Evaluating the Nutritional Fortification Potential of Bamboo (*Dandrocalamus Strictus*) Shoot Powder

Bhanu Pratap Nayak[1*]

[1]Assistant Professor, Govt. Rajeev Lochan P. G. College, Rajim, Gariyaband, Chhattisgarh

Received:1 September 2025
Accepted:25 September 2025
Genre: Food Science

Corresponding Author
Dr. Bhanu Pratap Nayak,
bh.nayak63@gmail.com

Cite this article
Nayak, B. P., (2025). Evaluating the Nutritional Fortification Potential of Bamboo (Dandrocalamus Strictus) Shoot Powder, JESS, 1(1), 1-8.

ABSTRACT

Food and nutrition security is still a major concern, especially in areas where people do not get enough protein and essential nutrients. Bamboo shoots are traditional forest foods that can help improve nutrition because they are rich in important nutrients. This study explores the nutritional value and fortification potential of bamboo shoot powder (BSP) made from *Dendrocalamus strictus*, a common bamboo species found widely in Central India, especially in Chhattisgarh.

Fresh bamboo shoots were cleaned, boiled to remove natural toxins, dried, and made into powder. The nutritional analysis showed that *D. strictus* BSP contains high protein, high fibre, useful minerals, and very little fat. These qualities make it a good natural ingredient for improving the nutrition of everyday foods. Using BSP in snacks, bakery items, and other food products can help increase nutrient intake and reduce hidden hunger.

Overall, *D. strictus* bamboo shoot powder is a safe, affordable, and nutritious option that can support better health, help local communities, and promote the sustainable use of forest resources.

Keywords: Bamboo shoot powder; *Dendrocalamus strictus*; Food fortification; Nutritional security; Functional foods; Non-timber forest products (NTFPs)

1. Introduction

Food and nutritional security remains a critical global concern affecting millions of people worldwide. With the global population projected to reach 9.7 billion by 2050 (United Nations, 2017), pressure on the world's food systems is intensifying at an unprecedented rate. Despite notable advancements in agricultural production, challenges such as unequal food distribution, limited affordability, inadequate nutrition education, and environmental stressors continue to restrict access to safe and nutritious food.

In India, these challenges are even more pronounced. Although the country is a leading producer of cereals and several other food crops, a significant portion of the population still struggles to meet basic nutritional requirements. Modern agricultural constraints including declining soil fertility, excessive use of chemical inputs, rising cultivation costs, groundwater contamination, and stagnating crop productivity have collectively contributed to the persistence of malnutrition (Satya et al., 2012).

Consequently, many communities experience "hidden hunger," a form of micronutrient deficiency in which food may be available but lacks essential nutrients required for healthy growth and development. This situation highlights the urgent need for sustainable, affordable, and accessible nutrition-enhancing strategies to strengthen food and nutritional security (Satya et al., 2012).

2. Food Fortification: A Sustainable Strategy for Nutritional Security

Food fortification is a practical and scientifically validated approach to improving nutritional intake. It involves enriching food products with essential nutrients, bioactive compounds, or therapeutic ingredients to enhance their health-promoting properties beyond basic nourishment. The growing global interest in functional, designer, and nutraceutical foods reflects a rising consumer demand for healthier lifestyle choices (Caragay, 1992; Thomas & Earl, 1994; Wahlgvist, 2004; German, Yeretzian, & Watzke, 2004; Siro et al., 2008; Granato et al., 2010).

Among various natural fortificants, edible bamboo shoots are gaining prominence due to their rich nutrient profile (Bhargava et al., 1996; Singhal et al., 2013), low caloric content, high dietary fibre (Nirmala, Bisht, & Sheena, 2011), and valuable phytochemicals with potential health benefits (Park & Jhon, 2009). Although certain processing methods may lead to a slight reduction in their natural nutrient composition, appropriate fortification and processing techniques can help restore or even enhance the nutrient density of bamboo-based products (Choudhury, Sahu, & Sharma, 2012; Nirmala & Bisht, 2017).

