Journal of Postharvest Technology
2024, 12 (3): 61-71
https://doi.org/10.48165/jpht.2024.12.3.07
www.jpht.in

RESEARCH ARTICLE

Fortification and nutritional analysis of muffins using banana (*Musa balbisiana*) flour

Nika Basumatary, Madhvi Daniel

Department of Food and Nutrition, School for Home Science, Babasaheb Bhimrao Ambedkar University (A Central University), Lucknow, Uttar Pradesh, India

ARTICLE INFO

Received : 02.05.2024
Accepted : 05.07.2024

ABSTRACT

The study aimed to develop muffins by substitution of all-purpose flour in formulations with banana (*Musa balbisiana*) peel and stem flour and to check the nutritional profile of the muffins. Two types of banana-fortified muffins were prepared using 5 % and 10% formulations and were treated as T1 and T2. The muffins prepared using all-purpose flour is treated as control whereas the fortified muffins with banana waste flour as treatment. The fortified muffins are then assessed for organoleptic properties in terms of colour, flavour, texture, and absence of defects using a composite scoring test. The muffins with 5 % banana flour (T1) scored the highest and are the most acceptable fortified muffins. Nutritional analysis (ash, moisture, protein, crude fiber, calcium, and fat) of control and accepted treatment muffins was assessed and compared to check the effect on the nutritional profile of the muffins. The substitution of all-purpose flour by banana waste flour in muffins significantly increased the nutrient content significantly calcium content. Ash, protein, and fat content show a slight increase in banana waste flour muffins.

Keywords: Banana flour, banana waste, bakery products, fortified muffins

Citation: Basumatary, N., & Daniel, M. 2024. Fortification and nutritional analysis of muffins using banana (Musa balbisiana) flour. *Journal of Postharvest Technology*, **12** (3): 61-71.

INTRODUCTION

The food industry is shifting towards healthy and organic food and so does the bakery market. The increasing awareness on mindful and healthy food choices of consumers led to the bakery market seek out for products prepared with healthier and organic ingredients (Chakraborty, 2023). Bakery products are becoming extensively popular among all age groups (Mout & Bora, 2020). The bakery market provides a wide variety of products from cookies, cakes to pastries, bread, and other baked goods (Chakraborty, 2023). The variety of shapes, tastes, flavours, affordability, and perception of freshness and quality of bakery products makes it a popular choice among consumers of all age groups (Luo et al., 2019). The longer shelf life of bakery products makes it a convenient choice for consumers to fill up the stocks for snacks and breakfast items (Chakraborty, 2023). The growth of consumer demand on tastes and functional requirements such as low fat, high fiber, high calcium, and high functional value led to the development of innovative baked products by bakery manufacturers in the market (Chakraborty,

* *For correspondence*: M. Daniel (Email: madhvidaniel@gmail.com) **ISSN: 2348-4330**

2023). With the increase in consumer interest in health and healthy diets, the need to incorporate healthy food ingredients into bakery products arises.

Muffins are sweet baked goods that are baked in appropriate proportions and are highly appreciated by consumers due to their soft texture and characteristic taste (Ramya & Anitha, 2020). As the demand for muffins is increasing day by day; its role in the bakery industries is of great importance (Yadav et al., 2022). Hence, the incorporation of banana (*Musa balbisiana)* peel and stem flour in formulations into all-purpose flour-based muffins will enhance the nutritional value of the muffins.

Musa balbisiana is a seeded banana that holds immense medicinal properties and can aid in the pharmacological industry (Narzary & Sharma, 2022). The banana is giant in size, seeded, and is mostly available in the Northeastern region of India, Andaman & Nicobar Island, and Peninsular India (Borborah et al. 2016). The banana belongs to the family *Musaceae* and is found both as wild and cultivated types (Swargiary et al., 2021). The banana is utilized traditionally as folk medicine by the tribal inhabitants of Northeastern India and the pseudostem and flower have been consumed as vegetables since ancient times (Borborah et al., 2016). Bananas have been used traditionally to treat wound healing, ulcers, diarrhea, jaundice, cough and cold (Swargiary et al., 2021). The fruit pulp of *Musa balbisiana* is a good source of macro and micronutrients including calcium, potassium, sodium, iron, carbohydrates, zinc, and magnesium (Sarma et al., 2021). *Musa balbisiana* possesses anti-oxidative and antiperoxidative properties that help prevent oxidative stress disorders and the fruit of the banana is rich in nutrients like dietary fiber, vitamin C, and Vitamin B6 (Borborah et al., 2016). The low glycaemic index content of banana pseudostem makes it beneficial for diabetes (Bhaskar et al., 2011) The fruits of the banana also exhibit anti-inflammatory, anti-urolithic, and antibacterial properties (Swargiary et al., 2021). Apiforol, a flavanol compound exhibits α-amylase and α-glucosidase inhibitory potential significantly and promotes glucose uptake in the cells which is isolated from seeds of *Musa balbisiana* (Gopalan et al., 2014). Borborah et al. (2016) reported that exudates deposited from pseudostem of *M. balbisiana* were used to cure women's infertility and remove intestinal worm infections. Bioactive compounds such as epicatechin, gallic acid, quercetin, chlorogenic acid, apigenin, and rutin are found significantly in different parts of *Musa balbisiana* (Kumari et al., 2020).

