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Development and Shelf-life Evaluation of Value Added Edible Products from Bamboo Shoots

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ABSTRACT

Apart from the diverse uses of bamboo, the tender shoots, being low in fat, high in dietary fiber and rich in mineral content (good source of potassium) have been consumed traditionally by the people. The shoots are consumed due to their exotic taste, flavour, medicinal and nutritive value. Bamboo shoots are available for a limited period and have a short shelf-life, thus, they need to be processed and utilized immediately after harvest. Therefore, a study was conducted to determine the nutritional value and develop value added edible products from different bamboo species viz., *Dendrocalamus strictus*, *Bambusa bambos* and *Bambusa tulda*, found in central India and *Dendrocalamus asper* (known edible bamboo species of Thailand) grown in central India. Nutritional analysis revealed that the nutritive value of *D. strictus, B. bamboos* and *B. tulda* is at par with *D. asper*. Thus, these species have a potential for edible shoot production in central India. Different value added products viz., nuggets (bari), pickle and papad (cracker) were made from fresh bamboo shoots. Organoleptic, sensory and chemical evaluation done at monthly intervals, to determine the shelf-life of product, revealed that the products were good in taste, texture and quality for 6 months from the date of processing at ambient conditions (25-40°C) in poly propylene and glass containers. Value addition (by making different edible products) will increase the utilization of bamboo shoots and provide livelihood opportunities to the local population. Present study will be useful in optimum utilization of bamboo shoots.

Key words: *Dendrocalamus strictus,* central India, edible products, processing, value addition

INTRODUCTION

Bamboos, known for their multiple uses both in the traditional way for the rural people as well as the modern society, are gaining popularity worldwide in the utilization of its shoots as healthy and nutritious food (Xia, 1989; Giri and Janmejoy, 1992; Qiu, 1992; Shi and Yang, 1992; Sharma *et al*., 2004; Bhatt *et al*., 2005; Cheng, 2006; Nirmala *et al*., 2007). About 100 bamboo species are commonly grown for edible shoot production (Midmore, 1998; Collins and Keilar, 2005). Bamboo shoot is a newly emerging young culm arising from the rhizomes. The shoots are harvested as soon as they appear above the soil surface. The edible part of shoots is covered with thick sheath of leaves which need to be removed to obtain edible portion. Generally new shoots appear in the monsoon season (July to August).

There are a number of bamboo species available in India and many of them are used for edible purposes. *Dendrocalamus longispathus, D. brandisii, Bambusa balcooa, B. polymorpha, B. pallida* and *Melocanna baccifera* are used for edible purpose in North Eastern part of India (Bhatt *et al*., 2004). Other than these, *Arundinaria aristata, A. hirsuta, B. arundinacea, B. glaucescens, B. longispiculata, B. vulgaris, Cephalostachyum capitatum, C. fuchsianum, D. hookeri and Oxytenanthera albociliata* are the edible species found in southern India (Shanmughavel, 2004). *D. strictus* and *B. bambos* are commonly occurring species of central India. The other species are *B. nutans, B. tulda, D. giganteus* and *D. hamiltonii*. However, *Dendrocalamus asper* an important edible species of Thailand (Fu *et al*., 1987) has been introduced in India for shoot production. In central India, bamboos are not commercially cultivated for its edible shoot production. Generally people harvest bamboo shoots from nearby forests. However, in some places it is also harvested from cultivated sources (plantations and home gardens).

Bamboo shoots are low in calories, high in dietary fiber and rich in various nutrients. The shoots contain good amount of minerals, mainly potassium, calcium, manganese, zinc, chromium, copper, iron and lower amount of phosphorus and selenium (Shi and Yang, 1992; Nirmala *et al*., 2007). Vitamin A, vitamin B1, vitamin B3, vitamin B6 and vitamin E are also present in fresh shoots (Visuphaka, 1985; Xia, 1989; Shi and Yang, 1992). Shoots contain flavonoids, phenols and phenolic acids which possess antioxidant activity (Gupta *et al*., 2010; Oboh, 2008; Pandey *et al*., 2011). They also contain lethal concentration of the anti-nutrient (cyanogen) (EFSA, 2004).

