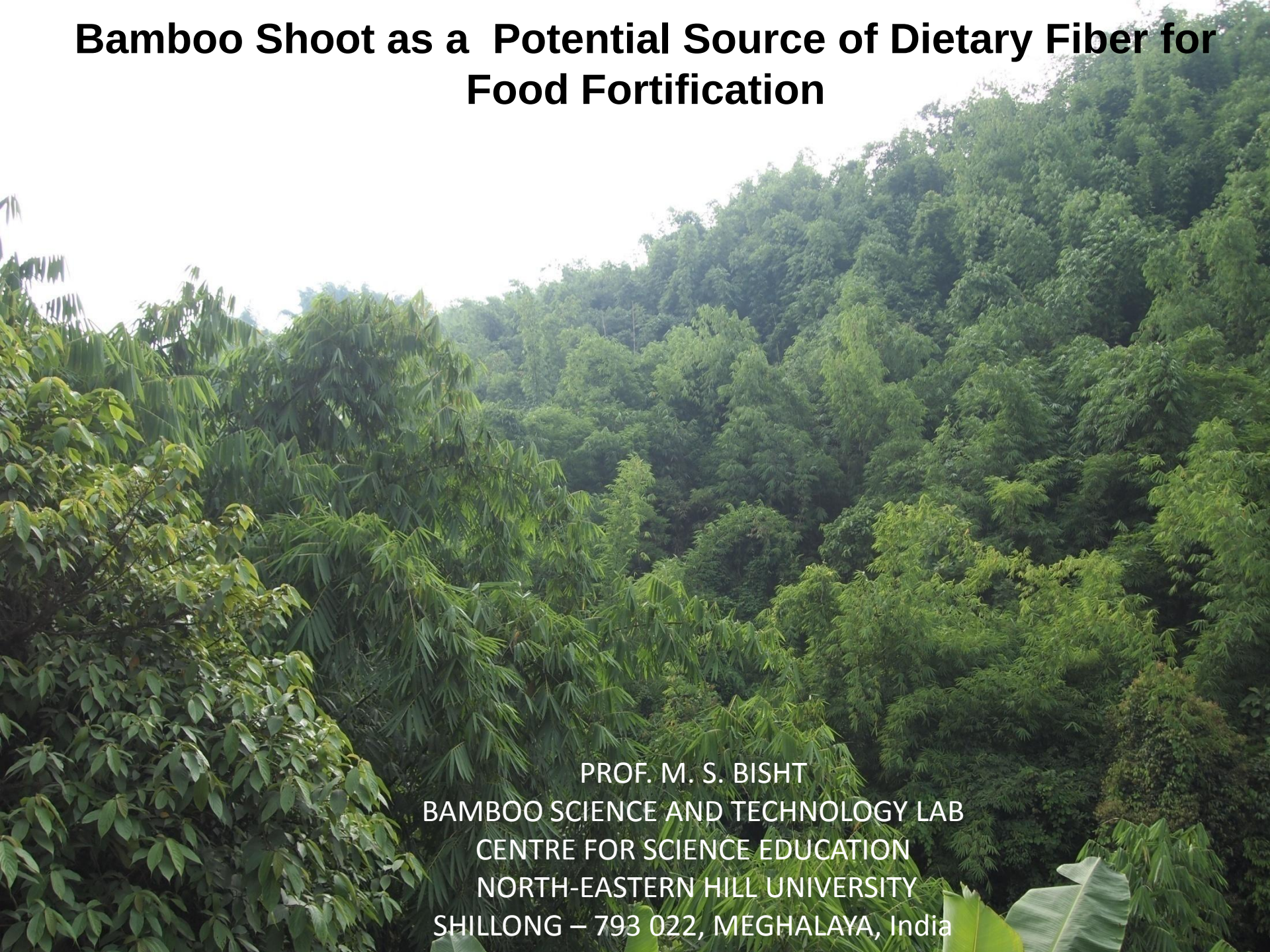
Bamboo Shoot as a Potential Source of Dietary Fiber for Food Fortification



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The word Bamboo

No one knows for sure how bamboo became bamboo. There are two primary speculations. One is that the origin is from the ancient Indian name for bamboo, "mambu". The other speculation is that it is Malayan in origin and comes from the sound bamboo makes when it burns. "Bam-Boom".