MATERIALS AND METHODS

The details of materials and methodologies were described under following sections to study proximate properties as well as the preparation of best-selected combination of Control and Fortified muffins.

Raw materials

In present study, *Musa balbisiana* flour and All-purpose flour were used as raw materials along with other ingredients. For muffins preparation, good quality commercially available all-purpose flour and other ingredients such as milk, butter etc are purchased from the local market. The *Musa balbisiana* flour is procured from Assam in which the stem and peel are utilized. The inner central core of stem and the peels were cut into small pieces and sundried and then ground to obtain the flour. The obtained flour is kept in an airtight container for further use.

Preparation of muffins

The control muffins were prepared using all-purpose flour and other ingredients such as milk, butter, egg etc.

The fortified muffins (T_1 and T_2) were prepared using banana (*Musa balbisiana)* peel and stem flour, all-purpose flour, and other ingredients. Two formulations (5% and 10%) of fortified muffins is prepared using *Musa balbisiana* flour by substitution of 5 % and 10% all-purpose flour (Fig. 1).

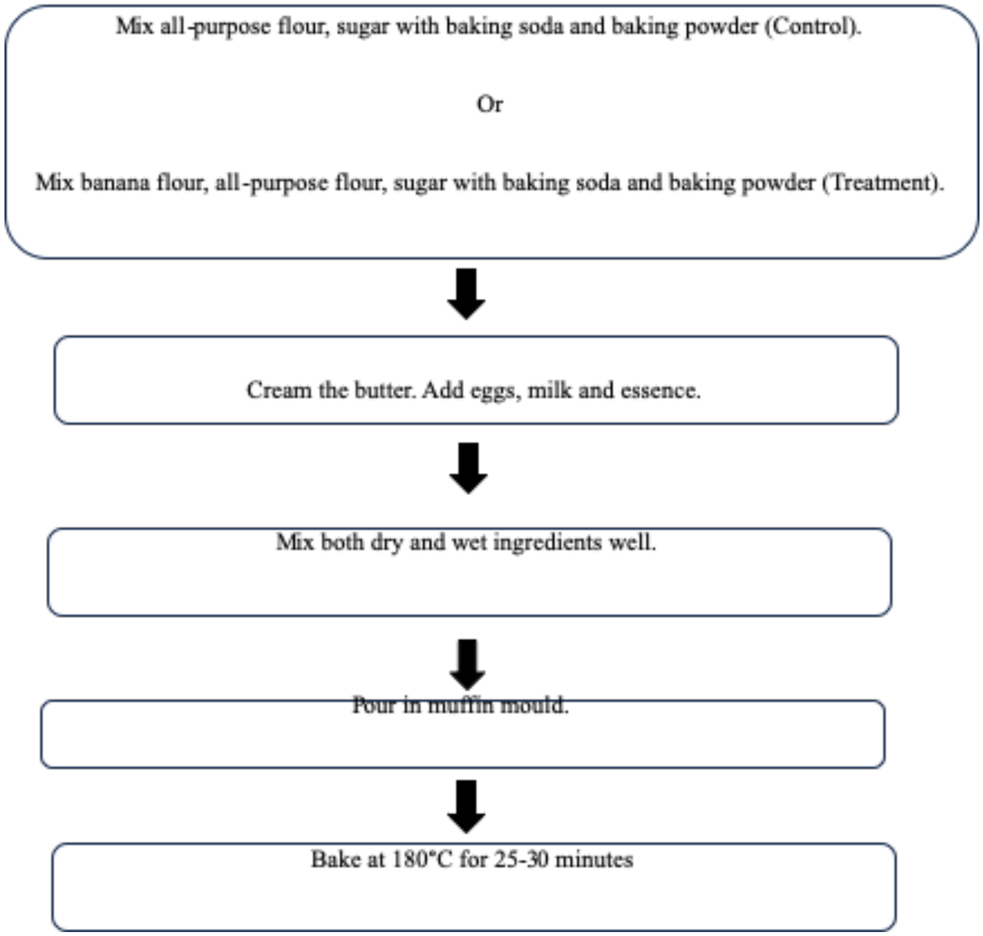

Figure 1: Flowchart of preparation of Control and Fortified muffins

Moisture estimation

About 5 gm of the prepared sample was weighed accurately in the petri dish that was dried previously in an oven at 105°C and weigh the sample. The temperature for the sample in the oven was 105± 2°C for 4 hours. After cooling the sample in the desiccator, the sample was weighed again. The process of drying, cooling, and weighing was repeated at 30-minute intervals until the difference between two consecutive weighings was found to be less than one mg. The lowest weight was recorded as moisture content (Bakery products - Methods of analysis, IS 12711 (1989).

