s

Volume: 5, Issue: 1, (June, 2023), pp 63-75
http://agri.rjt.ac.lk/sljae/

SRI LANKAN JOURNAL OF AGRICULTURE AND ECOSYSTEMS ***e-ISSN: 2673-1401***

SLJAE

ORIGINAL ARTICLE

Development of Novel Banana Supplemented Biscuits using Different Banana Cultivars (*Musa* spp)

K.S. Kunararathna[1], M.K.A. Shanika[2*], and S. Fernando[3]

[1]*Harischandra Mills PLC, Harischandra Mawatha, Matara*

[2]*Department of Export Agriculture, Uva Wellassa University of Sri Lanka, Passara Road, Badulla, Sri Lanka*

[3] *Department of Food Science and Technology, University of Ruhuna, Matara, Sri Lanka*

Correspondence:
[2]arundhishanka@gmail.com

DOI: https://doi.org/10.4038/sljae.v5i1.92

Abstract
A considerable postharvest loss has been documented in banana due to its very perishable nature and abundant production in Sri Lanka. The present study was conducted to develop banana biscuits utilizing banana flour obtained from three different local cultivars (ash plantain, seeni and ambun banana) with the purpose of decreasing the postharvest losses of banana. The composite mixture of unripe banana flour and wheat flour with varied degrees such as 0, 20, 40, 60, and 100% w/w were utilized to create biscuits from each banana cultivar and an initial sensory evaluation was carried out. Proximate composition, microbial qualities, and the shelf life were assessed for the biscuits developed. The biscuits containing 100% w/w ash plantain flour, 100% w/w ambun banana flour, and 80% w/w seeni banana flour were ranked at the highest for assessed properties in second sensory analysis. Among these, 100% w/w ash plantain biscuit was picked as the best product utilizing second sensory analysis. The ash, moisture, fiber, fat, protein, and carbohydrates of ash plantain biscuit were 2.3 ± 0.1%, 3.78 ± 0.5%, 4.33 ± 0.5%, 0.33 ± 0.01%, 4.56 ± 0.25%, and 87.73 ± 3.5%, respectively while moisture content and pH changes of all types of biscuits were ranged within 6.5 - 7.3 and 3.2 - 4.0%, respectively during the storage period. Microbial studies revealed that biscuits can be preserved for two months in biaxially oriented polypropylene containers under ambient temperature. In conclusion, the banana flour may be efficiently used to create the biscuits thereby lowering the postharvest losses of banana.

Keywords: Banana flour, proximate composition, sensory analysis, shelf life

Date of Submission: 09-02-2023 Date of Acceptance: 29-06-2023

1.0 Introduction

Banana is one of the most important and popular fruit crops in Sri Lanka. Production of bananas has increased during the last decades and approximately 54% of the total fruit cultivation lands in the country are used to grow bananas. In the global context, annual banana production was around 15.74 million tonnes and 28% of that was produced in South Asia. There are more than 1000 banana cultivars available in the world while Sri Lanka has 28 cultivars, many of which are indigenous to the country (Hathurusinghe et al., 2012). In the year 2017, Sri Lanka produced 62,549 tonnes of banana (Hathurusinghe et al., 2012) while Kurunagala, and Rathnapura districts are the main banana cultivation areas.

Banana is rich in calories but contains very low amounts of fat (Fida et al., 2020). Further, it is good source of fiber, minerals (potassium, phosphorus, magnesium, zinc), vitamins (vitamin C, B6 and pro-vitamin A), and bioactive compounds which could potentially contribute to the health benefits (Hathurusinghe et al., 2012). The unripe banana contains resistant starch, which provides positive effects on digestive health by increasing stool bulk, functioning as a prebiotic and promoting the growth and protection of beneficial bacteria present in the gut.

Due to the climacteric nature of bananas as well as the surplus of production, relatively higher postharvest losses (about 20-30%) (Hathurusighe et al., 2012) can be seen and it is important to find an effective remedy to minimize these losses. Banana flour is one of the best options to minimize postharvest losses as it has a high level of storage potential, long shelf life, and can readily be incorporated into the food products (Cahyana et al., 2019). The banana flour processing technique is a quite simple method (Qadri et al., 2018) and it can be used as substitute for wheat flour in the biscuit processing industry.

