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## Studies on standardization and organoleptic properties of bamboo shoots based pickle

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### Abstract

Bamboo is a natural resource which is wide spread globally. The young and tender bamboo plant, called bamboo shoot, is utilized as one of the food items in many countries. Bamboo shoots are low in fat and cholesterol content and high in potassium, carbohydrates and dietary fibers. Fresh bamboo the edible part has a high nutrient content. Bamboo shoots are a good source of edible fibre which helps in lowering the blood cholesterol. Fat content is extremely low in bamboo shoots that are, very good for weight conscious and dietary people. In India, shoots of *Bambusa vulgaris* are used as vegetable and pickle products. The samples were pre-processed by steaming, soaking and boiling for removing the bitterness. Among different Pre-treatments, soaking in 2% salt solution for 4 hours and boiling in water for 10 minutes was found to have less bitterness and recorded high sensory scores. The initial acid content of bamboo shoot pickle was 1.86 g per cent. The corresponding value of bamboo shoot pickle after five month was 2.5g and 2.47 g percent respectively. A gradual reduction in the pH of bamboo shoot pickle was observed throughout the storage period between treatments. Initially the pH of bamboo shoot pickle was 3.72 of Sodium benzoate (T<sub>1</sub>) and Without Sodium benzoate (T<sub>2</sub>). At the end of 150 days of storage pH was 3.11 in T<sub>1</sub> and 3.21 in T<sub>2</sub> respectively. An increasing trend in the reducing sugar content was observed throughout the storage period in all the samples. The reduction in the total sugar content of bamboo shoot pickle packed in glass bottle was found to be remarkable between the first day and 150 days of storage. An decreasing trend in the fat content was observed throughout the storage period in all the samples. The Mean score of bamboo shoots pickle was organoleptically evaluated. The colour and appearance, texture of bamboo shoots pickle was high in 8.0 when compared to favour (7.5). Taste was higher range (8.5) of bamboo shoot pickle. Overall acceptable of bamboo shoots was higher (8.0). The microbial load viz., total plate count, yeast and mould count of bamboo shoot pickle was Below Detectable Level (BDL) on 0 day (initial) of storage period. At the end of the 150 days of storage, the bamboo shoot pickle showed high in total plate count (8 cfu/ml) of T<sub>2</sub> sample when compared to T<sub>1</sub> sample. So storage study of the bamboo shoot pickle was acceptable for 150 days.

**Keywords:** Bamboo shoots, therapeutic properties, bamboo shoots pickle, organoleptic evaluation and microbial load

### Introduction

Bamboo shoot is considered as a traditional cuisine in different countries. As bamboo shoots content low fat, high potassium content, carbohydrate, vitamins and minerals etc., it is widely used by the people of India and outside. Bamboo shoots are consumed in different form. It is having good nutritional qualities as well as medicinal value. It is largely consumed by the tribes as they collect from the forest and consumed as a vegetable. Bamboos play an important role in daily life of rural people especially tribals in numerous ways, from house construction, agricultural implements to provide food, fodder etc. The edible parts of bamboo, i.e. shoot has a high nutritive content. 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) [1].

Bamboo shoots are the young and tender culms of bamboo that are traditionally consumed for various food items after harvesting. Bamboo shoots form a traditional delicacy in many countries. The freshly harvested shoot is cream yellow in color, has a strong smell and is sweet in taste. Bamboo shoots are presently among the most favorite food items among people all over the world, but there is hardly any organized bamboo shoot processing and marketing industry. Therefore, the product is being far off from standardization or globalization (Wongsakpaired, 2000) [13].

Bioactive component is a component contained in food and plays a role in human health. Bamboo shoots contain several phytochemical groups that have a role for health, namely phenolic compounds (flavonoids, phytoestrogens, and phenolic acids), carotenoids, saponins, phytosterols and phytostanol, and dietary fiber and prebiotics. (Chongtham *et al.*, 2011) [15].

Many nutritious and active materials such as vitamins, amino acids, and antioxidants such as flavones, phenols and steroids are present in the bamboo shoots. Bamboo shoots are valuable in pharmaceutical and food processing industries and can be processed into beverages, medicines, additives or health foods (Biswas, 2014) [2].

Bamboo shoot is one of the common food items in many countries and its popularity is growing day-by-day, as main or supplementary foodstuff. A thriving economy exists around bamboo and bamboo shoot based food items in the international market in terms of food security and nutrition. There exists great opportunity especially in the organized food processing sector to take up plantation, harvesting, processing and marketing of bamboo and bamboo shoots-based food products. Bamboo shoots can be dried, marinated, or sautéed to prepare various food items. Although fresh shoots (of *Dendrocalamus giganteus*) are healthier and nutritionally richer, (Nirmala *et al.*, 2008) [6] the younger shoots, later fortified, can be utilized for various small scale cottage industries by processing them into a wide range of long-standing products.

