



Research Article

PREPARATION AND STANDARDIZATION OF A CURRY POWDER FROM BAMBOO SHOOT AND MUSTARD GREEN

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ARTICLE INFO

Article History:

Received 10th November, 2023Received in revised form 28th November, 2023Accepted 15th December, 2023Published online 28th December, 2023

Keywords:

fibre, antioxidant, fermentation, convective, blending, sensory, proximate, phenolic, flavonoid

ABSTRACT

Curry powder is a mixture of spices that gives whatever dish it is used in a warm and powerful flavour. Bamboo shoots are rich in vital amino acids, selenium, a potent antioxidant, and potassium, both of which are good for the heart. They also have a high protein, moderate fibre, and low fat content. The peppery leaves of the mustard plant, known as mustard greens, are highly nourishing. The major focus of this work was to develop a new curry powder using these stuffs. First raw materials were collected from local market of Jorhat district, Assam. In the preparation process, collected raw materials were peeled, unwanted parts were removed and washed before further processing. The bamboo shoots were grated carefully and kept in shield bottles for fermentation. The fermented shoots and mustard greens were dried in a convective hot air oven adopting the best temperature. The drying behaviour of the stuffs were determined plotting moisture content against time. Dried products were ground carefully and the final samples were prepared by blending at different ratios i.e. Bamboo shoot : Mustard green = 3:7, 4:6, 5:5, 6:4, 7:3 A sensory analysis was conducted using 9-point hedonic scale to overview the colour, texture, taste, flavour, mouthfeel and overall acceptability. From the sensory analysis; the most preferable ratio was determined i.e. 6:4 and further analyses were carried out for the most preferable blended mix. The proximate compositions (carbohydrates, crude protein, crude fat, crude fibre, moisture, ash) were estimated using standard AOAC methods and it was found that the product contains moderate amounts of fibre i.e. 32.61% and carbohydrate i.e. 33.07%. Less amount of fat was found i.e. 1.19%. In mineral estimation, it was found that the product contains high amount of Potassium i.e. 1050 mg/100gm. To further standardize the product, some quality parameters such as microbial count, bulk density, total water holding capacity, total fat absorption capacity, foaming capacity, total phenolic content, total flavonoid content, total tannin were also examined.

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INTRODUCTION

In general, any seed, root, bark, fruit or other plant material that is used to flavour or colour food is considered a spice. In order to improve the flavour and taste of processed goods, spices are essential. Curry powder is the most often used of these combinations or blends, which sometimes contains 20 or more spices and is used to influence the distinctive flavour of an Indian curry, which is loved by people all over the world. Bamboo has a long history of being connected to people. A lesser-known use of bamboos, which are more commonly known for its industrial applications, is as a food that can be eaten fresh, fermented, or canned (Nirmala Chongtham, Madho Singh Bisht, Sheena Haorongbam, April, 2011). The edible shoots (new bamboo culms that emerge from the ground) of several bamboo species i.e. *Phyllostachys edulis* and *Bambusa vulgaris* are known as bamboo shoots or bamboo sprouts. Many Asian cuisines and broths use them as

veggies. Although it is delicious, the young shoots are low in fat and sugars and high in nutrients, particularly proteins, carbs, minerals, and fibre. Phytosterols, which are categorised as nutraceuticals or natural medicines and are piquing the interest of both scientists and health advocates, are also abundant in them (Nirmala Chomngtham, Madho Singh Bisht, Sheena Horongbam *et al.* April, 2011) Bamboo shoots are a staple of Assamese cuisine there. In Assamese, they are referred to as khorisa, bah gaj, and "hen-up" in Karbi. They are referred to as bashchuri by the Chakma people of Arunachal Pradesh's Diyun region. Medukkeye, the fermented variety, is frequently served with fried pork.

One of the healthiest green leafy vegetables available in the winter are peppery, crunchy mustard greens (*brassica juncea*), often known as leaf mustards. Its gorgeous top greens do, in fact, contain more antioxidants and vitamins A, K, carotenes, and flavonoids than certain common fruits and vegetables (Source:USDA National Nutrient data base).The mustard plant's

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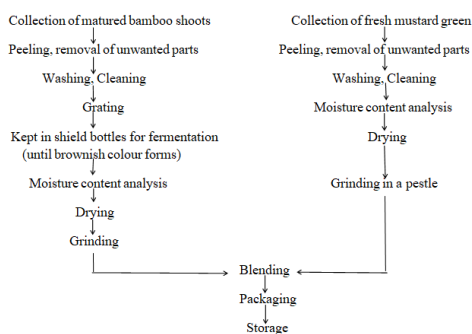
crispy, green tops are harvested while it is young, fragile, and just beginning to blossom. It is under the family of *Brassica*. The Assamese cuisine makes extensive use of this vegetable. In addition to producing salad, chutney, and several vegetable recipes, one may also prepare a delicious fish curry. It is a fairly straightforward dish that uses no spices.

