acids varied from 0.11 to 0.13 in four varieties. The results are similar to the findings of Kumbhare and Bhargava (2007).

pH

pH determines the acidity or alkalinity of a sample thereby, affecting the colour, flavor and texture of food. pH of four varieties of Bamboo shoots was calculated as 5.7, 6.2, 5.9 and 6.5 for V₁, V₂, V₃ and V₄ respectively, and reported in Table 3. The data is in line with Devi and Singh (1986) who reported an average value for pH 6.7 in Bamboo shoots. The slight variation could be varietal variation.

Table 3. Nutritional Parameters of Bamboo Shoots

| Varieties | pH | TSS (°Brix) | Acidity (%) | Ascorbic acid (mg/100g) | Sugars (%) | | |
|----------------|------|-------------|-------------|-------------------------|------------|----------|--------------|
| | | | | | Total | Reducing | Non-reducing |
| V ₁ | 5.70 | 1.20 | 0.32 | 3.20 | 1.11 | 0.72 | 0.37 |
| V ₂ | 6.20 | 1.60 | 0.16 | 4.80 | 1.22 | 0.81 | 0.43 |
| V ₃ | 5.90 | 0.90 | 0.28 | 5.30 | 0.80 | 0.41 | 0.37 |
| V ₄ | 6.50 | 0.80 | 0.15 | 4.90 | 0.74 | 0.34 | 0.38 |
| Mean | 6.07 | 1.12 | 0.28 | 4.55 | 0.97 | 0.57 | 0.38 |
| CD | 0.54 | 0.01 | 0.16 | 0.02 | 0.08 | 0.03 | 0.023 |

TSS

Total soluble solids consist of sugars and acids. It is also an index of the maturity of raw fruits and vegetables.

As evident from the Table 3, the values for TSS were recorded as 1.2, 1.6, 0.9 and 0.8 degree Brix in V₁, V₂, V₃ and V₄, respectively. No reference could be cited in literature on this parameter to support the present study.

Acidity

The acidity of Bamboo is largely due to the presence of citric acid which is a predominant acid present in Bamboo shoots.

The Table 3 reports the values for per cent acidity in *Phyllostachys pubescens*, *Dendrocalamus asper*, *Dendrocalamus hemilltoni* and *Bambusa bambos* was calculated as 0.32, 0.16, 0.28 and 0.35 per cent. The results obtained are in close agreement with Devi and Singh (1986) who reported 0.20 per cent acidity in Bamboo shoots.

Ascorbic acid

Table 3 depicts that the values for ascorbic acid (mg/100 g) were 3.2, 4.8, 5.3 and 4.9 mg/100g for V₁, V₂, V₃ and V₄, respectively, Bhatt and associates in the year 2005 also reported 5.3 mg/100 g ascorbic acid and thereafter, Nirmala *et al.* in 2007 also reported 3.2 mg/100 g ascorbic acid in Bamboo shoots. The results in the present study are in accordance to them.

Sugars

The sugars impart the sweetness in the products. Data regarding the values for Total sugars, Reducing sugars and Non- reducing sugars has been depicted in Table 6. Next parameter is Total sugars, the values calculated were 1.11, 1.22, 0.80 and 0.74 for V₁, V₂, V₃ and V₄ respectively. Devi and Singh (1986) reported 0.78 percent Total sugars. Reducing sugar content was estimated as 0.72, 0.81, 0.41 and 0.34 for same set of Bamboo shoots. Khumbhare and Bhargava (2007) reported 1.05 per cent reducing sugars in *Bambusa nutans*. The difference in values is due to varietal difference. The non-reducing sugars content was estimated as 0.37, 0.43, 0.37 and 0.38 for V₁, V₂, V₃ and V₄, respectively thus corroborating the pre findings.

Mineral content of Bamboo shoots

The mineral elements which were analyzed in the four varieties of Bamboo shoots include Calcium, Copper, Sodium, Potassium, Phosphorus, Selenium and Magnesium.

Table 4 depicts that the values for calcium were 13.00, 11.00, 15.00 and 12.00mg/100g for V₁, V₂, V₃ and V₄, respectively. However, Copper content was estimated to be 0.19, 0.25, 0.29 and 0.15mg/100g for V₁, V₂, V₃ and V₄, respectively. Sodium was estimated as 4.00, 4.10, 4.80 and 3.50mg/100g in V₁, V₂, V₃ and V₄ respectively.