Value addition refers to any activity that enhances the value in the market thereby increasing its utility and profit. Value addition in bamboo shoots can be done by making different edible products; which will lead to cultivation of bamboo shoots by the farmers and help in their income generation.

Hence, the aim of this study is to Standardization and Organoleptic Properties of Bamboo Shoots Based Pickle.

### Material and Methods

Bamboo shoots were purchased from Department of forestry, perumal malai, Madurai. Non-perishable items Spices, oil and Sodium benzoate (KMS) were purchased in bulk from the local market. Glass bottles (capacity 200 ml) with caps were used for storing the prepared bamboo shoot pickle.

### Methods

#### Processing techniques of bamboo shoots

Bamboo shoot samples were pre-processed by steaming, soaking and boiling for removing the bitterness. Steaming – 5 min and 10 min, Boiling – 5mins (2% salt), 10 min (2% salt) and 15 min (2% salt), Soaking + boiling – 2 h+10 min (1% salt), 2 h+10 min (2% salt) and Soaking + boiling – 4 h+10 min (1% salt), 4 h+10 min (2% salt).

T<sub>1</sub> - Steaming – 5 min and 10 min

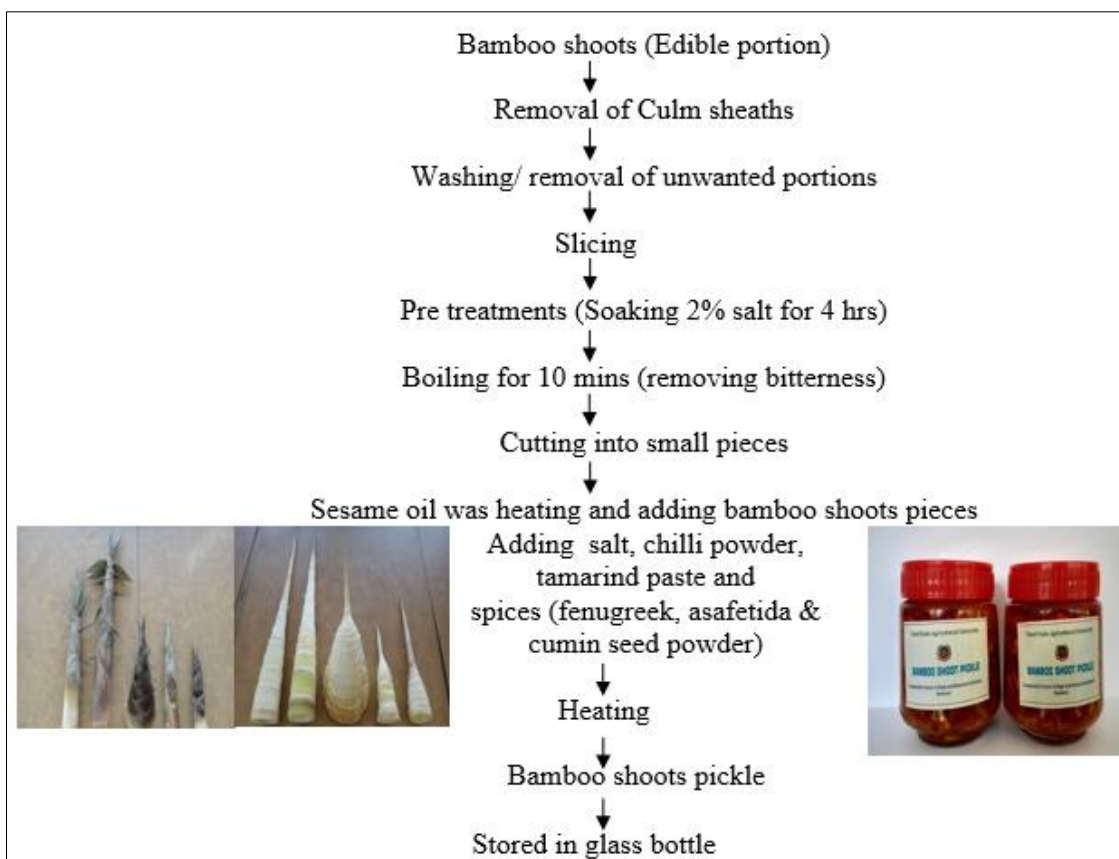
T<sub>2</sub> - Boiling – 5min (2% salt), 10 min (2% salt) and 15 min (2% salt)

T<sub>3</sub> - Soaking + boiling – 2 h+10 min (1% salt), 2 h+10 min (2% salt)

T<sub>4</sub> - Soaking + boiling – 4 h+10 min (1% salt), 4 h+10 min (2% salt)

Among different pre-treatments, soaking in 2% salt solution for 4 hours and boiling in water for 10 minutes (T<sub>4</sub>) was found to have less bitterness and recorded high sensory scores. The selected treatments and processed bamboo shoots were standardized and developed bamboo shoot pickle.