Bamboo a Multipurpose Plant

Wood and timber

Medicine

Sentimental and auspicious

Sports and entertainment

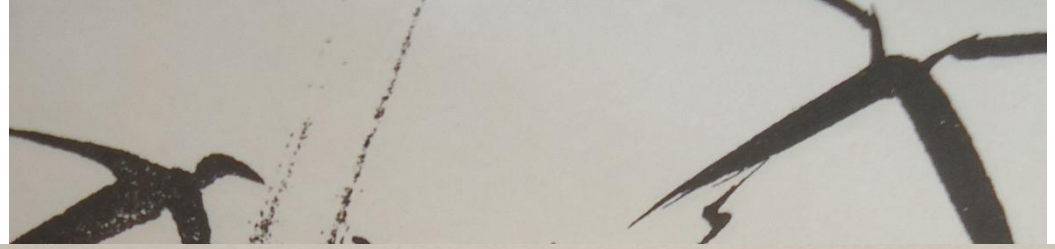
Food

Fuel and energy

Spiritual and mental healing

Restoration of degraded land

Ornaments and decorative items



वंशस्त्वक्सारकर्मारित्वचिसारतृणध्वजा: ।
शतपर्वा यवफलो वेणुमस्करतेजना: ॥
वंश: सरो हिम: स्वादु: कषायोबस्तिशोधन: ।
छेदन: कफपित्तघ्न: कुष्ठास्त्रव्रणशोथजित् ॥

(भावप्रकाशनिघण्टु : १५३–१५४)

[*Vans, Twaksar, Karmar, Twachisar, Trindhwaj, Shatparva, Yavphal, Venu, Maskar and Tejan, are the names of Bamboo (Bans)*
Bamboo by nature is laxative, frigid seminal curative, palatable, bladder purifier and full of astringent juice. It splits cough, subsides bile and cures leprosy, bloody flux, wounds and swellings]

Ingredients of Chyawanprash

I. Pradhan ingredients- Amla 5kg

II. Sansadhan ingredients- 1. Bidrikhand, 2. Safed Chnadan, 3. Vasaka, 4. Akarkara, 5. Brahmi, 6. Bitva, 7. Chhoti Harr, 8. Kamal Kesar, 9. Jatamansi, 10. Gokhru, 11. Bel, 12. Kachoor, 13. Nagarmotha, 14. Laung, 15. Dushkarmoola, 16. Kakadsinghi, 17. Dushamoola, 18. Jiwanti, 19. Punarnava, 20. Anjeer, 21. Ashwagandha, 22. Giloya, 23. Tulsi leaves, 24. Meetha neem, 25. Saunth, 26. Munakha, 27. Mulathi (All ingredients in 50 g each).

III. Yamak ingredients- 1. Ghee 250 g, 2. Til oil 250 g

IV. Samvahak ingredients- 1. Sugar 3 kg

V. Prekshap ingredients- 1. Pippali 100 g, 2. Banslochan 150 g, 3. Dalchini 50 g, 4. Tejpatra 20 g, 5. Nagakesar 20, 6. Chhoti illaichi 20 g, 7. Keasr 2 g, Shahad 250 g

BAMBOO SHOOT CONTAINS

Macronutrients

- Protein
- Amino acids
- Carbohydrates
- Starch

Bioactive Compounds

- Phytosterols
- Phenols
- Dietary Fiber

Vitamins

- Thiamine; Niacin; Vitamin A; Vitamin B6; Vitamin E

Minerals

Moisture, Ash

BAMBOO SHOOT A SOURCE OF DIETARY FIBER

Dietary Fiber

Hipsley coined the term “Dietary Fiber” in 1953. It is also called roughage, bulk or blast.

Dietary fiber is edible part in the food.

The food part which is resistant to digestion and absorption in the human small intestine.

Only plant parts are considered in the category of dietary fiber. Dietary fiber includes **polysaccharides** such as cellulose, hemicellulose, beta-glucans, inulin, arabinoxylans, arabinogalactans, etc. and **Oligosaccharides, lignin** and **associated plant substances** such as waxex, cutin and suberin.

