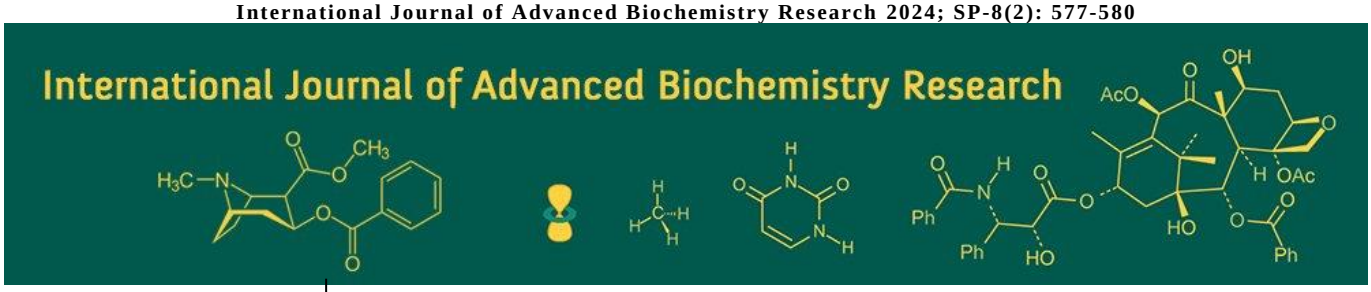

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(2): 577-580
www.biochemjournal.com
Received: 07-11-2023
Accepted: 11-12-2023

P Yasaswini
Ph.D Scholar, Food Science and Nutrition Department, UAS, Bangalore, Karnataka, India

T Kamalaja
Senior Scientist, AICRP-Home Science, Department of Foods and Nutrition, PGRC, PJTSAU, Hyderabad, Telangana, India

Corresponding Author:
P Yasaswini
Ph.D Scholar, Food Science and Nutrition Department, UAS, Bangalore, Karnataka, India

Nutritional and phytochemical properties of Thellachakrakeli tender banana pseudostem flour

P Yasaswini and T Kamalaja

DOI: https://doi.org/10.33545/26174693.2024.v8.i2Sh.652

Abstract
Aims: To evaluate the nutritional and phytochemical composition in the Thellachakrakeli tender banana pseudostem flour.
Place of Study: Department of Foods and Nutrition, PGRC, PJTSAU, Hyderabad, Telangana, India
Methodology: Pseudostems were dried, powdered and nutritional and phytochemical compounds were evaluated using standard procedures.
Results: The moisture content was 7.50±0.42 g/100 g, protein 4.35±0.13 g/100 g, fat 1.48±0.08 g/100 g, ash 23.51±0.26 g/100 g, carbohydrate 49.48±0.27 g/100 g, energy 228.71±0.91 kcal, crude fibre 13.67±0.41 g/100 g, dietary fibre 30.52±0.13 g/100 g, total phenols 165.36±2.45 mg of GAE/100 g, total flavonoids 1023.18±0.53 mg of RTE/100 g, DPPH 43.96±0.08% inhibition, tannins 3.74±0.03 mg of TAE/100 g, water holding capacity (WHC) 444.33±1.52 g/100 g and oil holding capacity (OHC) 278.66±1.52 g/100 g.
Conclusion: The pseudostem of bananas had high nutritional properties. Therefore, it can be utilized by the food industries to develop value added products.

Keywords: Banana pseudo-stem flour, Thellachakrakeli, food industries, nutritional properties