Moisture (%) = $\frac{100\,(W1-W2)}{W1-W}$

Where, W_1= Initial weight in g of the sample with the dish before drying

W_2 = Final weight in gm of the sample with dish after drying

W = Weight in gm of the empty dish

Ash estimation

Weigh about 5 gm of the sample accurately in a cleaned, tared silica dish. The sample in the dish is ignited with the flames of a suitable burner for about an hour. The muffle furnace is kept at 500±10°C to complete the ignition until the ash grey results are observed. The sample is then cooled in a desiccator and weighed. The process of igniting, cooling, and weighing is done at an interval of one hour until the difference between two successive weighings is found to be less than 1 mg. The lowest mass is recorded for ash determination (Bakery products - Methods of analysis, IS 12711 (1989).

Total ash = $\frac{(M2-M)\times 10000}{(M1-M)\,(100-W)}$

Where, M_2 = Mass of the dish with the ash in gm

M_1 = Mass of the dish with the sample in gm

M = Mass of the empty dish

W= Moisture percent in the sample

Carbohydrate estimation

The total carbohydrate was calculated according to the study of Aziz et al. (2011).

Carbohydrate % = 100 – (moisture + fat + ash + protein + crude fiber).

Protein estimation

The protein estimation is done using Methods for Determination of protein in Foods and Feeds IS 7219 (1973).

Protein (percent by mass) = $\frac{N \times 100 \times Conversion\ factor}{W}$

Where, N = mass of nitrogen content in g of original sample.

W = mass of sample in g.

Fat estimation

For fat estimation, the Soxhlet extraction method was used. The fat content was determined according to Bakery products - Methods of analysis, IS 12711 (1989).

Crude fat (%) = $\frac{100\,(W1-W2)}{W}$

Where, W_1= Weight in gm of the Soxhlet flask with the extracted fat.

W_2 = Weight in gm of the empty Soxhlet flask.

W = Weight in gm of the sample.

Fiber estimation

The Crude fiber content was estimated according to the FSSAI lab Manual for Sugar and Confectionary Product (2015).

$$\text{Crude fiber \% (on dry weight)} = \frac{W1-W2}{Weight\ of\ sample} \times \frac{100\times100}{(100-Moisture)}$$

Where, W_1 = Weight of the sample taken after acid and alkali treatment with sintered crucible.

W_2 = Weight of the residue after ashing with the crucible.

Calcium estimation

The Calcium content was determined according to Methods for Volumetric Determination of Calcium and Magnesium using EDTA IS 5949 (1990).

$$\text{Calcium percent as mass} = \frac{V1\times0.04008}{M}$$

Where, V_1= Volume in ml of EDTA solution consumed in titration.

M= mass in g of the sample in the solution.

RESULTS AND DISCUSSION

Proximate analysis of control muffins

Figure 2 represents the result of the parameters of proximate analysis of control muffins. The proximate properties were analyzed and values were observed in control muffins. The control muffins were studied for proximate composition such as moisture content, ash content, protein content, fat content, crude fiber and calcium content. The values observed were found to be 26.75% moisture, 1.25% ash, 5.95% protein, 5.64% fat, 2.7% crude fiber, 57.71% carbohydrate and the calcium content 38mg/100 gm.