### Method of preparation



### Chemical analysis

The acidity, pH, Moisture protein and carbohydrate of the sample was estimated by the Ranganna (1995) [9]. The pH of the sample was estimated by the method described by Hart and Fischer (1971) [3]. The total and reducing sugar content of the sample was determined by the Shaffer Somogyi micro method described by MC Donald and Foley (1960) [5]. The microbiological load of the stored sample was enumerated at regular intervals by the methods described by Istawankiss (1984) [4].

### Organoleptic evaluation

The developed bamboo shoot pickle was evaluated for organoleptic characteristics namely colour, appearance, flavour, texture, taste and overall acceptability by using score card with nine point hedonic rating scale (9-1).

### Statistical analysis

The data obtained from the various experiments were subjected to statistical analysis to find out the impact of storage condition used and storage period. Factorial Completely Randomized Design (FCRD) was applied for the

analysis of the study as described by Rangaswamy (1995) [10].

## Result and Discussion

### Chemical characteristics of the fresh and processed bamboo shoots

The chemical characteristics of the fresh and processed bamboo shoots such as moisture, carbohydrate, protein fat and fibre are presented in Table - 1. The moisture content of the fresh bamboo shoots was recorded higher than the processed bamboo shoots which ranged between 77.8 and 86.2g respectively. The samples obtained from fresh bamboo shoots showed a slightly higher carbohydrate content than the samples processed bamboo shoots (3.18 g & 3.36 g/100 g). The control sample (fresh) showed a protein content of 2.53 whereas in the processed bamboo shoots sample ranged between 2.53 and 2.42 g/100 g respectively. A slight variation in the protein was noted between fresh and processed bamboo shoots. Bamboo shoots are known for their low fat content. The fat content was no changes in fresh (0.30 g) and processed bamboo shoots 0.30 g/100 g). A slight variation in the fibre content was noted between fresh and processed bamboo shoots 4.52 and 4.18g/100g respectively.

**Table 1:** Changes in Chemical characteristics of the fresh and processed bamboo shoots

S. No	Nutrient content (100 g)	Fresh bamboo shoots (control)	Processed bamboo shoots (T <sub>4</sub> )
1.	Moisture (g)	77.8	86.2
2.	Carbohydrate (g)	3.18	3.36
3.	Protein (g)	2.53	2.42
4.	Fat (g)	0.30	0.30
5.	Crude fibre (g)	4.52	4.18

### Processing of bamboo shoot pickle

The bamboo shoot pickle was prepared by using the processed bamboo shoots. Bamboo shoots pickle was prepared with (T<sub>1</sub>) and without preservatives (T<sub>2</sub>) and packed individually in glass types of containers such as glass bottle (P<sub>1</sub>). Bamboo shoots pickle was stored in room (R<sub>1</sub>) temperature for a period of 150 days to study their storage stability. The observations viz., chemical, microbiological and organoleptic evaluation were analyzed periodically (once in 30 days) throughout the study period for both the storage conditions in all the stored samples selected for the study.

### Chemical characteristics of bamboo shoot pickle

The chemical characteristics of the bamboo shoot pickle such as acidity, pH, fat, reducing and total sugar are presented in Table - 2.

### Acid content and pH

The changes observed in the acid content of the bamboo shoot pickle was given in table 2. A slight variation in the acid

content was observed between Sodium benzoate (T<sub>1</sub>) and Without Sodium benzoate (T<sub>2</sub>). There was an increasing in the acidity of the bamboo shoot pickle throughout the storage period. It may be due to leaching of organic acid from the pieces into slurry and oxidation of ascorbic to dehydro ascorbic acid. The initial acid content of bamboo shoot pickle was 1.86 g per cent. The corresponding value of bamboo shoot pickle after five month was 2.5g and 2.47 g percent respectively.