1. Introduction
Banana is an herbaceous plant that belongs to the family Musaceae. In the world, banana is the 4th most important food product next to rice, corn and milk [1]. The global annual production of bananas was 116 million tons, and it is one of the most extremely consumed fruits [2]. In India, the top five banana producing states are Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu and Uttar Pradesh. Andhra Pradesh has the highest share (16.27%) in banana production and produces 5 million metric tonnes. Telangana's share was only 0.29% in India [3].
There are mainly two wild species of banana namely *Musa acuminata* and *Musa balbisiana*. Approximately all the edible parthenocarpic bananas belong to these 2 species [4]. Most important Musa cultivars include Red banana, Tella Chakrakeli, Robusta, Nanjangud Rasbale, Karpura Valli, Nendran and Grand-9 [5].
The stem of the banana plant is called pseudostem because each plant produces only a single bunch of bananas before dying and will be substituted by a new pseudostem [6]. The pseudostem comprises huge overlapping leaf stalk bases which are firmly rolled around each other to form a bundled and cylindrical structure with approximately 48 cm in diameter [7]. The banana pseudostem can be used more in food rather than in other industries. Therefore, the utilisation of waste banana pseudostems into various products could specifically benefit the environment and is cost-effective [8].
Despite the known potential of banana pseudostems, limited research explores the nutritional composition of specific cultivars, particularly "Tellachakrakeli tender pseudostem". This research aims to address this gap by analyzing the nutritional profile of Thellachakrakeli tender banana pseudostem flour, potentially unlocking its value as a functional food ingredient.
Understanding the nutritional content of Thellachakrakeli tender banana pseudostem flour is crucial for promoting its utilization as a nutritious and sustainable food resource. This research could benefit researchers, food developers, and individuals seeking alternative, nutrient-rich dietary options.

This research delves into the potential of "Tellachakrakeli" tender banana pseudostem flour, contributing to sustainable waste management while exploring new avenues for dietary diversification and nutritional security. The findings could inform future efforts to combat food insecurity and promote environmentally responsible food production.

2. Materials and Methods

In this present study, the pseudostems were dried, powdered and evaluated nutritional and phytochemical compounds present in the pseudostem flour. Banana pseudostems of Thellachakrakeli variety were procured from Medarametla village, Korisapadu Mandal, Andhra Pradesh. The banana pseudostem were cleaned under tap water. Then the outer sheaths were removed till the inner tender core. The inner tender core was made into slices with the help of a stainless steel knife. Then the slices were soaked in 0.2% w/v citric acid solution for 10 minutes to control the browning reaction. Then these tender core pieces were blanched at 100 °C for 2minutes and dried using a laboratory tray dryer at 60 °C. It took 8 hours to dry completely. The dried sample was powdered using a mixer. Then the powder was sieved with a 400-micron sieve and stored in air tight bags. One kg fresh weight of Thellachakrakeli tender core banana pseudostem after drying yields 25 g banana pseudostem flour.

The nutritional quality parameters of Thellachakrakeli banana pseudostem flour include moisture [9]; protein [10]; crude fibre [11]; ash [12] and fat [13]; carbohydrates & energy [14]; dietary fibre [15]; total phenols [16]; total flavonoid [17]; DPPH [18]; tannins [19] and physical parameters like water holding capacity and oil holding capacity [20] were analysed using standard methods.

3. Results and Discussion

Thellachakrakeli variety of tender core banana pseudo-stem flour consists of various nutrients which help to maintain good health. The nutrient parameters of the pseudo-stem powder are presented in Table-1.

Table 1: Nutritional composition of Thellachakrakeli tender banana pseudo stem flour (100 gms)

Nutritional parameters	Values	Units
Moisture	7.50±0.42	%
Protein	4.35±0.13	%
Fat	1.48±0.08	%
Ash	23.51±0.26	%
Crude fibre	13.67±0.41	%
Total dietary fibre	30.52±0.13	%
Carbohydrates	49.48±0.27	%
Energy	228.71±0.91	kcal
Total phenols	165.36±2.45	mg of GAE/100 g
Total flavonoids	1023.18±0.53	mg of RTE/100 g
DPPH	43.96±0.08	% inhibition
Tannins	3.74±0.03	mg of TAE/100 g
Water holding capacity (WHC)	444.33±1.52	%
Oil holding capacity (OHC)	278.66±1.52	%

*GAE- Gallic Acid Equivalent *RTE- Rutin Equivalent *TAE- Tannic Acid Equivalent

3.1 Proximate composition

3.1.1 Moisture

The moisture content of any flour less than 10% will helps to maintain good keeping quality (El Wakeel, 2007). The moisture content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) was 7.5±0.42% (Table 1). Sangroula [8] was found 6.2% of moisture content in banana pseudostem flour and 8.82% moisture content was observed by Aziz and co-workers [21]. The variations in moisture content may be due to differences in the variety of bananas, the size of the banana pseudostem slices and drying conditions.