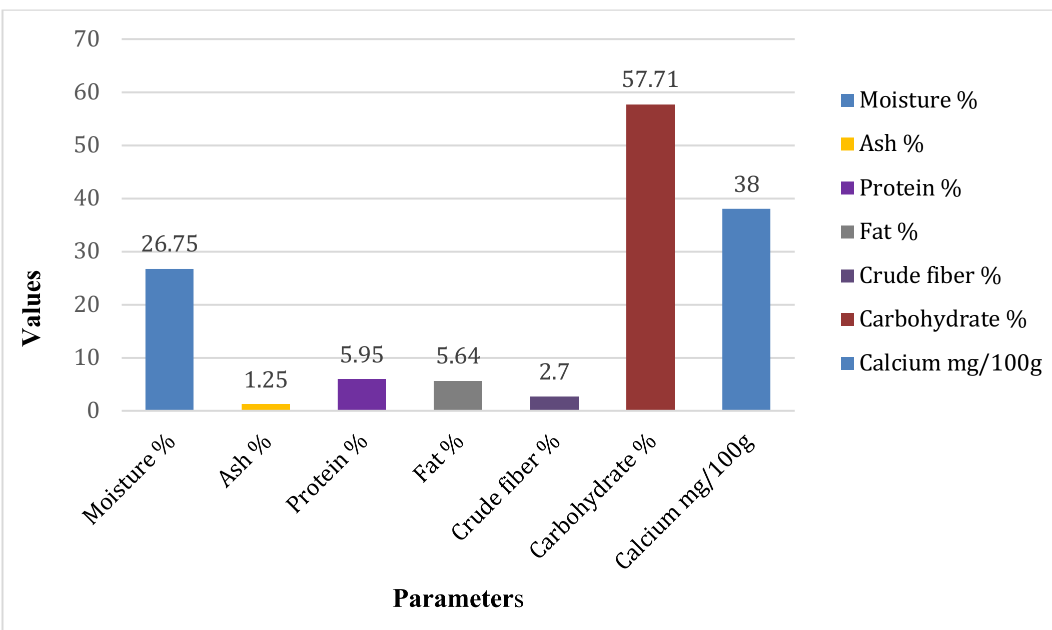

Figure 2. Proximate analysis of Standard muffins.

Proximate analysis of fortified muffins (T_1)

Figure 3 represents the result of the parameters of proximate analysis of Fortified muffins. The proximate properties such as crude protein, crude fat, fibre, ash, moisture, and calcium are important characteristics of any food products. In present study these characteristics were evaluated. The developed fortified muffins with 5% formulation (T_1) was the most acceptable treatment muffins and it was studied for moisture content, ash content, protein content, fat content, crude fiber, carbohydrate, calcium content and the observed values were found 24.93%, 1.51 %, 6.12%, 6.24 %, 2.38%, 58.82% and 105 mg/100g respectively.