Anti carcinogenic constituents present in shoots makes them a regular part of diet (Shi and Yang, 1992). It is believed that bamboo extract provide anti-inflammatory effects (Hu *et al*., 2000; Lu *et al*., 2005). Bamboo-derived pyrolysates possess antimicrobial and antifungal activities (Fujimura *et al*., 2005) which protect neurons from oxidative stress (Akao *et al*., 2004). Bamboo shoots are also a good source of phytosterols that are the precursors of many pharmaceutically active steroids found in plants (Srivastava, 1990; Sarangthem and Singh, 2003) and act as nutraceuticals (Miettinen and Gylling, 2003). Bamboo shoot juice possesses protease activity which helps in digestion of proteins (Choudhury *et al*., 2010). In Java, sap from inside the shoots of *B. vulgaris* is used for curing jaundice (Burkill, 1935).

The shoots are used as food in various ways and forms such as fresh, dried, preserved, shredded or pickled. Moreover, they are used as an extender as they take on the flavour of the ingredients they are cooked with. Different types of preparations like bamboo shoot curry, chutney, bamboo candy, pickle, fried shoots, pulav, keema, manchurian (oriental cuisine), soup, bamboo canned juice and bamboo beer are made from bamboo shoots. They are also used as biofertilizer, bioinsecticide and as medicine for stomach disorders (ERG, 2003). Juice of fermented shoots or bamboo vinegar, stored for about 50-60 days is used for flavouring vegetables (Sharma and Borthakur, 2008).

Value addition refers to any activity that enhances the value of product in the market thereby increasing its utility and profit. Value addition in bamboo shoots can be done by making different edible products; this will lead to cultivation of bamboo shoots by the farmers and help in their income generation. The present study was carried out to make different value added products from bamboo shoots and determine their shelf life with an objective to increase the utilization of bamboo shoots and provide quality products to the consumer when the fresh shoots are not available.

MATERIALS AND METHODS

Plant material source and preparation: The species selected for the study were *B. bamboos, B. tulda, D. strictus* and *D. asper*. The newly emerging shoots were collected from Non Wood Forest Produce (NWFP) nursery and Botanical Garden of Tropical Forest Research Institute (TFRI), Jabalpur, India. The collection of shoots was done during morning hours as transpiration is less. After peeling off the sheath the inner soft portion was taken for analysis and making products. The inner soft tissue was chopped into small pieces and subjected to various treatments to remove the toxic and bitter components.

Methods

Precooking processing: Bamboo shoots need to be processed before human consumption. The method developed by Pandey and Ojha (2011) was followed for processing of bamboo shoots to remove toxic components and retain optimum nutritional components. For *B. bambos* shoots were boiled in 5% NaCl for 15 min, *B. tulda* -1% NaCl for 10 min, *D. asper* -1% NaCl for 15 min and for *D. strictus* -5 % NaCl for 10 min. The remaining water was drained and boiled shoots were used for making various products.

Product development

Nuggets: Two parts (150 g) of boiled bamboo shoots were mixed with 1 part (75 g) of soaked pulse [Gram (Chana), Green gram (Moong), Soybean and Black gram (Urad)], 1/2 teaspoon red chili powder, 1/2 teaspoon turmeric powder and salt as per taste. The mixture was then ground to a coarse paste. Small equal sized balls were then made from the paste and dried in oven for 3 days at 45-50°C. Dried nugget's were then stored in airtight glass or poly propylene container.

Pickle: Bamboo shoots (250 g) were cut into small pieces (2 cm), boiled and dried in air for about 1 h. One teaspoon red chilli powder, 1 teaspoon turmeric powder, salt as per taste, 1/2 table spoon roasted and ground fenugreek seeds, 1 table spoon roasted and ground mustard seeds, 2 teaspoon black cumin seeds (kalonji) and 1/4 teaspoon asafoetida were mixed in a bowl, bamboo shoots were then added and transferred to a sterile glass container. Mustard oil (150 mL) was then heated till smoke comes, cooled for 10 min and poured into the container. The pickle was stirred once a day and kept unopened for a week.

Cracker (Papad): Papad is a thin, circular in shape, crispy wafer like dish. To make bamboo papad, 1 part (200 g) of boiled shoots was mixed with 1 part (200 g) of boiled potatoes, 1/2 teaspoon red chili powder, 1/2 teaspoon black pepper powder, 1/2 teaspoon cumin seeds and salt to taste. Mixture was then ground and dough was prepared. Equal sized balls were made from dough and rolled on a roiling board with the help of rolling pins in circular movements to make round papads. Papads were then dried in oven for 2 days at 45-50°C. Dried papads were then stored in airtight container.