Dietary Fiber in Different Food Items

Food items	Dietary fiber, g/100 g	Food items	Dietary fiber g/100 g
Dried kidney beans	19.3	Green soya bean	5
Dried pea	17.4	Cauliflower	3.7
Dried soya beans	17.1	Squash	2.8
Dried Japanese parsimmon	14	Spinach	2.8
Wheat flour (whole)	12.48	Carrot	2.7
Dried fig	10.9	Japanese reddish	1.4
Dried prune	7.2	Straw berry	1.4
Rye flour	12.9	Apple	1.5
Oatmeal	9.4	Cucumber	1.1
Parsley	6.8	Banana	1.1
Avocado	5.3	Bamboo shoots (fresh, which are consumed as food)	4.5-6.0

Dietary Fiber Intake by the Population (Recommended Amount is 25g/ day or More)

Countries	Daily dietary fiber intake at present in grams
Japan	15-18
United Kingdom	14.2
United States	15
France	16
Finland	16.7
Netherlands	20-25
Germany	21
Sweden	22.1
Switzerland	30-33
India	39-43

Nakaji et al 2002

Health Problems Associated with Inadequate Intake of Dietary Fiber

Firm and small amount of stool, which passes through gut very slowly.

Cause of diverticulosis coli and appendicitis.

Constipation is common among those having less fibrous food.

Rise of serum cholesterols and sugar.

Malignant tumours and colon cancer

These diseases or health problems are of New World or of developed countries due to less dietary fiber in their diet and depending more on non-vegetarian foods.

Bamboo Shoots for Dietary Fiber


Rs. 1000


Bamboo Shoots in Water

Fresh Bamboo Shoots in the Market


Processed Bamboo Shoots


Dried and fermented Bamboo Shoots
Fermented Bamboo Shoots
Dried Bamboo Shoots


Bamboo Shoot Chunks in Water


Bamboo Shoot Paste

Bamboo Shoots Canned, Bottled or Polypacked

Pickled Bamboo Shoot

Dietary Fiber in Shoots of Some Edible Species of Bamboo			
Species	**Dietary fiber g/100 g**	**Species**	**Dietary fiber g/100 g**
Bambusa kingiana	4.5 ± 0.06	*B. polymorpha*	3.82 ± 0.06
B. vulgaris	4.24 ± 0.01	*B. bambos*	3.54 ± 0.02
Gigantochloa rostrata	4.20 ± 0.09	*D. asper*	3.54 ± 0.07
G. albociliata	4.15 ± 0.11	*D. membranaceus*	2.91 ± 0.06
Dendrocalamus brandisii	4.03 ± 0.07	*D. giganteus*	2.65 ± 0.03
B. tulda	3.97 ± 0.02	*B. nutans*	2.28 ± 0.01
D. hamiltonii	3.90 ± 0.03	*D. strictus*	2.26 ± 0.01


Cheap Alternative to: wheat/oat/corn/potato /pea/soybean/apple fiber
Common ingredient: in breakfast cereals/pasta/shredded cheese/ sauces/ mustard/ ketchup/ beverages/fruit juices/ snacks/ frozen desserts/ bakery products
Improves textures in the products moisture content
Useful in powdered mixes, where anti-caking properties and extra fiber are needed
Bamboo shoot fiber
Can replace silicon dioxide in order to achieve an all-natural label

Dietary Fiber Components (g/100 g) in Wheat Flour and *D. hamiltonii flour* (Shoots boiled for 20 minutes prior to converting powder)

Dietary fiber components	Wheat flour (whole)	Shoot powder
NDF (Neutral detergent fiber)	53.43 ± 0.04	58.98 ± 0.05
ADF (Acid detergent fiber)	0.46 ± 0.01	14 ± 0.01
Lignin	0.42 ± 0.01	3.66± 0.01
Hemicellulose	52.97 ± 0.04	44.30 ± 0.06
Cellulose	0.04 ± 0.01	8.92 ± 0.05

Ways of Bamboo Shoot Consumption for Intake of Dietary Fiber
Whole bamboo or chunks
Fermented or dried bamboo
Bamboo paste or powder
Tablets and capsules (as nutraceuticals)