Biscuits are one of the popular bakery products because their convenient, inexpensive, versatile and is with longer shelf life compared to other bakery products (Elhassaneen et al., 2016). Further, it is a chemically leavened bakery product containing a high percentage of fat and sugar (Chavan et al., 2020). However, wheat flour biscuits are considered as less nutritious food due to reduction of nutrients such as dietary fiber, vitamins, and minerals during the refining process of wheat flour (Karki, 2016). Thus, biscuits produced from unripe banana flour could be a healthy and a delicious alternative for refined wheat flour as it is rich in fiber, minerals, and bioactive compounds. Therefore, the present invention discloses the development and evaluation of quality attributes of biscuits prepared using unripe banana flour with the most popular three different banana cultivars available in Sri Lanka. The results obtained from the present study will be useful for the commercial application of banana flour in other bakery products such as cakes, bread, and pasta as well.

2.0 Materials and Methods

2.1 Sample collection

The three different cultivars of *Musa* spp. namely, Ash plantain, *Ambun*, and *Seeni* bananas were purchased from super market in

Matara, Sri Lanka. All the samples were in immature stage with green peel.

2.2 Preparation of flour using unripe banana

Banana flour was prepared according to the method described by Chavan et al., (2020) with slight modifications. The green banana fingers were manually separated from the banana bunches with a sharp knife. Cleaned banana fingers were blanched in boiling water (100 °C) for 4 min. Blanched fruits were then peeled and cut into 2 mm thickness slices followed by dipping them in citric acid solution (1.0 M v/v). After that, pieces were kept in an oven dryer at 60 °C for 3 - 5 hrs. Dried chips were milled using pin mill (Kolloplex250z/Mill power Tech, Taiwan, FFC 37) to obtain banana flour.

2.3 Determination of particle size of banana flour

Particle size distribution profiles of banana flour (100 g) were analyzed using the laboratory sieve shaker (300, 212, 180, 150, 106, and 75 µm) (BS 410/1986, England) for 15 min.

2.4 Development of biscuits using unripe banana flour

Banana biscuits were prepared according to the method described by Sagar et al., (2020) with slight modifications. All the ingredients (flour - 68%, margarine - 5%, sugar - 25%, Ammonium bicarbonate - 1% and baking soda - 1% w/w) were weighed separately and mixed together using laboratory mixer (CWO/234, Japan). Treatment combinations used to prepare composite flour mixtures with three different banana cultivars are shown in Table 1. The soft dough was prepared in a dough mixer with incorporating all the ingredients. The dough was spread into a sheet (0.7 mm) and cut into a suitable shape and size. Prepared biscuits were baked (170 °C for 15 min) and allowed to cool under ambient temperature. Finally, biscuits were packed using Oriented Polypropylene (OPP) and stored at ambient temperature (35 °C).

2.5 Evaluation of sensory characteristics of banana biscuits

First sensory analysis was carried out for each three types of banana biscuits separately. Then selected best biscuit of each banana type was subjected to second sensory evaluation to compare the cultivars. The sensory attributes such as colour, taste, texture, aroma, crunchiness, and overall acceptability of banana biscuits were evaluated by thirty semi-trained panelists using nine-point Hedonic scale.

2.6 Determination of proximate composition, spread ratio and pH of banana biscuits

The moisture, ash, crude fat, crude fiber, and crude protein content of the developed banana biscuits were analyzed using method described in Association of Official Agricultural Chemists 2000. Total carbohydrate content was determined by the difference between 100 and the total sum of the percentage of fat, moisture, ash, crude fiber, and protein contents. The spread ratio of biscuits was analyzed using a Gage meter (2046S, Japan) while the pH of the biscuit samples was analyzed using a digital pH meter (54X249101, Singapore).