Chemical analysis: Chemical analysis of the fresh shoots and developed products was performed for estimating nutritional and anti-nutritional constituents using different established methods. The total carbohydrate content was analyzed spectrophotometrically by Anthrone's method (Hedge and Hofreiter, 1962), total proteins by Lowry's method (Lowry *et al*., 1951), total phenols by using Folin-Ciocalteau method (McDonald *et al*., 2001), ascorbic acid by titrimetric method

(Raghu *et al.*, 2007), cyanogens were estimated as hydrocyanic acid equivalents spectrophotometrically (Hogg and Ahlgren, 1942), minerals and dietary fibers (AOAC, 1990). Monthly analysis of the products was done to observe the change in nutritional status and determine the shelf-life.

Statistical analysis: Data were subjected to statistical analysis using SPSS (Version 14.0) software. Data are expressed as mean±SD (n = 3).

RESULTS AND DISCUSSION

Nutritional status of fresh bamboo shoots of selected species is presented in Table 1. It has been observed that there isn't any significant difference ($p<0.05$) in the nutritional status of the studied species. *D. strictus* contains 2.98±0.57 g/100 g of total carbohydrates, 1.68±0.30 g/100 g of total proteins and 1.25±0.68 g/100 g of total phenols while *D. asper*, considered as the edible bamboo all over the world contains 2.64±0.67 g/100 g of total carbohydrates, 1.45±0.31 g/100 g of total proteins and 0.84±0.25 g/100 g of total phenols. Thus, *D. strictus* (commonly available species of central India) can also be considered as a good edible species as it contains nutrients at par with *D. asper*. However, *B. bambos* contains 2.32±0.28 g/100 g of total carbohydrates, 1.64±0.23 g/100 g of total proteins and 0.76±0.47 g/100 g of total phenols and *B. tulda* contains 2.85±0.04 g/100 g of total carbohydrates, 1.46±0.2 g/100 g of total proteins and 0.96±0.56 g/100 g of total phenols. Anti-nutrient (cyanogen) content didn't varied significantly in *D. asper, D. strictus* and *B. tulda* (0.017, 0.019 and 0.019 g/100 g, respectively) but was found less in *B. bamboos* (0.11 g/100 g). Bhatt *et al.* (2005) have also conducted a study on nutritional values of some commercially edible bamboo species of North Eastern Himalayan region and our results are comparable with their findings.

The fresh bamboo shoots are perishable in nature and cannot be stored for longer period. They are prone to undergo texture change during storage because of changes in Phenylalanine Ammonia Lyase (PAL) activity (Matsui *et al.*, 2004). Therefore different value added edible products were made which can be stored for longer period. The value added edible products (nuggets, pickle and cracker) made from bamboo shoots were good in taste and texture as assessed by the organoleptic and sensory evaluation. The products were accepted in terms of flavour, odour, appearance and taste. Table 2 represents the amount of nutrients and anti-nutrients initially

Table 1: Nutritional status in fresh samples of bamboo shoots (g/100 g)

Nutrients	*D. asper*	*D. strictus*	*B. tulda*	*B. bambos*
Crude fiber	0.72±0.05^{c}	0.96±0.05^{a}	0.75±0.05^{bc}	0.82±0.04^{b}
Carbohydrates	2.64±0.67^{a}	2.98±0.57^{a}	2.85±0.04^{a}	2.32±0.28^{a}
Proteins	1.45±0.31^{a}	1.68±0.30^{a}	1.46±0.2^{a}	1.64±0.23^{a}
Total phenols	0.84±0.25^{a}	1.25±0.68^{a}	0.96±0.56^{a}	0.76±0.47^{a}
Cyanogens	0.017±0.00^{a}	0.019±0.00^{a}	0.019±0.00^{a}	0.011±0.00^{b}
Ascorbic acid	0.005±0.00^{a}	0.004±0.00^{a}	0.005±0.00^{a}	0.005±0.00^{a}
Potassium	0.49±0.03^{a}	0.42±0.04^{a}	0.43±0.04^{a}	0.32±0.03^{b}
Sodium	0.06±0.03^{a}	0.05±0.03^{a}	0.05±0.02^{a}	0.05±0.02^{a}
Phosphorus	0.04±0.03^{a}	0.06±0.04^{a}	0.04±0.03^{a}	0.04±0.03^{a}
Calcium	0.16±0.01^{a}	0.10±0.03^{ab}	0.09±0.05^{b}	0.10±0.02^{ab}
Magnesium	0.15±0.03^{a}	0.16±0.01^{a}	0.16±0.01^{a}	0.16±0.01^{a}