Table 2 summarizes the changes in pH of bamboo shoot pickle. A gradual reduction in the pH of bamboo shoot pickle was observed throughout the storage period between treatments. Initially the pH of bamboo shoot pickle was 3.72 of Sodium benzoate (T<sub>1</sub>) and Without Sodium benzoate (T<sub>2</sub>). At the end of 150 days of storage pH was 3.11 in T<sub>1</sub> and 3.21 in T<sub>2</sub> respectively.

Statistical analysis of data revealed that there was significant difference between treatments and packing materials of the samples after six months of storage in nutrient contents.

**Table 2:** Changes in Acid content (%) and pH of bamboo shoot pickle during storage (g/100g)

Period of storage (days)	Acid (g)		pH	
	Sodium benzoate (T <sub>1</sub> )	Without Sodium benzoate (T <sub>2</sub> )	Sodium benzoate (T <sub>1</sub> )	Without Sodium benzoate (T <sub>2</sub> )
0	1.86	1.86	3.72	3.72
30	1.94	1.91	3.63	3.68
60	2.13	2.03	3.55	3.62
90	2.29	2.23	3.38	3.49
120	2.48	2.42	3.24	3.34
150	2.52	2.47	3.11	3.21

Source	SED	CD (0.05)	CD(0.01)
D	0.06293	0.06293	0.16587**
P	0.03364	0.06689	0.08866**
T	0.04120	0.08193	0.10859**
DP	0.08900	0.17698	0.23458**
PT	0.05826	0.11586	0.15357**
TD	0.10900	0.21676	0.28730**
DPT	0.15415	0.30654	0.40630**

Source	SED	CD (0.05)	CD(0.01)
D	0.03708	0.07374	0.09773**
P	0.01982	0.03941	0.05224**
T	0.02427	0.04827	0.06398**
DP	0.05244	0.10428	0.13822**
PT	0.03433	0.06827	0.09048**
TD	0.06423	0.12772	0.16928**
DPT	0.09083	0.18062	0.23940**

### Reducing and total sugar

Table 3. summarises the changes in reducing sugar content of bamboo shoot pickle during storage period. The initial reducing sugar content of the samples was 0.44 and 0.36 g per cent of bamboo shoot pickle. An increasing trend in the reducing sugar content was observed throughout the storage period in all the samples. The reducing sugar content was slightly higher in Without Sodium benzoate (T<sub>2</sub>) when compared to Sodium benzoate (T<sub>1</sub>) samples.

The reduction in the total sugar content of bamboo shoot

pickle packed in glass bottle was found to be remarkable between the first day and 150 days of storage. The initial total sugar content of bamboo shoot pickle with sodium benzoate (T<sub>1</sub>) 1.46 g per cent and without sodium benzoate (T<sub>2</sub>) 1.50 g per cent. The reduction was found to be gradual in all the samples. After a storage period of 150 days, there was found to be slightly higher in the bamboo shoot pickle.

Statistical analysis of data revealed that there was significant difference between treatments and packing materials of the samples after six months of storage in nutrient contents.

**Table 3:** Changes in reducing sugar (%) and total sugar (%) of bamboo shoot pickle during storage (g/100g)

Period of storage (days)	Reducing sugar (g)		Total sugar (g)	
	Sodium benzoate (T <sub>1</sub> )	Without Sodium benzoate (T <sub>2</sub> )	Sodium benzoate (T <sub>1</sub> )	Without Sodium benzoate (T <sub>2</sub> )
0	0.44	0.36	1.46	1.50
30	0.59	0.42	1.41	1.45
60	0.63	0.48	1.33	1.38
90	0.69	0.53	1.27	1.31
120	0.75	0.59	1.23	1.27
150	0.82	0.68	1.20	1.23

Source	SED	CD (0.05)	CD(0.01)
D	0.06154	0.12238	0.16221**
P	0.03290	0.06542	0.08670**
T	0.04029	0.08012	0.10619**
DP	0.08703	0.17307	0.22939**
PT	0.05698	0.11330	0.15017**
TD	0.10659	0.21197	0.28095**
DPT	0.15074	0.29977	0.39732**

Source	SED	CD (0.05)	CD(0.01)
D	0.11498	0.22866	0.30307**
P	0.06146	0.12222	0.16200**
T	0.07527	0.14969	0.19840**
DP	0.16261	0.32337	0.42860**
PT	0.10645	0.21170	0.28058**
TD	0.21170	0.21170	0.52492**
DPT	0.21170	0.21170	0.74236**

### Fat

Table 4. summarises the changes fat content of bamboo shoot pickle during storage period. The initial fat content of the

samples was 8.76 g per cent of bamboo shoot pickle. A decreasing trend in the fat content was observed throughout the storage period in all the samples.