Given their affordability, cultural acceptability, and superior nutritional qualities, bamboo-derived ingredients present a promising option for addressing nutrient deficiencies, particularly in regions burdened with protein–calorie malnutrition.

3. Non-Timber Forest Products (NTFPs) and Their Utility

Non-Timber Forest Products (NTFPs) encompass all valuable biological materials derived from forests excluding timber such as fruits, leaves, medicinal plants, seeds, resins, gums, honey, and bamboo shoots (Arinana et al., 2008; Satya et al., 2012). For centuries, NTFPs have played a vital role in the sustenance of forest-dependent communities, serving as essential sources of food, nutrition, income, traditional medicine, and socio-cultural practices. Their multifunctional value makes them indispensable for both daily subsistence and long-term livelihood resilience.

Globally, nearly 80% of the population in developing countries depends on NTFPs for enhancing dietary diversity and meeting primary healthcare needs (Arinana et al., 2008; Tamang & Tamang, 2009; Rajyalakshmi & Geervani, 1994). With over 150 forest-based products traded internationally, NTFPs significantly contribute to rural economies and offer important opportunities for employment, especially for women and marginalized groups. The ecological sustainability of NTFPs further strengthens their relevance in poverty alleviation and community-based resource management.

Within this broad category, bamboo holds a distinctive position. Its rapid growth rate, ecological adaptability, and exceptional versatility make it one of the most economically and environmentally valuable NTFPs. Bamboo contributes to soil conservation, carbon sequestration, climate resilience, and provides raw materials for food, handicrafts, construction, and industrial applications (Tewari, 1988; Scurlock et al., 2000; Yuming et al., 2004). The edible shoots of bamboo, in particular, hold promising potential in addressing nutritional challenges, reinforcing the importance of bamboo as a sustainable and livelihood-enhancing resource.

4. Bamboo: Diversity, Food Relevance, and Nutritional Significance

Bamboo, a member of the Poaceae family under the subfamily Bambusoideae, is renowned for its exceptional ecological and economic value. Often referred to as "green gold," "the poor man's timber," and "the cradle to coffin plant," bamboo has earned these titles due to its remarkable versatility and widespread applications across construction, craft industries, environmental management, and food systems (Kumar et al., 2017).

4.1 Uses: Bamboo's multifunctionality is reflected in its extensive applications across industrial, medicinal, and food sectors. In industrial and structural domains, bamboo is widely utilized in construction, furniture making, handicrafts, paper production, and fibre-based industries due to its high tensile strength, flexibility, and renewability (Singhal et al., 2013). In traditional medicine, various bamboo-derived products including bamboo salt, bamboo vinegar, and plant extracts are used for their therapeutic properties, particularly in managing conditions such as diabetes, inflammation, and hypercholesterolemia.

Bamboo also holds substantial significance in food systems, where its edible shoots are consumed as vegetables and incorporated into salads, pickles, fermented preparations, and numerous regional delicacies. Recent innovations have expanded its use into value-added products such as cookies, candies, curries, and beverages, further highlighting its culinary versatility and nutritional potential (NMBA, 2009).

4.2 Nutritional Properties of Bamboo Shoots: Bamboo shoots possess a rich nutritional profile, making them a valuable dietary component with significant functional food potential.