3.1.2 Protein

The protein content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) (4.35±0.13%) was specified in Table 1. Farzin and co-workers [22] reported that protein content in banana pseudostem flour of Bichi variety and Kacha variety was 9.13% and 4.26% respectively. The results of the TCHBPF variety were in accordance with the results reported in the above findings. This might be due to the same soil and climatic conditions in the cultivated crops.

3.1.3 Fat

The fat content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) was 1.48±0.08% (Table 1). Sangroula [8] in his study on banana pseudostem flour found that the fat content was 1.8%. The slight variation in the present study may be due to the varietal difference.

3.1.4 Ash

The ash content represents the mineral content of the sample. The mean ash content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) was 23.51±0.26% (Table 1). Tiroutchelvame and co-workers [23] represented 28% ash content in the banana pseudostem flour.

3.1.5 Crude Fibre

Crude fibre is the indigestible cellulose, pentoses, lignins and other components present in the food. The crude fibre content of TCHBPF (13.67±0.41) was represented in Table 1. Tiroutchelvame and co-workers [23] reported higher crude fibre content (15%) in banana pseudostem flour. While Sangroula [8] reported lower crude fibre content (13.3%) compared to the present investigation. This might be due to differences in the maturity levels of banana pseudostems.

3.1.6 Dietary fibre

Total dietary fibre is comprised of both soluble dietary fibre and insoluble dietary fibre. It is a type of carbohydrate, which holds digestion and absorption. Consumption of dietary fibre has a lot of positive health effects such as it aids in the maintenance of GI tract function, reduces the risk of diabetes, obesity, coronary heart disease and several types of cancer [24]. The dietary fibre analytical results of TCHBPF (30.52±0.13%) was given in Table 1. Bhaskar and co-workers [25] reported 28.8% of dietary fibre content in the Elakki bale variety which was slightly lower than the present investigation. This was due to differences in the usage of drying processing techniques in the banana pseudostem flour preparation.

3.1.7 Carbohydrates

The carbohydrate content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) was 49.48±0.27% (Table 1). The highest carbohydrate content was due to the lower protein, fat, ash content of TCHBPF. Ramu and co-workers [26] represented the carbohydrate content of banana pseudostem flour as 46.58%. This might be due to differences in the drying conditions of the pseudostems.

3.1.8 Energy
The energy content of TCHBPF was 228.71±0.91 Kcal/100 g (Table 1). Farzin and co-workers [22] reported that the energy content in Bichi and Kacha varieties of pseudostem flour was 363.8 Kcal/100 g and 335.94 Kcal/100 respectively which were higher than the present investigation. This might be due to lower ash content in Bichi (10%) and Kacha (8%) varieties compared to TCHBPF.

3.2 Phytochemical composition
3.2.1 Total phenols
Total phenols content of Thellachakrakeli tender banana pseudostem flour (TCHBPF) was 165.36±2.45 mg of GAE/100 g (Table 1). Ramu and co-workers [26] stated that the total phenols content in *Musa* species Nanjangud Rasa Bale pseudostem flour was 188.64 mg of GAE/100 g. The variation might be due to differences in the banana pseudostem species.

3.2.2 Total flavonoids
Total flavonoid content (1023.18±0.53 mg of RTE/100 g) of Thellachakrakeli banana pseudostem flour (TCHBPF) was given in Table 1. However, the total flavonoids content in tender banana pseudostem flour (*M. acuminata* × *balbisiana* Colla cv. Awak) was 1042 mg of CEQ/100 g [21]. This was on par with the results of TCHBPF which was due to similar climatic conditions.

3.2.3 DPPH antioxidant activity
DPPH antioxidant activity of Thellachakrakeli banana pseudostem flour (TCHBPF) was 43.96±0.08% inhibition (Table 1). Saravanan and Aradhya [26] estimated the DPPH radical scavenging activity in methanol extract of different banana pseudostem cultivars was found 40.02 to 12.73% inhibition. The variation might be due to different cultivation practices and levels of maturity in banana pseudostems.

3.2.4 Tannins
Tannins are anti-nutrients that inhibits the absorption of dietary minerals such as iron, copper and zinc. The tannin content of Thellachakrakeli tender banana pseudostem flour (3.74±0.03 mg of TAE/100 g) was given in Table 1. The supplementation of condensed tannic acid (1.5, 0.35 and 0.03 g 3 times/day) for four weeks had no effect on iron bioavailability or status in premenopausal women [28]. Hence, the amount of tannin content present in the TCHBPF had no effect on human health when consumed at adequate levels.