Food products can be dried by removing their moisture. It extends the food's shelf life by reducing microbial deterioration and the impact of enzymes. It is done to add value and improve the quality, i.e., colour, flavour, fragrance, taste, mouthfeel, etc., by blending various ingredients. Foods' moisture, ash, crude fat, crude protein, and carbohydrate contents make up their proximate composition. For product development, quality control (QC), or regulatory purposes, estimation of these food components is crucial. Analyses may be done quickly for quality control or accurately but slowly for official purposes. For quality control, it's crucial to analyse certain functional and physio-chemical aspects of a food product, such as bulk density, foaming ability, water and oil absorption capacities, phenolic content, tannin, flavonoids, minerals and microbial count.

MATERIALS AND METHODS

The process of preparation includes collection of raw materials, washing, cleaning, peeling, grating, drying, grinding, blending by different machines and equipments.

Process flow chart



The fresh bamboo shoots were collected in the months of September, 2022 from nearby villages of Jorhat town, Assam and fresh mustard green leaves were collected from a nearby market of Jorhat town in the month of October 2022. The weight of the bamboo shoots was 7 kg. The weight of the fresh mustard green leaves was 2kg. Peeling is the process of removing of outer covering or skin from a fruit or vegetable. The bamboo shoots were peeled carefully so that only skin and unwanted parts are removed and then they were ready for grating. The unwanted parts of the mustard green leaves were peeled carefully with a sharp knife. The bamboo shoots and mustard green leaves were washed after peeling carefully so that no useful parts are lost. The food cleaning and disinfecting machine is an easy operative machine that is used for washing and cleaning of large capacity of product in very short time. Advanced bubble shock wave technology eliminates hazardous bacteria, cleanses the surface, disinfects it, and decomposes pesticide residues on fruits and vegetables. It is widely used for washing of leafy/root vegetables, soft fruit and mushrooms etc. Grating is the process of transforming solid, firm food items into small pieces by rubbing the item against a grating instrument. The bamboo shoot grating machine we used is a high capacity grater where

time taken for 1 peeled shoot is 2 min. There is a 0.25 hp motor which runs the blade to grate the peeled bamboo shoots put under it. Before grating, the machine was cleaned and fully sanitized to avoid contamination.



Figure1 grating of bamboo shoots

The production of fermented bamboo shoots involves the natural fermentation process with various lactic acid bacteria playing dominant role in imparting flavour, taste and aroma to the product. *Lactobacillus plantarum*, *L. brevis*, *L. casei*, *L. fermentum*, *L. curvatus*, *Leuconostoc mesenteroides*, *L. fallax* and *Tetragenococcus halophilus* are predominantly found in fermented shoots (Potshangbam Nongdam; et al. World bamboo congress;2015).The bamboo shoots were kept in the bottles until the slight dark white colour forms.

The process of removal of moisture was the most important step of this work. The oven drying method was used for drying both bamboo shoots and mustard greens. A convective hot air oven consists of heated chamber, where both time and temperature can be set used to remove water, moisture and other solvents from objects. The fan or turbines in the oven sparks the convection process and dries the materials. The bamboo shoots were dried at 60°C and after 7th hour, the constant weight came. The initial weight was 2500 gram and final weight after drying was 290 gram. The mustard green leaves were dried at 55°C and 70°C. After 9th hour the constant weight came 55°C. The initial weight was 1850 gram and final weight after drying was 105 gram and after 6th hour the constant weight came in 70°C and the initial weight was 2000 gram and final weight was 121 gram.

Time	Weight(gram)
0 hour	2500
1 hour	2150
2 hour	1650
3 hour	1150
4 hour	730
5 hour	580
6 hour	340
7 hour	290

Table1 Bamboo shoots drying

Time	Weight(gram)
0	1850
1	1530
2	1150
3	859
4	495
5	380
6	276
7	191
8	121
9	105

Table 2 Drying of mustard green at 55⁰C

Time	Weight(gram)
0	2000
1	1521
2	1014
3	592
4	288
5	136
6	121

Table 3 Drying of mustard green at 70⁰C

Grinding is a unit operation widely used in the food industry and designed to reduce the size of materials. An industrial grinder was used to grind the dried bamboo shoots to reduce the particle size into preferable powder. The dried mustard green leaves were grinded carefully in a pestle. The grinder was washed and sanitized before the operation. Blending is the process of mixing or combining things together. The blending process was done in 5 ratios i.e. Bamboo shoot: Mustard greens = 3:7, 4:6, 5:5, 6:4, 7:3