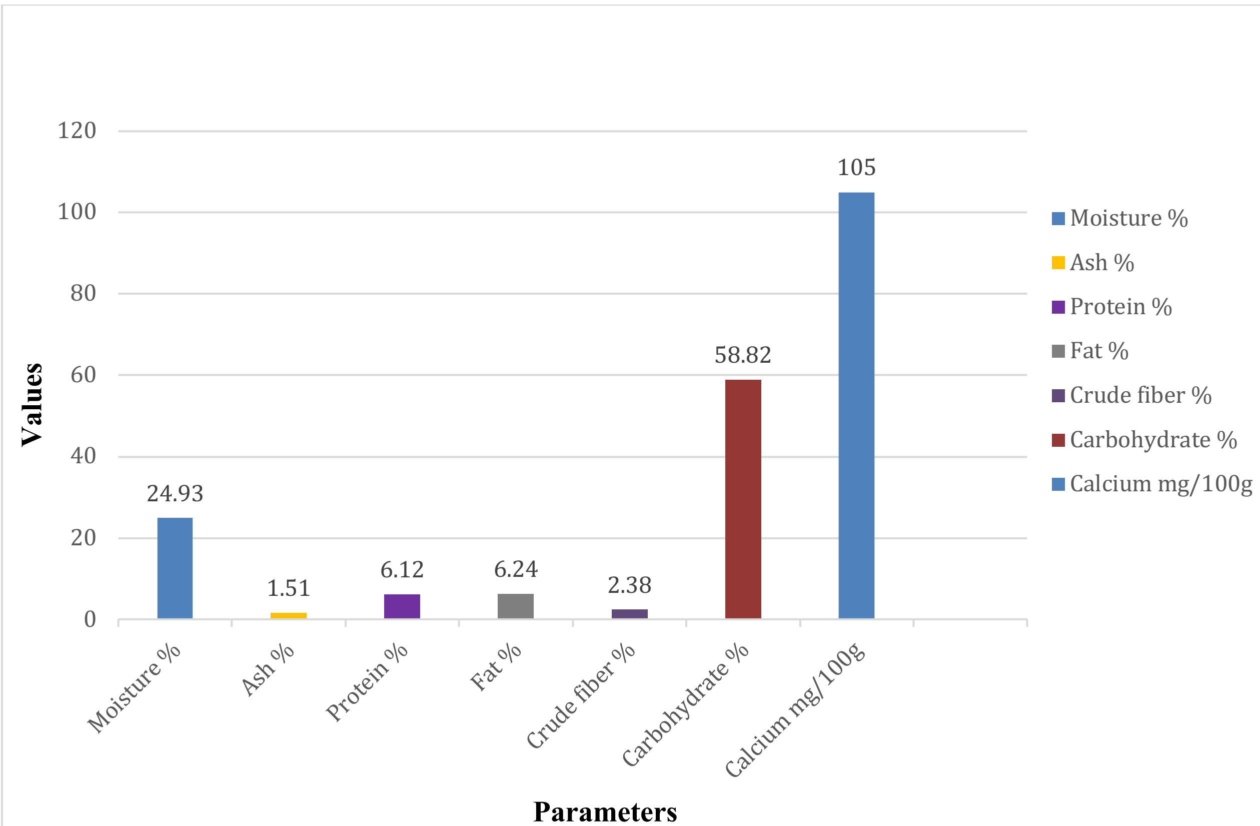

Figure 3. Proximate analysis of Fortified muffins (T_1).

Proximate analysis of control muffins in comparison with fortified muffins (T_1)

The proximate values of control muffins obtained were used in this study as a reference to compare with best selected combination of developed fortified muffins (T_1) in Figure 4.

The result of the proximate analysis of developed fortified muffins (T1) after comparison with the control muffins shows that there is a significant increase in calcium content in fortified muffins prepared with banana peel and stem flour. The high calcium content in fortified muffins is due to the addition of calcium-rich *Musa balbisiana* flour. A slight increase in fat content was observed. The moisture content and the crude fiber content was decreased in fortified muffins although the ash and protein content remained to be relatively similar.

The moisture content of control and fortified muffins were ranged from 26.75 to 24.93%. This may be due to decrease in the total starch content from 70% to less than 1% of the dry weight when banana ripens (Sarangi and Gaurav, 2014). This suggests the addition of fortifying ingredients may have contributed to a slight decrease in moisture which could have implications in texture and consistency of food. Bennett and Saliu, (2022) A study conducted on *Musa balbisiana* fresh peels showed the content of moisture was found lower for Musa balbisiana. Lower moisture value signifies longer shelf life without mold growth (Wanjuu et al., 2018). The moisture content increases with increased storage temperature due to osmotic flow of water and respiration breakdown of starch (Kumari et al., 2023). The moisture content in pulp increases during ripening process due to respiratory breakdown of starches into sugar and migration of moisture from peel to pulp (Marriott et al., 1981).

The data from Figure 6 reveals that slight increase in ash content in fortified muffins (T_1) in compared to the control muffins. The ash content ranged from 1.25 to 1.51%. The soluble component of the banana (*Musa balbisiana)* plant pseudo-stem fiber ash is about 32% which may also lead to the increase of ash content in fortified muffins (Deka and Neog, 2021). The ash content is higher in Musa balbisiana; indicating that Musa balbisiana contains more inorganic residue (Bennet and Saliu, (2022). The ash content in banana peels composed of high levels of potassium and zinc (Happi et al., 2007). The textural quality, chemical and biochemical reactions, as well as microbial growth rates are greatly affected by the moisture content of food products (Ovando et al., 2009).

The protein content of the fortified muffins shows a slight increase ranging from 5.95 to 6.12%. *Musa balbisiana* may have a good contribution toward the high protein content which shows that it can have a good impact on the nutritional value (Baishya et al.,2022). Banana peel flour has also been reported to contain a high protein content compared to banana peels. The reason for the same is attributed to varietal variance, analytical methodologies, agro-ecological situations, or time gaps between harvesting and evaluation (Khatun et al., 2021). Hence protein in the pseudostem can be used for making low-gluten foods like cakes (Maskey et al., 2018).

The fat content of the muffins sample ranged from 5.64 to 6.24%. High fat content was found in fortified muffins in comparison to control muffins. The maturation of the fruits involved a slight increase in lipid and fat content (Mahapatra et al., 2010). According to the studies conducted by Emaga et al. (2007); the fat content in pulp remains almost constant (1%) during the ripening process. Peel contains lipid (2.2-10.9%) and is also a rich source of unsaturated fatty acids, particularly linoleic acid and α- linolenic acid.

Crude fiber content was found to have a slight decrease from control muffins to fortified muffins. They range between 2.7 to 2.38%. Low crude fiber content might be due to presence of *Musa balbisiana* flour which attributed to the solubilisation of polysaccharides during the thermal treatment on processing, which results in a decrease of the content of total fiber (Tatjana et al., 2002).

The carbohydrate content ranged from 57.71% to 58.82%. High carbohydrate content was found in fortified muffins than that of control muffins. There have been a few studies done on the by-products of banana and plantain in order to evaluate its nutrient content as a potential source of dietary food components such as carbohydrate, proteins, dietary fibers, and minerals for human consumption (Emaga et al., 2007; Mohapatra et al., 2010). A study conducted by Emaga et al. (2007) to study the chemical composition of banana peels revealed the maturation of fruits involved an increase in soluble sugar content and, at the same time, a decrease in starch. The degradation of starch under endogenous enzymes may explain the increase in the soluble sugar content. They attributed the degradation of starch to the action of endogenous enzymes, which may explain the increase in the soluble sugar content.