- **High Protein Content:** Fresh bamboo shoots contain approximately 2.6 g of protein per 100 g, which can increase up to 25% on a dry weight basis, highlighting their potential as a plant-based protein source (Yamaguchi, 1983; Kumbhare & Bhargava, 2007).
- **Rich Dietary Fibre:** The fibre content ranges from 2.23 to 4.20 g per 100 g of fresh shoots, contributing to improved digestion, gut health, and the prevention of metabolic disorders (Nirmala et al., 2014).
- **Essential Amino Acids:** Bamboo shoots provide essential amino acids such as tyrosine and lysine particularly significant because lysine is a limiting amino acid in cereal-based diets enhancing overall protein quality when used in mixed diets (Kumbhare & Bhargava, 2007; Singhal et al., 2013).
- **Vitamins:** They contain important vitamins including thiamine (B1), niacin (B3), vitamin A, vitamin B6, and vitamin E, supporting metabolism, immunity, vision, and antioxidant functions. (Nirmala et al., 2007)
- **Minerals:** Bamboo shoots are rich in potassium (533 mg per 100 g), which aids cardiovascular health, along with selenium, calcium, and phosphorus, essential for antioxidant defense, bone strength, and metabolic processes. (Nirmala et al., 2007)
- **Low Fat Content:** With only 0.3 g of fat per 100 g, bamboo shoots are naturally low in fat, making them suitable for low-calorie and health-oriented diets.
- These nutritional characteristics collectively make bamboo shoots a promising functional food ingredient with significant potential for incorporation into fortified and value-added food products (Nirmala et al., 2011; Singhal et al., 2013).

5. Edible Bamboo Species and the Significance of *Dendrocalamus strictus*

Edible bamboo shoots are harvested from young, newly emerging culms that are enclosed within protective sheaths. Although highly nutritious, fresh shoots naturally contain the cyanogenic glycoside taxiphyllin, which can liberate hydrogen cyanide. Therefore, appropriate pre-processing such as boiling, fermenting, or drying is crucial to ensure safety and edibility.

5.1 Importance of *Dendrocalamus strictus*

Dendrocalamus strictus, commonly known as “male bamboo,” is one of the most widely distributed bamboo species in India. Its significance stems from several ecological, cultural, and nutritional attributes:

- **Extensive Distribution in India:** This species is abundant across various Indian states, with particularly high availability in Chhattisgarh, making it an important regional resource (Nayak & Palta, 2022).
- **Traditional Consumption:** Tribal and forest-dependent communities have consumed D. strictus shoots for generations, incorporating them into traditional

diets and fermented preparations.

- **Ecological Adaptability:** It thrives in both moist and dry deciduous forests, demonstrating resilience to varying climatic conditions and contributing to soil conservation and forest biodiversity.
- **Nutritional Superiority:** Compared to species such as *D. asper*, *D. strictus* is reported to possess higher levels of key nutrients, making it particularly suitable for nutritional fortification and food product development.

5.2 Nutritional Profile of Raw *D. strictus* Shoots (per 100 g edible portion)

- Moisture: 85.98%
- Ash (Total Minerals): 1.14%
- Phosphorus: 58.13 mg
- Calcium: 139.5 mg
- Iron: 2.74 mg

This nutrient composition highlights *D. strictus* as a highly valuable food resource with considerable potential for use in both traditional consumption and modern value-added food processing (Nayak & Palta, 2022).

6. Detoxification and Preparation Steps

- **Procurement and Trimming:** Fresh, tender, and edible young bamboo shoots are collected, and their outer sheaths are removed to expose the soft inner portion.
- **Cutting and Rinsing:** The shoots are cut into small uniform chips or slices and thoroughly washed to remove dirt and surface impurities.
- **Blanching:** The chips are blanched for approximately 30 minutes, with water replaced every 10 minutes.
- This step is critical for leaching out taxiphyllin and significantly reducing cyanide content.
- **Drying:** Blanched shoots are dried at 55–70°C until the moisture content reaches about 5%, preventing microbial growth and improving storage stability.
- **Grinding and Sieving:** The dried chips are finely ground and passed through a 100-mesh sieve to obtain a uniform bamboo shoot powder.
- **Packaging:** The resulting BSP is packed in airtight, moisture-proof polyethylene pouches to maintain quality, prevent contamination, and ensure extended shelf life.

6.1 Significance of Processing

- **Efficient Removal of Taxiphyllin:** Processing effectively eliminates cyanogenic glycosides, ensuring safety for consumption.
- **Improved Palatability and Acceptability:** Removal of bitterness and undesirable flavours makes the product more appealing for diverse food applications.