2.7 Microbial analysis of the developed biscuits

The aerobic plate count of developed banana biscuits was analyzed using the plate count method. The dilution series (10^{-1} to 10^{-9}) was prepared using 1 g of biscuit and the samples from the 10^{-1} to 10^{-4} diluent series were taken and incubated at 25 °C for 48 hrs. After incubation, the number of microbial colonies was counted using colony counter and multiplied with a dilution factor. Results were presented as the Colony Forming Unit per gram (CFU g^{-1}) of banana biscuits.

Table. 1: Treatment combination used to develop banana biscuit using three different banana cultivars

***Seeni* banana**		**Ash banana**		***Ambun* banana**	
BF : WF w/w	Treatment	BF : WF	Treatment	BF : WF	Treatment
100:0	AT1	100:0	BT1	100:0	CT1
80:20	AT2	80:20	BT2	80:20	CT2
60:40	AT3	60:40	BT3	60:40	CT3
40:60	AT4	40:60	BT4	40:60	CT4
20:80	AT5	20:80	BT5	20:80	CT5
0:100 (control)	WT6	0:100 (control)	WT6	0:100 (control)	WT6

BF: Banana Flour and WF: Wheat Flour

2.8 Data Analysis

The data are reported as mean, ± standard deviation of triplicates of the experiment. Sensory data were analyzed using the Friedman Nonparametric statistical method using SPSS software Version 9.0 for Windows. Statistical significance of proximate and physicochemical properties of banana flour were analyzed using One-Way Analysis of Variance (ANOVA) with Tukey's post-hoc multiple comparison test at $p < 0.05$ significant level.

3.0 Results and Discussion

3.1 Evaluation of particle size of the banana flour

The particle size of the flour mainly influences the spread ratio, water absorption capacity, and density of the biscuits (Agrahar-Murugkar et al., 2015). The desirable particle size of wheat flour for the biscuit manufacturing process should be less than 150 μm to have suitable sensory properties (Karki et al., 2016). The results of the present study showed that the particle size of the three different types of banana flour was around 106 ± 0.35 μm which is compatible with the desirable particle size recommendation for having perfect mouth feel. Sagar et al., (2020) also reported that the particle size of the banana flour should be below 200 ± 0.23 μm to be appropriate to produce banana biscuits. Moreover, Rodrigues-Garcia et al., (2013) stated that flour with fine particle size result biscuits with higher density can be seen during the baking. Therefore, the higher particle size of composite flour prepared had desirable for making biscuits with hard dough (Sanni et al., 2006). The present study showed that the banana flour had desirable particle size compared to the available literature and it may affect to increase the textural and quality attributes of the banana biscuits.

3.2 Evaluation of sensory properties of banana biscuits

Sensory analysis generally provides valuable information to assess the consumer satisfaction of the developed products. In the present study, the first sensory analysis was conducted for biscuits prepared using different ratios of *seeni*, ash plantain and *ambun* banana flour separately to find out the best composite flour mixture from each banana cultivars. Sensory properties of *seeni* banana biscuits, showed that there was no significant difference ($p > 0.05$) for color among the biscuits. The reason may be that the same baking conditions and the same sugar amount were used for all treatments (Bala et al., 2015). The biscuit products become golden brown color due to Maillard reaction of sugar with protein. Therefore, the use of same sugar amount may result no significant difference ($p > 0.05$) among the treatments. Further, there was no significant difference ($p > 0.05$) among all banana biscuit types for texture and smell. However, AT2 biscuit sample (80% w/w banana flour) secured highest mean rank for all attributes and therefore was selected for further analysis.

Sensory analysis of the ash plantain banana biscuits did not show any significant difference ($p > 0.05$) for color, texture, and odor among the treatments. However, the BT1 (100% w/w banana flour) treatment obtained the highest mean rank values for taste, aroma, and color from the sensory analysis. Therefore, the BT1 biscuit sample was selected as the best ash plantain banana biscuit sample for further analysis.