The calcium content of fortified muffins was found to increase significantly. The calcium content ranged from 38 to 106mg/100g. Significantly highest calcium content was found in fortified muffins as *Musa balbisiana* is reported as a rich source of calcium (Borborah et al. 2016). Calcium is a mineral that is typically linked to strong bones and teeth. It also aids in blood clotting, promotes muscle contraction, and controls regular heart and nerve activity (Bennet & Saliu, 2022). The study conducted found that the concentration of Ca in banana peel flour exceeded the amount obtained from banana pulp, peels and unpeeled bananas (Selema & Fargo, 1996; Emaga et al., 2007; Haslinda et al., 2009; Twyford & Walmsley, 1974) The concentration of Ca is relatively high in pseudostem due to the vital role of this element in the cell strength of the trunk that supports the plant.

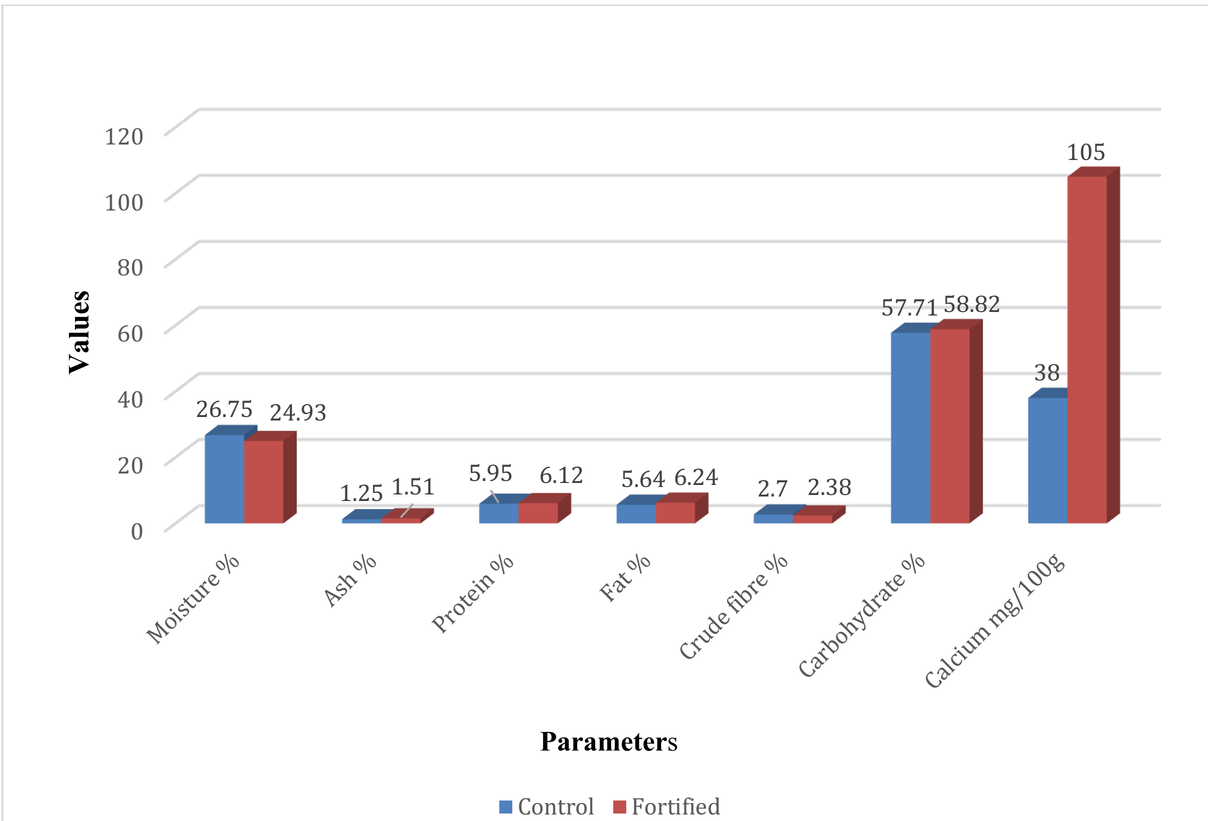

Figure 4. Comparison of proximate analysis of Control and Fortified muffins (T_1)