- **Enhanced Microbial Safety:** Reduced moisture and proper packaging prevent microbial spoilage.
- **Extended Shelf Life:** While raw bamboo shoots perish within 2–3 days, BSP remains stable for extended periods, enabling year-round use in value-added and fortified foods.

7. Nutritional Superiority of *Dendrocalamus strictus* Bamboo Shoot Powder

Chemical analysis of *D. strictus* bamboo shoot powder (BSP) demonstrates its rich nutrient profile and suitability as a functional food ingredient. The proximate composition (per 100 g) is represented in Table 1.

Table 1: Nutritional Composition of *D. strictus*

Component	**Value (g/100 g)**
Protein	26.28
Fibre	17.42
Carbohydrates	36.84
Ash	9.63
Fat	4.83
Moisture	5.00

Key Nutritional Advantages

- **Protein-Rich:** With over 26 g of protein per 100 g, *D. strictus* BSP can substantially supplement diets that are deficient in protein, particularly in communities relying heavily on cereals or plant-based foods.
- **High Dietary Fibre:** The notable fibre content supports digestive health, helps regulate cholesterol levels, and aids in the prevention of metabolic disorders.
- **Mineral-Dense:** The high ash content reflects abundant mineral availability, supporting various metabolic and physiological processes essential for maintaining health.
- **Low Fat and Low Calorie:** Containing only 4.83 g of fat, BSP is suitable for health-conscious consumers and ideal for low-calorie dietary formulations.
- **Nutraceutical Potential:** The presence of phytosterols and other bioactive compounds contributes to cholesterol-lowering effects and offers additional health benefits, enhancing its applicability in functional and therapeutic foods.

Collectively, these characteristics underscore *D. strictus* BSP as a potent natural ingredient for food fortification, dietary diversification, and innovative product development.

8. Conclusion

Dendrocalamus strictus bamboo shoot powder emerges as a nutrient-dense, culturally acceptable, and shelf-stable forest-based food ingredient with exceptional potential to address both global and national challenges of food and nutritional security. Its superior nutritional composition high protein, substantial fibre, essential minerals, and low fat combined with its bioactive properties, positions it as an effective natural fortificant.

The processing of bamboo shoots not only ensures the removal of toxic cyanogenic compounds but also enhances safety, sensory acceptability, and year-round availability. This enables the incorporation of BSP into a wide variety of commonly consumed foods such as bakery items, snacks, beverages, complementary foods, and traditional preparations.

Integrating *D. strictus* BSP into daily diets can significantly improve nutritional quality and help combat "hidden hunger." Beyond improving public health, its utilization opens avenues for new product development, rural livelihood enhancement, and sustainable use of indigenous forest resources.

Thus, *D. strictus* bamboo shoot powder holds remarkable promise as an affordable, natural, and sustainable solution for strengthening food and nutrition security while fostering innovation in functional food development.

Author Contributions

Dr. Bhanu Pratap Nayak – Research Idea, Design of study, Mansucript writing

Funding Sources

No funding or support was received from organizations that may gain or lose financially through this publication.

Acknowledgement

The author would like to express his sincere gratitude to Principal, Govt. Rajeev Lochan P. G. College, Rajim for his kind permission and support contributed to the successful completion of this research work.

Statement of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research paper.

References

1. Arinana, H., Hinsui, J., Ignatius, B., Kronseder, K., Kärkkäinen, J., Pingoud, P., & Sandra, E. (2008). Non timber forest products in Northern Thailand.
2. Bhargava, A., Kumbhare, V., Srivastava, A., & Sahai, A. (1996). Bamboo parts and seeds for additional source of nutrition. Journal of Food Science and Technology, 33(2), 145–146.
3. Bhatt, B. P., Singh, K., & Singh, A. (2005). Nutritional values of some commercial edible bamboo species of the North Eastern Himalayan Region, India. Journal of Bamboo and Rattan, 4(2), 111–124.
4. Caragay, A. B. (1992). Cancer preventive foods and ingredient. Food Technology, 46(4), 65–68.
5. Choudhury, D., Sahu, J. K., & Sharma, G. D. (2012). Bamboo shoot: Microbiology, biochemistry and technology of fermentation – A review. Indian Journal of Traditional Knowledge, 11(2), 242–249.
6. German, J. B., Yeretzian, C., & Watzke, H. J. (2004). Personalizing foods for health and preference. Food Technology, 58(12), 26–31.
7. Granato, D., Branco, G. F., Nazzaro, F., Cruz, A. G., & Faria, J. A. F. (2010). Functional foods and nondairy probiotic food development: Trends, concepts, and products. Comprehensive Reviews in