Whereas, potassium (mg/100 g) was found to be 459.00, 503.00, 533.00, 521.00 for four varieties. Phosphorus was calculated as 55.00, 59.00, 61.00 and 65.00. Values for selenium and magnesium were 6.80, 6.70, 6.80 and 1.10 and 3.40, 4.50, 3.90 and 3.50 mg/100g, respectively for V₁, V₂, V₃ and V₄.

Table 4. Mineral Content of Bamboo Shoots

| Varieties | Calcium (mg/ 100g) | Copper (mg/ 100g) | Sodium (mg/ 100g) | Potassium (mg/ 100g) | Phosphorus (mg/100g) | Selenium (ug/ 100g) | Magnesium (mg/ 100g) |
|----------------|--------------------|-------------------|-------------------|----------------------|----------------------|---------------------|----------------------|
| V ₁ | 13.00 | 0.19 | 4.00 | 459.00 | 55.00 | 6.80 | 3.40 |
| V ₂ | 11.00 | 0.25 | 4.10 | 503.00 | 59.00 | 6.70 | 4.50 |
| V ₃ | 15.00 | 0.29 | 4.80 | 533.00 | 61.00 | 6.80 | 3.90 |
| V ₄ | 12.00 | 0.15 | 3.50 | 521.00 | 65.00 | 1.10 | 3.50 |
| CD | 0.10 | 0.09 | 0.80 | NS | NS | 0.12 | 0.08 |

In the year 2007, Jetvig analyzed Bamboo samples for their mineral composition. The values for calcium (10mg), magnesium (2mg), phosphorus (45mg), potassium (402mg) and sodium (3mg). the slight difference could be due to varietal difference and agro-climatic reasons.

4. CONCLUSION

From the foregoing discussion it is inferred that bamboo shoots are good source of all the nutrients. Amongst all the varieties *Dendrocalamus hemilltoni* which is grown abundantly in the region was found best in terms of quality parameters. These shoots can be exploited for the development of various value added products to add new dimension in the market.

REFERENCES

Anonymous. 2004. www.Bamboo shoots.com
 AOAC 1990. Approved methods of association of official analytical chemists. Washington D.C. U.S.A. 11th edition. P- 240.
 Bhargava A, Kumbhare V, Srivastava A and Sahai A. 1996. Bamboo parts and seeds for additional source of nutrition. *Journal of Food Science and Technology* 33(2) : 145- 146.
 Bhatt BP Singh K and Singh A. 2005. Nutritional values of some commercial edible Bamboo species of North Eastern Himalayan Region, India. *Journal of Bamboo and Rattan* 4(2): 111-124.
 Devi SP and Singh HT. 1986. Studies on the chemical and nutritional changes of Bamboo shoots during fermentation. *Journal of Food Science and Technology* 23: 338- 339
 Jegtig Shereen. 2007. www.Bamboo shoots.com.
 Kumbhare Vishakha and Bhargava Alka. 2007. Effect of processing on nutritional value of central Indian Bamboo shoots.part- 1. *Journal of Food Science and Technology* 44(1): 29- 31.

- Nirmala C, David E and Sharma ML. 2007. Changes in nutrient components during ageing of emerging juvenile Bamboo shoots. *International Journal of Food Science and Nutrition* : 1-7.
- Nirmala C, Sharma ML and David E.2008. A comparative study of nutrients components of freshly harvested, fermented and canned Bamboo shoots of *Dendrocalamus giganteus* Munro. *The Journal of America Bamboo Society*. 21(1): 33- 39.
- Ranganna S. 1995. Handbook of analysis and quality control for fruits and vegetables products. 3rdedition
- Roohani E David, Richa and Nirmala C. 2001. Nutritive value of Edible shoots of two Exotic Indian Bamboos. *Acta Horticulturae*. 752:1
- Satya Santosh, M. Bal, Lalit SP and Naik SN. 2009. Food quality and safety aspect (a review). *Trends in food science and technology*. 21(4) : 181-189
- Sharma S, Dhaliwal, YS and Kalia M. 1998. Candied Apples : a new Perspective. *Journal of Food Science and Technology* 35 : 79-82
- Tripathi YC. 1998. Food and nutrition potential of Bamboo. *MFP- News*. 8(1) : 10-11