Data are presented as Means± SD (n = 3), Mean values within each row followed by different letters differ significantly at $p<0.05$

Table 2: Nutritional status of bamboo products in the month of September (initial data) (g/100 g)

Sample name	Carbohydrates	Proteins	Phenols	Cyanogens	K	Na	P	Ca	Mg	Ascorbic acid
Nugget (*D. stictus*+green gram)	26.03±0.04	3.19±0.03	2.43±0.03	0.002±0.001	1.06±0.02	1.88±0.06	0.2±0.02	0.17±0.01	0.2±0.02	0.004±0.0
Nugget (*D. stictus*+soya bean)	8.63±0.01	3.43±0.02	2.26±0.02	0.002±0.001	1.11±0.02	1.88±0.05	0.21±0.0	0.16±0.02	0.18±0.03	0.004±0.0
Nugget (*D. stictus*+black gram)	24.27±0.02	3.26±0.02	1.52±0.04	0.002±0.0	0.98±0.02	1.62±0.06	0.21±0.03	0.16±0.04	0.17±0.04	0.004±0.0
Nugget (*D. stictus*+gram)	35.1±0.09	2.53±0.03	1.94±0.02	0.002±0.0	1.14±0.02	1.82±0.05	0.22±0.02	0.16±0.02	0.18±0.04	0.004±0.0
Nugget (*B. tulda*+soya bean)	6.37±0.02	2.94±0.01	1.3±0.03	0.002±0.0	0.92±0.02	1.80±0.09	0.21±0.02	0.16±0.0	0.18±0.02	0.004±0.0
Nugget (*B. tulda*+black gram)	31.47±0.01	1.97±0.02	1.56±0.02	0.002±0.001	0.9±0.01	1.80±0.05	0.22±0.03	0.17±0.03	0.2±0.03	0.004±0.0
Nugget (*B. tulda*+green gram)	23.23±0.02	2.46±0.04	1.35±0.02	0.002±0.0	1.1±0.03	1.78±0.07	0.2±0.03	0.16±0.02	0.19±0.04	0.004±0.0
Nugget (*B. tulda*+gram)	34.94±0.02	2.06±0.04	1.34±0.04	0.002±0.0	0.98±0.02	1.95±0.06	0.2±0.03	0.17±0.02	0.2±0.03	0.004±0.0
Nugget (*D. asper*+black gram)	22.12±0.02	2.32±0.02	1.97±0.02	0.002±0.0	1.08±0.02	1.98±0.05	0.21±0.03	0.16±0.02	0.17±0.03	0.004±0.0
Nugget (*D. asper*+green gram)	25.01±0.01	2.45±0.03	1.62±0.01	0.002±0.0	1.11±0.02	2.02±0.05	0.21±0.0	0.18±0.01	0.21±0.04	0.004±0.0
Nugget (*D. asper*+soya bean)	7.25±0.02	2.86±0.02	1.87±0.02	0.002±0.0	0.92±0.02	2.02±0.06	0.23±0.02	0.18±0.02	0.19±0.01	0.004±0.0
Nugget (*D. asper*+gram)	36.12±0.02	2.15±0.03	1.68±0.03	0.002±0.0	1.16±0.01	2.03±0.07	0.2±0.03	0.17±0.01	0.21±0.02	0.004±0.0
Nugget (*B. bambos*+black gram)	17.5±0.02	3.98±0.04	1.65±0.02	0.001±0.0	0.85±0.02	1.78±0.05	0.24±0.03	0.15±0.02	0.22±0.03	0.004±0.0
Nugget (*B. bambos*+green gram)	34.69±0.01	4.15±0.03	1.75±0.02	0.001±0.1	1.01±0.02	1.82±0.05	0.21±0.0	0.16±0.01	0.21±0.04	0.004±0.0
Nugget (*B. bambos*+soya bean)	9.49±0.02	3.52±0.02	1.82±0.02	0.001±0.2	0.76±0.02	1.85±0.04	0.22±0.02	0.18±0.02	0.19±0.01	0.004±0.0
Nugget (*B. bambos*+gram)	35.55±0.02	3.95±0.03	1.80±0.03	0.001±0.3	1.13±0.01	1.76±0.05	0.19±0.03	0.17±0.01	0.21±0.02	0.004±0.0
Papad (*D. asper*)	34.14±0.02	2.85±0.02	1.02±0.06	0.001±0.0	1.02±0.01	1.72±0.07	0.24±0.02	0.16±0.01	0.16±0.01	0.006±0.0
Papad (*D.* strictus)	35.11±0.04	2.98±0.01	1.42±0.02	0.001±0.0	1.15±0.02	1.71±0.05	0.24±0.03	0.16±0.01	0.16±0.01	0.006±0.0
Papad (*B. tulda*)	31.15±0.04	2.81±0.02	1.36±0.06	0.001±0.0	1.05±0.02	1.64±0.05	0.2±0.02	0.16±0.01	0.16±0.01	0.006±0.0
Pickle (*D. asper*)	1.4±0.02	0.87±0.01	0.5±0.03	0.002±0.0	1.76±0.02	3.5±0.03	0.2±0.01	0.16±0.00	0.22±0.00	0.05±0.0
Pickle (*D.* strictus)	1.76±0.01	0.95±0.03	0.48±0.03	0.002±0.0	1.76±0.02	3.5±0.02	0.2±0.02	0.16±0.00	0.22±0.00	0.05±0.0
Pickle (*B. bamboos*)	1.69±0.04	0.90±0.04	0.75±0.04	0.002±0.0	1.8±0.03	2.4±0.01	0.16±0.01	0.14±0.00	0.20±0.00	0.05±0.0