Food Science and Food Safety, 9, 292–302.
8. Kumar, P. S., Kumari, K. U., Devi, M. P., Choudhary, V. K., & Sangeetha, A. (2017). Bamboo shoot as a source of nutraceuticals and bioactive compounds: A review. Indian Journal of Natural Products and Resources, 8(1), 32–46.
9. Kumbhare, V., & Bhargava, A. (2007). Effect of processing on nutritional value of central Indian bamboo shoots. Part I. Journal of Food Science and Technology, 44(1), 29–31.
10. Nayak, B. P., & Palta, A. (2022). Development of bamboo (Dendrocalamus strictus) shoot powder and its nutritional value. International Journal of Food and Nutrition Sciences, 11, 15–20.
11. Nirmala, C., Bisht, M. S., & Sheena, H. (2011). Nutritional properties of bamboo shoots: Potential and prospects for utilization as a health food. Comprehensive Reviews in Food Science and Food Safety, 10(3), 153–165.
12. Nirmala, C., Bisht, M. S., & Laishram, M. (2014). Bioactive compounds in bamboo shoots: Health benefits and prospects for developing functional foods. International Journal of Food Science and Technology, 49(6), 1425–1431.
13. Nirmala, C., & Bisht, M. S. (2017). Bamboo: A prospective ingredient for functional food and nutraceuticals. Bamboo Journal, 30, 82–99.
14. NMBA (National Mission on Bamboo Applications). (2009). Recipes standardized by ERG, Bangalore.
15. Park, E. J., & Jhon, D. Y. (2009). Effects of bamboo shoot consumption on lipid profiles and bowel function in healthy young women. Nutrition, 25(7–8), 723–728.
16. Rajyalakshmi, P., & Geervani, P. (1994). Nutritive value of the foods cultivated and consumed by the tribals of South India. Plant Foods for Human Nutrition, 46, 53–61.
17. Satya, S., Singhal, P., Bal, L. M., & Sudhakar, P. (2012). Bamboo shoot: A potential source of food security. Mediterranean Journal of Nutrition and Metabolism, 5(1), 1–10.
18. Singhal, P., Bal, L. M., Satya, S., Sudhakar, P., & Naik, S. N. (2013). Bamboo shoots: A novel source of nutrition and medicine. Critical Reviews in Food Science and Nutrition, 53(5), 517–534.
19. Siro, I., Kapolna, E., Kapolna, B., & Lugasi, A. (2008). Functional food: Product development, marketing and consumer acceptance—A review. Appetite, 51, 456–467.
20. Tamang, B., & Tamang, J. P. (2009). Traditional knowledge of biopreservation of perishable vegetables and bamboo shoots in Northeast India as food resources. Indian Journal of Traditional Knowledge, 8(1), 89–95.
21. Tewari, D. N. (1988). Bamboo as poverty alleviator. Indian Forester, 114, 610–612.
22. Wahlqvist, M. L. (2004). Requirement for healthy nutrition: Integrating food sustainability, food variety, and health. Journal of Food Science, 68, 16–18.
23. Yamaguchi, M. (1983). World vegetables: Principles, production and nutritive values. AVI Publishing.
24. Yuming, Y., Kanglin, W., Shengji, P., & Jiming, H. (2004). Bamboo diversity and traditional uses in Yunnan, China. Mountain Research and Development, 24(2), 157–165.