Japanese Recipe

Japanese Recipe


Indian Bamboo Shoot Masala Curry

Ooti - Indian Recipe


Kangsoi-Indian Recipe


Bamboo Shoots with Beans or Pulses


Bamboo Shoot Macroni


Bamboo Shoot Sweet Meat (Halwa)


Bamboo Shoot Bhujia

Bamboo Shoot Paste Puri

Bamboo Shoot Paste Chapati

Bamboo Shoot Paste Cookies

Bamboo Paste Curd in bamboo cups

Bamboo Shoot Paste Tomato Ketchup

Bamboo Shoot Paste Mayonnaise

Dietary fiber from Bamboo (Nutraceutical)

Shennong Honey Bio-Tech Co., Ltd., China

Changsha Winner Bio-Tech Co., Ltd., China

Harbin Yeekong Herb Inc., China

Dietary Fiber Content of Products Fortified with 20 Minutes Boiled Dried Shoot Flour (*D. hamiltonii*) g/100 g				
Dietary fiber components	**Control biscuits**	**Fortified biscuits**	**Control namkeen (salty snacks)**	**Fortified namkeen (salty snacks)**
NDF	46.15 ± 0.23	63.21 ± 0.01	65.25 ± 0.02	71.25 ± 0.02
ADF	1.90 ± 0.01	3.46 ± 0.01	1.47 ± 0.01	5.25 ± 0.01
Lignin	0.09 ± 0.01	0.98 ± 0.01	0.46 ± 0.01	1.60 ± 0.01
Hemicellulose	44.26 ± 0.23	59.76 ± 0.01	63.77 ± 0.02	66.01 ± 0.02
Cellulose	1.21 ± 0.01	2.48 ± 0.01	1.02 ± 0.01	4.10 ± 0.01

Sensory Analysis of Bamboo Shoot Fortified Products on 9 point Hedonic scale

Parameters 9	Control biscuits	Fortified biscuits	Control namkeen (salty snacks)	Fortified namkeen (salty snacks)
Colour	5.45± 1.19	5.86 ± 1.83	5.45 ± 0.88	4.90 ± 1.68
Aroma	6.00 ± 0.92	6.25 ± 1.23	6.00 ± 1.03	5.10 ± 1.71
Texture	5.55 ± 1.73	6.17 ± 1.74	6.10 ± 0.97	5.71 ± 1.75
Taste	5.90 ± 1.99	6.31 ± 1.74	6.45 ± 1.28	5.80 ± 2.07
Overall	6.20 ± 1.51	6.55 ± 1.37	6.25 ± 0.97	5.75 ± 2.01

Bamboo Shoot Fortified Food Items

Products	Bamboo species	Form used	Refernces
Pork nuggets	*Bambusa polymorpha*	Fresh	Thomas et al 2014
Cookies	-	Fresh	Mustafa et al 206
Chapatti, Bhujia, Cookies, Bread, paneer	*Dendrocalamus hamiltonii*	Paste from boiled shoots	Bisht et al 2015
Biscuits	*Bambusa balcooa*	Fresh	Choudhury et al 2015
Candies	-	Fresh	Nimisha et al 2015
Chips	*Bambusa vulgaris*	Fresh	Maroma , 2015
Pork Pickles	-	Fermented	Chavhan et al 2015
Candy, Chutney, Chukh, Cracker, Nugget	*Dendrocalamus hamiltonii*	Fresh	Sood et al 2013
Chicken nuggets	*Bambusa auriculata*	Fermented	Das et al 2013
Amareti cookies	-	-	Farris and Piergiovanni 2008

Conclusions

Better food processing techniques and non-vegetarian diet has greatly reduced the daily dietary fiber intake.

Decrease in daily dietary fiber intake has caused various serious health problems including cancer.

The health problems related to dietary fiber are more in developed and industrialized nations as the intake of dietary fiber is comparatively less in these countries.

Bamboo shoots are one of the cheapest and best source of dietary fiber.

Bamboo shoots are less in fats and calories and more in dietary fiber and other bioactive compounds.

Fortification of food items with dietary fiber from bamboo shoots is very easy and convenient.

Bamboo shoot dietary fiber provides various health benefits besides providing various characteristics to the food fortified with it.