Data are presented as Means± SD (n = 3)

present in different products made from bamboo shoots. The carbohydrate content ranged from 6.37 g/100 g to 36.12 g/100 g. The maximum carbohydrate content was found in nuggets made from gram pulse and minimum in those made from soybean. Protein content of the nuggets varied from 1.97 to 4.15 g/100 g and was found to be maximum in nuggets made from soybean and minimum in those made from gram pulse. The total phenol content in nuggets ranged from 1.3 to 2.43 g/100 g but didn't follow a definite trend of increase or decrease. However, minerals content did not vary significantly among the nuggets. In case of cracker (papad) and pickle all nutritional parameters didn't vary significantly except phenols where it was minimum in crackers made from *D. asper* (1.02 g/100 g) and pickle made from *D. strictus* (0.48 g/100 g). Preliminary data taken in the month of September revealed that products contain good amount of nutrients and value addition has increased their nutritive value.

Table 3 shows the nutritional data of products after seven months (March) of processing and it has been observed that the amount of nutrients has decreased at a considerable rate. In case of nuggets the decrease in carbohydrate content ranged from 8.64-25.89%, protein from 13.07-29.02%, phenols from 6.58-52.12%, sodium from 16.16-35.71%, potassium content 0-10.81%. In crackers, the decrease in carbohydrate content ranged from 54.04-58.62%, proteins from 23.85-29.87%, phenols from 7.84-15.44%, sodium from 8.72-13.45%, potassium from 0-13.04%. In pickles the decrease in carbohydrate content ranged from 32.14% - 39.64%, proteins from 26.44% - 38.89%, phenols from 13.33-18.00%, sodium from 23.43-38.75%, potassium from 36.93-37.50%. However, cyanogens, phosphorous, calcium, magnesium and ascorbic acid content decreased to zero in all the products. The data revealed that the products are good to consume within 6 months from the date of processing for nuggets and 8 months for pickle and papad (cracker) as they retained substantial

Table 3: Final nutritional status of bamboo shoot products *(g/100 g)