Figure 2 Bamboo shoot powder



Figure 3 Mustard green powder

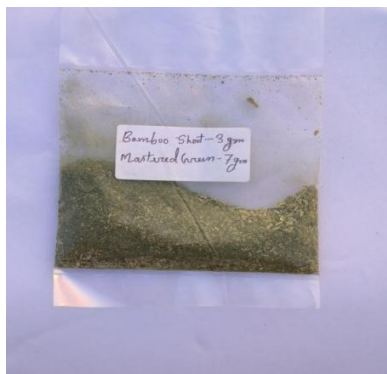


Figure 4 Sample 1, BS: MG: 3:7



Figure 5 Sample 2, BS: MG: 4:6



Figure 6 Sample 3, BS: MG: 5:5

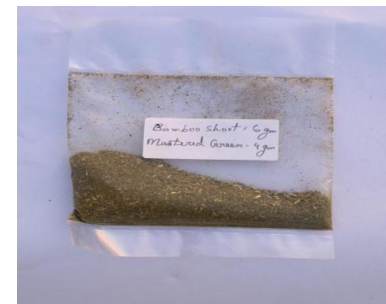


Figure 7 Sample 4, BS: MG: 6:4



Figure 8: Sample 5, BS: MG: 7:3

Moisture	Hot air oven	AOAC 2000
Crude protein	Kjeldahl apparatus	AOAC 2000
Crude fat	Fat extraction unit(SOCS PLUS, model SSS6)	AOAC 2000
Crude fibre	Hot air oven, muffle furnace	AOAC 2000
Ash	Burner, muffle furnace	AOAC 2000
Carbohydrate	-	By difference(Thomas et. al.2013)

Minerals estimation

To estimate the minerals, a mineral solution was prepared from the ash that was created in the ash content analysis. The minerals were estimated taking suitable aliquotes of the mineral solution. The minerals estimation was performed with the methods given below.

Table 4: Proximate analyses

Potassium (K)	Systronic flame photometer	A.O.A.C (1984)
Calcium(Ca)	Systronic flame photometer	A.O.A.C, 2000.
Sodium (Na)	Systronic flame photometer	AOAC, 2000
Phosphorus (P)	Spectrophotometer (620nm)	Fiske and Row 's method desc ribed by Ranga nna (2011)

Microbial count

The developed product was evaluated for microbial count using PDA. The developed product was evaluated for microbial count using PDA .10 ml of sterilized distilled water blank were added one gram of sample to, and the mixture was vigorously agitated. One millilitre of the 10-1dilution was added to blank of 9.0 millilitres sterilised water. This was diluted to 10^{-2} . Similarly dilutions of 10^{-3} , 10^{-4} , and 10^{-5} were created. In petri dishes with medium, 0.1 ml of the dilutions were added. For 24 to 48 hours, plates were incubated at $30\pm 2^{\circ}\text{C}$.

$\text{CFU} = \text{No. of colonies} \times \text{dilution factor} / \text{volume of the culture}$

Bulk density

By adding a known weight of the mixture to a measuring cylinder, tapping the cylinder a predetermined number of times, and calculating the resulting bulk volume, the bulk density of the sample (g/ml) was determined.

$\text{Bulk density (g/ml)} = \text{mass/bulk volume}$

Water absorption capacity

The method of Onwuka (2005) was used to calculate the WAC of a sample. In a conical graduated centrifuge tube, 1g of the material was metered out and mixed with 10 ml of distilled water. After thoroughly mixing the sample for 30 seconds, the sample was left to stand at room temperature for 30 minutes before being centrifuged at 5000 g for an additional 30 minutes. The graduated centrifuge tube was used to directly measure the supernatant's volume. The results were reported as g/100g by multiplying the amount of absorbed water by the density of water

Fat absorbtion capacity

The Sosulki et al. (1976) method was used to estimate FAC. samples weighing 1 gram was put into a 15 ml centrifuge tube were .It was then given 10 ml of refined ground nut oil. For 30 minutes, the content was shaken and then centrifuged for 25 minutes at 3200 rpm. Then the volume of free oil was read. FAC was expressed as the amount (ml) of oil bound by 100g sample.