3.3 Functional properties
3.3.1 Water holding capacity (WHC)
Water holding capacity is the ability to hold water which is an important property for the digestion and satiety of foods rich in fibre. WHC also helps to reduce the loss of nutrients present in the foods. WHC of TCHBPF was 444.33±1.52%. (Table 1). Yuliatmoko [29] described that the WHC of *Musa Cavendish* banana pseudostem flour was 433% which was lower than the present investigation. The dissimilarity might be due to differences in the drying techniques.

3.3.2 Oil holding capacity (OHC)
Oil holding capacity helps to improve the texture of a product. OHC of Thellachakrakeli banana pseudostem flour (TCHBPF) was 278.66±1.52% given in Table 1. Yuliatmoko [29] studied the OHC of Musa Cavendish banana pseudostem flour and reported 300.40% which was higher than the present investigation varieties. This might be due to the varietal differences of banana pseudostems.

4. Conclusion
In conclusion, the research on the nutritional composition of Thellachakrakeli tender banana pseudostem flour underscores its potential as a valuable resource rich in dietary fiber, crude fiber, and phytochemicals. These components play essential roles in maintaining gastrointestinal health, combating free radicals, and providing essential minerals. Moreover, the findings suggest that Thellachakrakeli banana pseudostem flour can be utilized in the development of various value-added products aimed at improving human health. Importantly, promoting the utilization of banana pseudostems offers a sustainable and cost-effective solution for banana farmers, mitigating environmental pollution caused by burning pseudostems. Overall, this research highlights the nutritional benefits and practical applications of Thellachakrakeli tender banana pseudostem flour, contributing to both agricultural sustainability and human well-being.

5. Funding and Acknowledgement
There is no external funding provided for this research. Ethics statement no specific permits were required for the described field studies because no human or animal subjects were involved in this research.

6. Competing interests
Authors have declared that no competing interests exist.

7. References
1. Rana GK, Singh Y, Mishra SP, Rahangdale HK. Potential use of banana and its byproducts: A review. International Journal of Current Microbiology and Applied Sciences. 2018;7(6):1827-1832.
2. FAOSTAT (Food and Agriculture Organisation Statistics). FAO statistical databases. Food and Agriculture Organisation Statistics; c2018. http://www.fao.org/faostat/en/#data/QC
3. NHB (National Horticulture Board), Ministry of Agriculture, Government of India, Indian Horticulture Database; c2018. https://agriexchange.apeda.gov.in/India%20Production/India_Productions.aspx?cat=fruit&hscode=1042
4. Robinson JC, Sauco VG. Bananas and plantains. 2010;19:1-21.
5. Hasan SA, Khasim, SM. Evaluation of Rapd analysis to differentiate the genotypes of 11 Musa cultivars. Journal of Biotechnology and Biochemistry. 2010;4(2):29-36.
6. Anhwange BA, Ugye TJ, Nyiaatargher TD. Chemical composition of *Musa sapientum* (banana) peels. Electronic Journal of Environmental, Agricultural and Food Chemistry. 2009;8(6):437-442.
7. Ho LH, Tan TC, Aziz, NAA, Muhamad N. Physical and functional properties of banana pseudostem flour and its effect on the quality (texture and microstructure) of formulated bread. Journal of Agrobiotechnology. 2017;8(1):1-12.