**Table 4:** Changes in fat content (%) of bamboo shoot pickle during storage (g/100g)

Storage period (days)	Fat (g/100 g)
<b>Initial (0 day)</b>	
Sodium benzoate (T <sub>1</sub> )	8.76
Without Sodium benzoate (T <sub>2</sub> )	8.76
<b>Final (150 days)</b>	
Sodium benzoate (T <sub>1</sub> )	8.58
Without Sodium benzoate (T <sub>2</sub> )	8.54

### Organoleptic evaluation

The bamboo shoots pickle was organoleptically evaluated by using a panel of ten untrained judges with 9 to 1 hedonic scale (Table 5). The sensory attributes *viz.*, colour and appearance, flavour, taste, texture and overall acceptability of the bamboo shoot pickle showed slight variation in the 60 days (8.5 in T<sub>1</sub> and 8.0 T<sub>1</sub>) of storage period at room temperature. The change in the quality attributes directly influenced in the organoleptic

evaluation scores. As the storage period progress there was a slight change in the colour and appearance, flavour, taste, texture and overall acceptability of the product. At the end of 150 days of storage bamboo shoot pickle T<sub>1</sub> sample the sensory attributes *viz.*, colour and appearance, flavour, taste, texture and overall acceptability was higher in T<sub>1</sub> sample (8.0) when compared to T<sub>2</sub> sample (7.0).

**Table 5:** Organoleptic evaluation of bamboo shoot pickle

Storage period (days)	Organoleptic characteristics										
	Colour and Appearance		Flavour		Texture		Taste		Overall acceptability		
	T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>1</sub>	T <sub>2</sub>	
0 day	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
30 days	8.5	8.5	8.5	8.0	8.5	8.0	8.5	8.0	8.5	8.0	8.0
60 days	8.5	8.0	8.5	8.0	8.5	8.0	8.5	8.0	8.5	8.0	8.0
120 days	8.0	7.5	8.0	7.5	8.0	7.5	8.0	7.5	8.0	7.5	7.5
150 days	8.0	7.5	8.0	7.0	8.0	7.5	8.0	7.0	8.0	7.0	7.0

### Microbial load

The microbial load *viz.*, total plate count, yeast and mould count of bamboo shoot pickle was Below Detectable Level (BDL) on 0 day (initial) of storage period. At the end of the

150 days of storage, the bamboo shoot pickle showed high in total plate count (8 cfu/ml) of T<sub>2</sub> sample when compared to T<sub>1</sub> sample. So storage study of the bamboo shoot pickle was acceptable for 150 days. (Table 6).

**Table 6:** Changes in microbial load of bamboo shoot pickle during storage

Microbial load	Yeast & Mold (cfu/ml)	Total Plate Count (cfu/ml)	Yeast & Mold (cfu/ml)	Total Plate Count (cfu/ml)
Day	0 <sup>th</sup> (Initial)		150 <sup>th</sup> day (Final)	
Dilutions	10 <sup>3</sup>	10 <sup>5</sup>	10 <sup>3</sup>	10 <sup>5</sup>
T <sub>1</sub>	BDL	2	4	6
T <sub>2</sub>	BDL	2	6	8

### Cost benefit analysis

The final unit cost of bamboo shoot pickle Rs. 25.83/200g packed in glass bottles. The quantum of raw materials and type of packaging used for processing had influenced their final unit cost.

slight increase in the microbial population was observed in the product. Among the value added fruit product of bamboo shoot pickle had secured higher sensory score values. The final unit cost of bamboo shoot pickle was Rs. 25.83/200g packed in glass bottles. The unit cost of the prepared bamboo shoot pickle was found to be less than that of market sample.

### Conclusion

Bamboo is a plant species that incorporates several economic, ecological and social benefits in the day to day life of human beings. Therefore, organized cultivation for bamboo shoot may be encouraged. The young and tender bamboo plant, called bamboo shoot, is utilized as one of the food items in many countries. Bamboo shoots are low in fat and cholesterol content and high in potassium, carbohydrates and dietary fibers. Fresh bamboo the edible part has a high nutrient content. It could be possible to process value added products from bamboo shoot pickle. Storage condition and packaging the bamboo shoot pickle in suitable packaging materials (Glass bottles) could extend the shelf life of the product with minimum changes in the chemical composition. Value added fruit products of bamboo shoot pickle showed an increasing trend in acidity and reducing sugar whereas a decreasing trend in pH, total sugar and contents were noticed during storage. A

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