CONCLUSION

The study concludes that fortifying muffins with banana flour significantly affected the nutritional profile of standard muffins. The calcium content of standard muffins was observed to be 38 gm; however, an increase of 105 gm was observed in the calcium content after fortification of the muffins. A slight increase in fat, protein, and ash content was also observed although the moisture content was decreased. The fortified muffins were more nutritious than that of muffins prepared from all-purpose flour and is a healthier alternative. Hence, banana waste flour can be incorporated with all-purpose flour to prepare muffins to improve the calcium content and other nutrients. The incorporation of banana peel and stem flour in bakery products is a useful strategy to enhance the calcium content in human diet and hence, it can also be used to treat calcium deficiency. The fortification of muffins with banana peel and stem flour can also contribute in decreasing the environmental hazards that is caused as a result of underutilization of the banana plant after harvesting of the banana by industries. Thus, the utilization of banana (*Musa balbisiana)* stem and peel flour as a functional ingredient in the preparation of fortified muffins can create a huge marketplace in future.

REFERENCES

Aziz, N.A.A., Ho, L.H., Azahari, B., Bhat, R., Cheng, L.H. & Ibrahim, M.N.M. 2011. Chemical and functional properties of the native banana (*Musa acuminate* × balbisiana Colla cv. Awak) pseudo-stem and pseudo-stem tender core flours. Food Chemistry, 128(3), 748-753.

Baishya, H., Goswami, R. & Gogoi, L.J. 2022. Development of Ready-to-Eat Functional food from seeded banana Bhimkol (Musa balbisiana Colla) and Black rice (Oryza sativa L.). Journal of Applied Biology and Biotechnology, 11(1):183-187.

Bakery products - Methods of analysis. (1989). Bureau of Indian Standards.

Bennett, V. & Saliu, I.O. 2022. Exploring the Biochemical Components of Fresh Peels of Three varities of *Musa sapientum* (Banana). Journal of Food and Nutrition Sciences, 10(4):115-119.

Borborah, K., Borthakur, S.K. & Tanti, B. 2015. Musa Balbisiana Colla – Taxonomy, Traditional Knowledge and Economic Potentialities of the Plant in Assam, India. Indian Journal of Traditional Knowledge, 15 (1):116-20.

Chakraborty, C., Bandyopadhyay, K., Ganguly, S., Banerjee, B. & Mukherjee, S. 2017. Potential of raw banana peel as a source of polyphenol in muffins. The Pharma Innovation Journal, 6(10): 40-43.

Chakraborty, S. (2023, March 27). The Battle of the Brands: A Look at the Competitive Landscape of the Bakery Market. Linkedin.

https://www.linkedin.com/pulse/battle-brands-look-competitive-landscape-bakery-sneha-chakraborty

Das, P., Devi, R., Dutta, A.S., Boro, R.C. & Sarmah, T.C. 2016. Studies on Nutritional Components, Antioxidant Activities and Microbial Load in Simple Processed Product Developed from Banana (Cv. Bhimkol). Asian Journal of Chemistry, 29 (1): 47-50.

Deka, D.C. & Neog, S.R. 2021. Agricultural Benefits of Postharvest Banana Plants. Bentham Science Publisher, pp. 123-132 (10).

Deka, P., Kashyap, A., Sharma, D. & Baruah, C. 2018. A Review on Musa Balbisiana Colla. International Journal of Pharmaceutical Science Invention, 7(7): 14-17.

Emaga, T.H., Andrianaivo, R.H., Wathelet, B., Tchango, J.T. & Paquot, M. 2007. Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. Food Chemistry, 103: 590–600.

Gopalan, G., Prabha, B., Joe, A., Reshmitha, T.R., Sherin, D.R., Abraham, B., Sabu, M., Manojkumar, T.K., Radhakrishnan, K.V., & Nisha, K. 2018. Screening of Musa balbisiana Colla. Seeds for Anti-diabetic Properties and Isolation of Apiforol, A Potential Lead, with Antidiabetic Activity. Journal of the Science of Food and Agriculture, 99 (5): 2521-29.

Gurumayum, N., & Devi, R. 2020. Antioxidant, Anti-Glycation and Glycolytic Enzyme Inhibitory Potential of Musa Balbisiana Colla Seed. Proceedings of International Conference on Drug Discovery (ICCD) 2020.

Haslinda, W.H., Cheng, L.H., Chong, L.C. &Noor Aziah, A.A. 2009. Chemical composition and physiochemical properties of green banana (*Musa acuminata* X *balbisiana* Colla cv. Awak) flour. Internal Journal of Food Sciences and Nutrition, 60(S4):232-239.

Irawan, C., Utami. A., Styani, E., Putri, I.D., Putri, R.K., Dewanta, A & Ramadhanti. A. 2021. Potential of Ethanolic Extract from Ripe Musa Balbisiana Colla Fruit using Ultrasound-Assisted Extraction as an Antioxidant and Anti-gout. Pharmacognosy Journal, 13(6): 1332- 40.