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Freeze-dried bamboo shoot powder for food fortification: enrichment of nutritional content and organoleptic qualities of fortified biscuits

Abstract

Background: Bamboo shoots are low-calorie vegetables rich in nutrients and phytochemicals. Due to the presence of antinutrients and short shelf life, the shoots need to be processed for long term usage. Vacuum freeze-drying is the best method of water removal from perishable vegetables compared to other methods of drying. Edible portion of shoots were freeze dried in three forms, fresh, 20minutes boiled and 24hour soaked and compared with wheat flour. Freeze dried bamboo shoot powder were used for fortification of biscuits. Nutrients, bioactive compounds and minerals were increased in bamboo shoot fortified biscuits as compared to control biscuits. Nutritional content was observed to be maximum in fresh freeze dried fortified biscuits with 0.30g/100g amino acids, 1.27g/100g protein, 20.45g/100g carbohydrate, 0.22g/100g phenol, 0.18g/100g phytosterol, 62.44g/100g neutral detergent fiber (NDF) and 5.16g/100g acid detergent fiber (ADF) whereas anti-nutrients content was minimum in 20minute boiled shoot fortified biscuits with 5.98mg/kg amongst the fortified biscuits. Anti-nutrient content in all the fortified biscuits were much below the permissible level. Sensory analysis showed higher acceptability in 20minute boiled fortified biscuits. Compared to the control, minerals such as K, P, S, Na, Ca, Zn, Fe, Mn, increased in fortified biscuits. Freeze-dried bamboo shoot fortified biscuits were better in nutritional quality as well as better organoleptic properties compared to the control.

Keywords: bamboo shoot, processing, freeze-dried, biscuits, nutrients, fortification

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Introduction

Bamboo shoots have a long history of being used as a source of food and medicine in China and South-East Asia being considered as "King of Forest Vegetables" and a "Treasure Dish". The young shoots are not only consumed as fresh vegetable but are also processed and preserved in many forms such as dried, fermented, salted, pickled, water soaked and canned. The juvenile shoots are not only delicious but are rich in nutrients mainly proteins, carbohydrates, minerals and vitamins and low in fat and calories. The presence of bioactive compounds like phenols, phytosterols and dietary fibers with health promoting properties play a vital role in protection against oxidative stress, inflammation, diabetes, cancer, obesity and cardiovascular diseases. Moreover, the shoots are a rich source of natural antioxidants due to the presence of phenols, vitamin C & E and mineral elements such as selenium, copper, zinc, iron and manganese and have huge potential in the food and pharmaceutical industry.[1] Due to their health enhancing properties, bamboo shoots are now being considered as a health food or natural functional food.[2,3] However, bamboo shoots sprout only during the monsoon season due to which they have to be harvested and processed within a very short period for use round the year. Moreover, the shoots contain an anti-nutrient cyanogenic glucoside which needs to be removed for safe consumption.

Bamboo mainly grows in tropical and subtropical parts of the world like South-East Asia, South America and some parts of Africa but major demand for bamboo shoots is from developed countries like United States, Canada, Europe and Australia which require proper processed and well-packed shoots for long distance transportation and increase in shelf life.[4,5] Novel processing techniques are required in order to meet the demand for shoots for food fortification and developing nutraceuticals. Among the different processing techniques, drying and dehydration is one of the most important and widely practiced technique as it is convenient for packaging, storage and transportation.[6] During the last decade, novel ways of bamboo shoot consumption have developed that require bamboo shoots in various usable forms. Converting of bamboo shoots into powder for food fortification is one very popular and convenient processing method which is being used worldwide.[7,8] The present study was carried out to study nutritional content and organoleptic qualities from freeze dried powder fortified biscuits from fresh, 20minutes boiled and 24hours plain water soaked shoots of bamboo. As far as per our knowledge, this is the first report of usage of bamboo shoot freeze dried powder for food fortification.

Materials and methods

Procurement of plant material

Young shoots of *Dendrocalamus hamiltonii* Nees & Arn. ex Munro was collected from the local vegetable market of Shillong, Meghalaya (India), during the months of June to September and transported to Chandigarh for further experiments. Outer culm sheath was peeled and damaged parts removed and edible part of the shoot was washed properly.

The presented work is collaborative research between

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