Sample name	Carbohydrates	Proteins	Phenols	K	Na
Nugget (*D. strictus*+green gram)	6.38±0.05	0.43±0.05	0.42±0.04	0.00	0.45±0.03
Nugget (*D. strictus*+soya bean)	0.95±0.06	0.94±0.07	0.56±0.05	0.12±0.0	0.40±0.04
Nugget (*D. strictus*+black gram)	4.96±0.05	0.85±0.04	0.10±0.03	0.00	0.27±0.03
Nugget (*D. strictus*+gram)	7.13±0.06	0.50±0.03	0.28±0.05	0.07±0.02	0.54±0.06
Nugget (*B. tulda*+soya bean)	0.86±0.04	0.79±0.04	0.09±0.01	0.00	0.60±0.05
Nugget (*B. tulda*+black gram)	5.03±0.03	0.30±0.03	0.11±0.01	0.00	0.35±0.05
Nugget (*B. tulda*+green gram)	2.67±0.05	0.46±0.05	0.10±0.03	0.00	0.42±0.05
Nugget (*B. tulda*+gram)	4.65±0.05	0.47±0.04	0.12±0.02	0.00	0.50±0.05
Nugget (*D. asper*+black gram)	3.56±0.05	0.34±0.07	0.24±0.04	0.00	0.48±0.05
Nugget (*D. asper*+green gram)	3.74±0.07	0.48±0.04	0.27±0.04	0.03±0.0	0.63±0.06
Nugget (*D. asper*+soya bean)	0.89±0.06	0.83±0.04	0.22±0.04	0.00	0.60±0.03
Nugget (*D. asper*+gram)	7.52±0.04	0.34±0.04	0.14±0.04	0.00	0.64±0.05
Nugget (*B. bambos*+black gram)	4.53±0.05	0.52±0.03	0.86±0.03	0.00	0.46±0.03
Nugget (*B. bambos*+green gram)	8.44±0.04	0.74±0.04	0.25±0.02	0.09±0.0	0.65±0.02
Nugget (*B. bambos*+soya bean)	0.82±0.02	0.72±0.03	0.20±0.03	0.00	0.60±0.02
Nugget (*B. bambos*+gram)	6.83±0.04	0.68±0.04	0.28±0.03	0.00	0.53±0.02
Cracker (*D. asper*)	18.45±0.05	0.68±0.04	0.08±0.01	0.00	0.15±0.05
Cracker (*D. strictus*)	18.98±0.07	0.89±0.05	0.18±0.02	0.15±0.02	0.23±0.04
Cracker (*B. tulda*)	18.26±0.05	0.74±0.04	0.11±0.02	0.10±0.01	0.20±0.02
Pickle (*D. asper*)	0.65±0.03	0.23±0.03	0.09±0.02	0.8±0.01	1.40±0.03
Pickle (*D. strictus*)	0.57±0.02	0.37±0.02	0.08±0.03	0.8±0.01	1.40±0.03
Pickle (*B. bamboos*)	0.67±0.03	0.35±0.02	0.10±0.02	0.8±0.01	1.40±0.03

Data are presented as Means±SD (n = 3), *March in case of all nuggets and sauce while April in case of pickle, papads and crunches

amount of nutrients and are also good in taste and texture. Further analysis was not done due to change in texture and taste of the products. Many ready to eat recipes like bamboo shoot vegetable, chutney, pickle, fried shoots (pakoda) etc. have also been made from bamboo shoots and standardized by the Engineering Resource Group in India (ERG, 2003). Since bamboo shoots are known to possess many medicinal properties and contain nutritional constituents such as minerals, flavones, phenols and steroids (Shimada, 1972; Sarangthem and Singh, 2003), some people like to consume them throughout the year. But high moisture content of bamboo shoots makes them easily perishable giving space for growth of undesirable microorganisms like bacteria, molds and yeasts. Making different value added edible products from fresh shoots has been proved to be effective in abating rancidity and preventing the growth of microorganisms. Lobovikov (2003) and Majumdar (2006) have also reported that bamboo shoots can be processed into variety of beverages, medicines, additives and health foods. Our products viz., nuggets, papad and pickle can be used when the shoots are not available after the rainy season (at least for 6 months).

CONCLUSION

Bamboo shoots have high nutritive value and are good source of potassium and dietary fiber. The nutritional status in fresh bamboo shoots of studied species did not vary significantly. Although *D. asper* is considered as an edible species, *D. strictus, B. tulda* and *B. bambos* have a potential to be explored for edible purpose as their nutritional status is at par with *D. asper*. Fresh bamboo shoot contains good amount of phenols which are responsible for the antioxidant activity of bamboos. Since bamboo shoots are available for a limited period, different value added products such as nuggets, cracker and pickle were prepared. The products made were good in taste and texture having a shelf life of 6 months from the processing date. Value addition has increased their nutritional value and may also increase its acceptability and marketability. This is the first study on development of value added bamboo shoot products and evaluation of their shelf life. Being a lesser known food product, bamboo shoot processing has vast potential to be developed as a new, innovative and promising enterprise in India. Bamboo shoots are getting popular as a nutritional supplement among the communities. Hence, development of different products from bamboo shoots will be useful in optimum utilization of bamboo shoots which will lead to sustainable management of bamboo resources.

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