Khatun,M., Ahmed,M.W., Hossain,M.M., Karmoker,P. & Iqbal,A.(2021). Utilization of banana peelflour in biscuit making as wheat flour substitute. European Journal of Agriculture and Food Sciences,3(6), 32–35.

Kumari,S., Katare, P.B., Elanchera,R., Nizami, H.L., Paramesha, B., Arava, S., Sarma,P.P., Kumar, R., Mahajan, D., Kumar, Y.,Devi, R.,& Banerjee, S.K. 2020. *Musa balbisiana* Fruit Rich in Polyphenol Attenuates Isoproterenol-Induced Cardiac Hypertrophy in Rats via Inhibition of Inflammation and Oxidative Stress. Oxidative Medicine and Cellular Longevity.

Kumari, P., Gaur, S.S. & Tiwari, R.K. 2023. Banana and its by-products: A comprehensive review on its nutritional composition and pharmacological benefits. eFood, 4(5), e110.

Kusuma, S.A.F., Wardhani, P., & Febrina, E. 2017. Stool Form Scale as an Indicator of Klutuk Banana (Musa Balbisiana Colla) Fruit Extracts Inhibition Effect against Shigella Dysenteriae Atcc 13313 in Vivo. Asian Journal of Pharmaceutical and Clinical Research, 10(12).

Kutoš,T., Golob, T., Kač, M. & Plestenjak, A. 2002. Dietary fiber content of dry and processed beans. Food Chemistry, 80: 231–235.

Luo, X., Arcot, J., Gill, T., Louie, J.C.Y. & Rangan, A.2019. A review of food reformulation of baked products to reduce added sugar intake. Trends in Food Science and Technology, 86:412–25.

*Manual of M*ethods *and Analysis of Foods*. (2015). Food Safety and Standards Authority of India.

Marriott, J., Robinson, M. & Karikari, S.K. 1981. Starch and sugar transformation during the ripening of plantains and bananas. Journal of the Science of Food and Agriculture, 32:1021-1026.

Maskey, B., Sangroula, P. & Shrestha, N.K. 2020. Utilization of Banana (Musa acuminata) pseudostem for Biscuit Making. Himalayan Journal of Science and Technology, 3-4: 74-80.

Methods for Determination of protein in Foods and Feeds. (1973). Bureau of Indian Standards.

Methods For Volumetric Determination of Calcium and Magnesium using EDTA. (1990). Bureau of Indian Standards.

Mohapatra, D., Mishra, S. & Sutar, N. 2010. Banana and its by-product utilization: an overview. Journal of Scientific and Industrial Research, 69:323–329.

Mout, J., & Bora, B. 2020. Development and quality characteristics of muffins from dried Smilax perfoliata leaf powder. International Journal of Research and Analytical Reviews., 7(3).

Narzary, P. & Sharma, D. 2022. Therapeutic Potential of Musa balbisiana Colla as a Super Food- A Review. Indian Journal of Natural Sciences, 13(73).

Ovando-Martinez, M., Sayago-Ayerdi,S., Agama-Acevedo, E., Goni, I., & Bello-Perez, L.A. 2009. Unripe banana flour as an ingredient to increase the undigestible carbohydrates of pasta. Food Chemistry, 113: 121–126.

Sarangi, M. & Gaurav, K.S. 2014. A review on banana starch. Planta Activa, 1-8.

Soberano, D.R., Parojenog, R. & Crisologo V.B. 2022. Sensory Evaluation of Herbs Flavoured Muffin Using Banana Blossom "Saba" (Musa Acuminata x Balbisiana) Flour. Psychology and Education: A Multidisciplinary Journal, 5 (2): 16-28.

Suhaimi, M.A., Ho, L.H. & Tan, T.C. 2020. Banana Pseudostem as a Potential Functional Ingredient for Food Products – A Review of Recent Research. Journal By Innovative Scientific Information and Services Network, 17 (1):17-35.

Swargiary, A. & Daimari, M. 2022. Identification of major compounds and α-amylase and α-glucosidase inhibitory activity of rhizome of Musa balbisiana Colla: An in-vitro and in-silico study. Comb Chem High Throughput Screen, 25(1):139-148.

Twyford, I.T. & Walmsley, D. 1974. The mineral composition of the robusta banana plant II. The concentration of mineral constituents. Plant and Soil, 41:459-470.

Wanjuu, C., Abong, G., Mbogo, D., Heck, S., Low, J. & Muzhingi, T. 2018 The physiochemical properties and shelf life of orange-fleshed sweet potato puree composite bread. Food and Science Nutrition, 6 (6): 1555–1563.