Foaming capacity

The Onwuka (2005) method was used to determine foaming capacity. In a 100 ml measuring cylinder, 2 grams of sample was weighed and 50 ml of distilled water was added in a 100 ml measuring cylinder. After thoroughly shaking the suspension to create foam, the total volume was measured after 30 seconds. The percentage increase in volume after 30 seconds is expressed as foaming capacity.

Total phenolic content

According to AOAC (1984), phenolic content was estimated. The samples were refluxed for 10 min with acidic methanol(99 ml of methanol and 1 ml of concentrated HCl). Three times the extraction procedure was carried out. The extracts were reduced to 90 ml from 300ml putting on a hot plate. The contents were diluted with acidic methanol to a volume of 100 ml. To 0.5 ml of extract, 0.5ml Folin-Ciocaltue (FC) reagent was added. 2 ml of saturated sodium carbonate solution was added to this, volume. was made up to 5 ml with distilled water. At 760 nm, the absorbance was measured in a spectrophotometer afetr 30 minutes. The results were determined as mg gallic acid equivalent GAE/g sample and expressed as mg/100 g dry wt.

Total flavonoid content

The total flavonoid content was measured by the method described by Pathak et al. (2017). 2.25 ml of distilled water and 0.15 ml of a 5% sodium nitrite solution were added to 0.5 ml of the extract in a test tube, and the mixture was thoroughly mixed before being maintained for 6 minutes.0.3 ml of aluminium trichloride hexahydrate solution was added to this combination, and the mixture's contents were thoroughly mixed before being let to stand for 5 minutesfollowed by addition of 1ml of 1M sodium hydroxide. After the mixture was vortexed, the absorbance at 510 nm was immediately measured. Results were expressed as quercetin equivalent (mg QE/ 100 g) of sample.

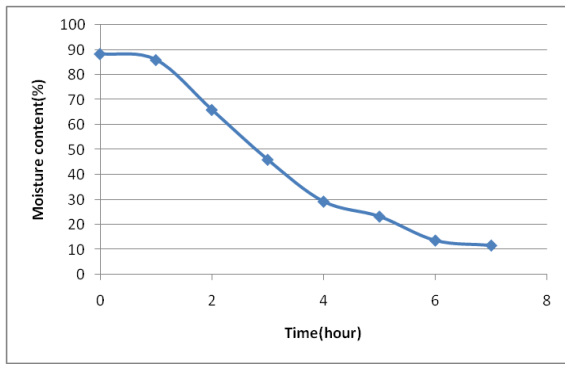
Total tannin content

Using Schanderi's (1970) methodology, tannin was examined. 0.25 g of powder was extracted with 37.5 ml of distilled water after gently heating the flask for 30 minutes.The sample mixer was centrifuged at 2000 rpm for 20 minutes, and then the supernatant was ultimately diluted with distilled water to a level of 37.5 ml in a flask of 100 ml. An aliquot of 0.5ml treated with 1 ml of Folin-Ciocaltue reagent, 2 ml of sodium carbonate, and left to stand for colour development. In a spectrophotometer, the reaction mixture's absorbance was determined at 700nm. Using, Tannic acid standard, tannin content was evaluated and expressed as tannic acid equivalents (TAE) in mg per 100 g of dry wt.

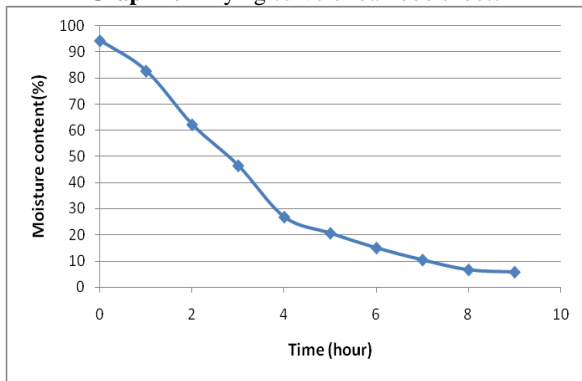
RESULT AND DISCUSSIONS

Drying behaviour of the raw materials

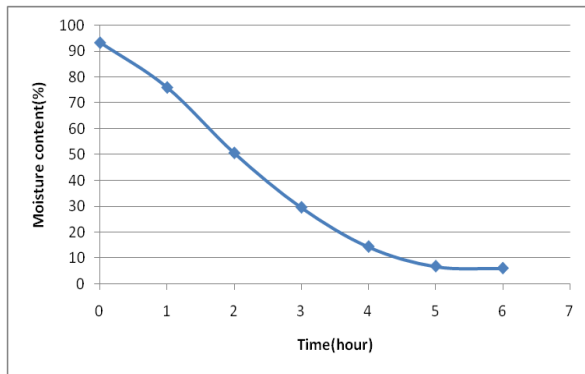
The drying curves were prepared plotting moisture content against time.