Sensory analysis of *Ambun* banana biscuits, showed no significant difference ($p > 0.05$) among all the treatment for aroma and color. The same recipe, baking conditions, and baking time were used to develop treatments may be the reason for showing no significant difference among the treatments. However, significant difference ($p < 0.05$) was found among the treatments for texture, crunchiness, taste, mouth feel, and overall acceptability while CT1 (100% w/w banana flour) treatment showed the highest mean rank values. Further, there was a significant difference ($p < 0.05$) between control and CT1 treatment for texture, crunchiness, taste, and overall acceptability whereas, CT1 treatment showed the highest mean rank values for the said attributes. Therefore, CT1 biscuit sample was selected as the best treatment *Ambul* flour biscuits for further analysis.

The BT1, CT1 and AT2 treatments which were selected from the first sensory analysis were subjected to second sensory analysis to find the best treatment among the different types of banana cultivars. The BT1 sample showed significant difference ($p < 0.05$) compared to other samples in all sensory attributes securing highest mean rank values. Therefore, BT1 (100:0 w/w ash plantain flour) treatment was selected as the best treatment among the other two samples and used for further analysis.

3.3 Proximate composition of banana flour and developed biscuits

Proximate analysis is one of the most important methods in food manufacturing industry as it is useful to determine the macronutrients composition which are present in the food products (Sun et al., 2020). Initially, proximate composition of banana flour was determined as it is one of the main ingredients which determines the quality of the final biscuit product and results are summarized in Table 2. According to the results, there was a significant difference ($p < 0.05$) among the proximate composition of three different types of banana cultivars. However, the amount of fiber content was significantly higher in ash plantain flour than the flour from other banana cultivars. The moisture content of ash plantain flour (4.45 ± 0.20% w/w) was significantly lower (p < 0.05) than the moisture content of *seeni* banana and *ambun* banana flour. The moisture content of the banana may be changed due to the climatic conditions, variety, and soil conditions (Lau et al., 2020). In the present study, there was a significant difference ($p > 0.05$) among the moisture content of flour obtained from three types of banana cultivars due to varieties. The average protein content of banana flour was 8.7 ± 0.85% (w/w) and seeni banana flour showed higher protein content than ash plantain flour and *ambun* banana flour. The protein content of banana also may differ from each other due to the genome type, variety, over-ripening process and the effect of climate conditions (Fida et al., 2020; and Arise et al., 2021).

The moisture content of banana biscuits (Table 3) from three different varieties were decreased when significantly increasing the percentage of wheat flour. This may be due to the higher water holding capacity of wheat flour and during baking process, it swells due to gelatinization, and thus, results reduction of moisture content in biscuit products (Lau et al., 2020).

Proximate analysis of selected best biscuit product (100% w/w ash plantain flour biscuit) and wheat flour biscuits showed that the ash plantain biscuit had a higher fiber content as well as higher carbohydrate content, and moisture content when compared with the wheat flour biscuit (Table 4). The highest carbohydrate content was found in the ash plantain biscuit suggests their highly energetic potential.

3.4 Evaluation of spread ratio and pH of the biscuits

The spread ratio is one of the most important parameters of biscuit production as it is directly affected by the texture of the biscuit products. Further, it is used to determine the quality of the flour used for the preparation of biscuits as well as the ability of biscuits to rise in baking time (Bala et al., 2015). The results showed that increasing the level of wheat flour resulted in a decrease in the thickness and diameter ratio of biscuits (Table 5). The reason could be the higher water-holding capacity of banana flour than wheat flour (Adeola et al., 2018). Various research studies have reported that with an increase in pentose and protein levels the spread ratio declines as it enhances the flour hydration capacity (Hathurusinghe et al., 2012) Similarly, it observed that a declining trend in spread ratio of biscuits after baking and it could be due to the competition of water between banana flour and wheat flour for dough consistency.

The pH value of the food is one of the direct measurements of free hydrogen ions present in the foods. It gives the information of acidity of the product which is directly connected to their distinct sour flavor (Sitthiya et al., 2018). The recommended range of pH for the biscuit product was ranged between 6.5 to 7.3 (Lau et al., 2020) and the pH values of the developed biscuit products were within the recommended range.