8. Sangroula P. Utilization of banana pseudostem for biscuit making. Doctoral dissertation. Department of Food Technology, Central Campus of Technology Institute of Science and Technology, Tribhuvan University, Nepal; c2018.
9. AOAC. Official Methods of Analysis for moisture in flour. Association of Official Analytical Chemists. 18th Edition. Arlington VA 2209, USA. AOAC 929.03, chapter 32; c2005. p. 02.
10. AOAC. Official Methods of Analysis for protein. Association of Official Analytical Chemists. 18th Ed.Arlington VA 2209, USA; 2005; AOAC 984.13, chap 04, pp 31.
11. AOAC. Official Methods of Analysis for crude fiber. Association of Official Analytical Chemists. 15th Edition. Washington, D.C. USA; c2005
12. AOAC. Official Methods of Analysis for ash in flour. Association of Official Analytical Chemists. 18th Ed. Edition. Arlington VA 2209, USA. AOAC 929.09, chapter 32; c2005. p. 01.
13. AOAC. Official Methods of Analysis for fat (crude) or ether extract in flour. Association of Official Analytical Chemists. 1997; 16th Ed. 3rd Revision. Gaithersburg, Maryland 20877-2417. AOAC 920.85. Chap 32, pp05.
14. AOAC. Official Methods for computation of carbohydrates and energy. Association of Official Analytical Chemists. 14th Edition. Washington, D.C. USA; c1980.
15. AOAC. Official Methods of Analysis for fiber. Association of Official Analytical Chemists. 14th Edition. Washington, D.C. USA; c1995.
16. Slinkard K, Singleton, VL. Total phenol analyses: Automation and comparison with manual methods. American Journal of Enology and Viticulture. 1977;28:49-55.
17. Zhishen J, Mengcheng T, Jianming W. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chemistry. 1999;64(4):555-559.
18. Tadhani MB, Patel VH and Subhash, R. In vitro antioxidant activities of Stevia rebaudiana leaves and callus. Journal of Food Composition and Analysis. 2007;20(4):323-329.
19. Kavitha CCI, Indira G. Quantitative estimation of total phenolic, flavonoids, tannin and chlorophyll content of leaves of Strobilanthes Kunthiana (Neelakurinji). Journal of Medicinal Plants Studies. 2016;4(4):282-286.
20. Chau CF, Huang YL. Comparison of the chemical composition and physicochemical properties of different fibers prepared from the peel of Citrus sinensis L. Cv. Liucheng. Journal of Agricultural and Food Chemistry. 2003;51(9):2615-2618.
21. Aziz NAA, Ho LH, Azahari B, Bhat R, Cheng LH, Ibrahim MNM. Chemical and functional properties of the native banana (*Musa acuminata* × *balbisiana* Colla cv. Awak) pseudo-stem and pseudo-stem tender core flours. Food Chemistry. 2011;128(3):748-753.
22. Farzin S, Nowrin FH, Rahman MM. Utilization of banana pseudo-stem in production of mineral sap drinks, flour and liquid detergent. International Conference on Chemical Engineering; c2014. p. 29-30.
23. Tiroutchelvame D, Pragalyaashree MM, Peter D. Process development for the value addition of banana central core (pseudo stem). International Journal of Recent Technology and Engineering. 2019;8(4):1055-1060.
24. Lattimer, JM, Haub MD. Effects of dietary fiber and its components on metabolic health. Nutrients. 2010;2(12):1266-1289.
25. Bhaskar JJ, Shobha MS, Sambaiah K, Salimath PV. Beneficial effects of banana (*Musa* sp. var. elakki bale) flower and pseudostem on hyperglycemia and advanced glycation end-products (AGEs) in streptozotocin-induced diabetic rats. Journal of Physiology and Biochemistry. 2011;67(3):415-425.
26. Ramu R, Shirahatti PS, Anilakumar KR, Nayakavadi S, Zameer F, Dhananjaya L, *et al*. Assessment of nutritional quality and global antioxidant response of banana (*Musa* sp. CV. Nanjangud Rasa Bale) pseudostem and flower. Pharmacognosy Research. 2017;9 (1):74-83.
27. Saravanan K, Aradhya, SM. Polyphenols of pseudostem of different banana cultivars and their antioxidant activities. Journal of Agricultural and Food Chemistry. 2011;59(8):3613-3623.
28. Delimont NM, Fiorentino NM, Kimmel KA, Haub MD, Rosenkranz SK, Lindshield BL. Long-term dose-response condensed tannin supplementation does not affect iron status or bioavailability. Current Developments in Nutrition. 2017;1(10):1-14.
29. Yuliatmoko W, Murdiati, A, Pranoto Y, Marsono Y. Chemical and functional properties of Cavendish Jepara 30 (*Musa cavendishii*) banana pseudostem flour after blanching and soaking in sodium bisulphite solution. Pakistan Journal of Nutrition. 2019;18(10):936-945.