Graph 4.1 Drying curve of bamboo shoots



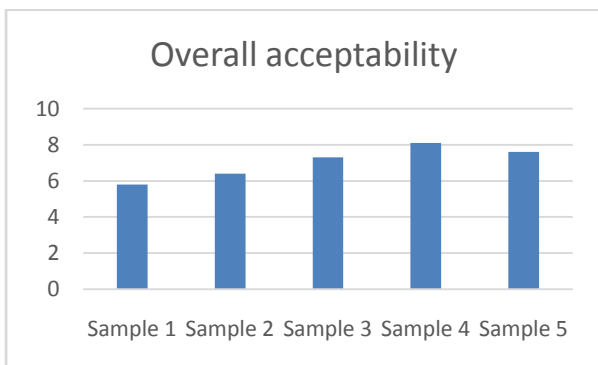
Graph 4.2 Drying curve of mustard green at 55°C



Graph 4.3 Drying curve of mustard green at 70°C

Sensory analysis

Sensory Evaluation method conducted for each ratio of the product. Curry of moong dal (Green gram beans) bor was prepared for each ratio of the product and served to five members. The panelists evaluated the curry using a 9-point Hedonic scale for colour, taste, texture, flavor, mouthfeel and overall acceptability.

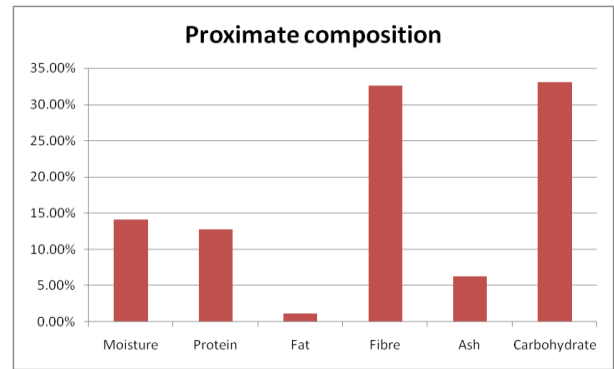


Graph 4.4 Overall acceptability (AAO)

It is observed that the sample 4 got highest sensory score in terms of overall acceptability.

Proximate composition

Moisture	14.09%
Crude protein	12.73%
Crude fat	1.19%
Crude fibre	32.61%
Total ash	6.31%
Carbohydrate	33.07%
Energy	193.91 KCal/100 gram



Graph 4.5 Proximate composition

From the proximate analysis it is observed that the product contains moderate amounts of carbohydrates and protein. It contains the required amounts of proteins, ash and moisture. It contains small amount of fat. Energy value was determined using the method of Gopalan et al. (2000).

Minerals

Minerals	Amount
Potassium(K)	1050 mg/100 gm
Calcium(Ca)	340 mg/100 gram
Sodium(Na)	47 mg/ 100 gram
Phosphorus(P)	240 mg/100 gram

Microbial count

No of colonies = 56

Dilution factor = 10³

CFU = Colonies count x dilution factor / volume of the culture

= 56 x 10³ / 0.1

= 56 x 10⁴ / gram

Other parameters

Bulk density	0.4 gram/ml
Water holding capacity	5 gram/100 gram
Fat absorption capacity	50 ml/100 gram
Foaming capacity	8%
Total phenolic content	19.335 mgGAE/gram
Total Tannin content	26.75 mg TAE/gram
Total flavonoid content	1.45 mgQE/gram

CONCLUSION

Bamboo shoot and mustard green leaves are popular delicacy. They are used to prepare various delicious dishes across different countries. They not only have delicious flavour, aroma, taste etc, but also various nutritional properties which I have mentioned, for which they are widely consumed across the world. They are very popular among the ethnic people of North East India including making different meat dishes, different curries etc. But they are not available along the

whole year. For availability through the year, they can be dried and preserved, which I have done in this work. From the sensory analysis that we carried out to overview the product, it was found that the product has got very good acceptability and has strong market potential which can pave the way for entrepreneurship development among unemployed youths and commercial adoption of this method seems to be a profitable venture for utilization of this vegetable thereby providing new products for the market.

To make the work perfect, I made some suggestions
Modern and sophisticated equipments should be used.
Drying and blending should be done in perfect manner.

Acknowledgement

The authors are thankful to the facilities provided by AICRP on PHET, Department of Agricultural Engineering, Assam Agricultural University, Jorhat, Assam.

Conflict of interest

There is no conflict of interest among the authors.

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