3.5 Microbial analysis of developed biscuit products

Microbial analysis is often used in the food industry to detect the possible contamination and growth of microorganisms during the processing and storage of the food product. The microbial count of the best biscuit sample (CT1 - 100% w/w ash plantain flour) which was stored under ambient temperature was determined every other week until two months of period. The results showed that the TPC amount was 1.02×10^{-4} CFU/g after two months of period. According to the Sri Lankan Standard for biscuit, the standard value of the TPC count of biscuit products is 1×10^{-4} and the developed products had the microbial count within the range (Fida et al., 2019). Therefore, developed ash plantain biscuit product had two months shelf-life period without adding preservatives under room temperature (30 ± 2 ºC).

4.0 Conclusion

The biscuit product with 100% (w/w) ash plantain flour (BT1) was selected as the best product for commercial biscuit production. Nutritional value of the ash plantain flour showed a considerably higher amount of ash, fat, fiber, and carbohydrates than the other types of banana flour. Microbial analysis revealed that the developed biscuits can be stored in oriented polypropylene (OPP) packages for two months period at ambient temperature (30 ± 2 °C). Therefore, it can be concluded that green banana flour of ash plantain can be used effectively to develop healthy biscuit products.

Table .2: Proximate compositions of banana flour from different varieties

Flour type	Ash %	Moisture %	Fat %	Fiber %	Protein %	Carbohydrate %
Ash Plantain	2.40 ± 0.05[a]	4.45 ± 0.2[c]	1.66 ± 0.1[a]	3.33 ± 0.2[a]	2.7 ± 0.1[b]	45.45 ± 2.67[c]
Seeni	2.30 ± 0.1[b]	5.32 ± 0.2[a]	1.10 ± 0.01[b]	3.02 ± 0.1[b]	3.4 ± 0.1[a]	84.86 ± 3.78[b]
Ambun	2.23 ± 0.1[c]	5.24 ± 0.1[b]	1.33 ± 0.01[c]	3.0 ± 0.2[c]	2.60 ± 0.1[c]	85.60 ± 3.1.2[a]

The values in a table are the arithmetic mean of three replicates with standard deviation (±). Different letters in the same column are significantly different at $p < 0.05$.

Table .3: Comparison of moisture content in biscuits of different treatments from three types of banana varieties

Ratio (banana flour: wheat flour w/w)	Moisture content %		
	***Seeni* banana biscuits**	**Ash plantain banana biscuits**	***Ambun* banana biscuits**
T1 (100:0)	3.60±0.15[a]	3.76±0.15[b]	3.89±0.15[c]
T2 (80:20)	3.56±0.12[a]	3.45±0.25[b]	3.73±0.15[c]
T3 (60:40)	3.54±0.14[a]	3.42±0.10[b]	3.43±0.21[c]
T4 (40:60)	3.45±0.15[a]	3.23±0.10[b]	3.42±0.23[c]
T5 (20:80)	3.44±0.10[a]	3.22±0.15[b]	3.32±0.10[c]
T6 (0:100)	3.31±0.10[a]	3.31±0.12[b]	3.31±0.10[c]

Data presented as mean ± SD. Same letters in the column showed no significant difference at $p > 0.05$.

Table .4: Comparison of proximate composition of 100% w/w wheat flour biscuit and 100% w/w plantain banana flour biscuit

Composition (%)	**BT1**	**Wheat flour biscuit**
Moisture	3.76±0.50[a]	3.32±0.50[b]
Ash	2.30±0.10[a]	1.84±0.01[b]
pH	4.33±0.50[a]	5.35±0.65[b]
Fiber	0.92±0.01[a]	0.33±0.01[b]
Protein	4.56±0.25[a]	5.52±0.25[b]
Carbohydrate	87.14±3.50[a]	76.47±3.34[b]

The values in the table are the arithmetic mean of three replicates with standard deviation (±) Different letters in the same raw are significantly different at $p < 0.05$.

Table .5: pH value and Spread Ratio of the biscuits prepared from composite flour mixture of banana flour and wheat flour

Ratio (BF:WF w/w)	***Seeni* banana biscuits**		**Ash plantain banana biscuits**		***Ambun* banana biscuits**	
	pH	SR	pH	SR	pH	SR
T1 (100:0)	6.90±0.10[b]	9.55±0.1[b]	6.95±0.23[b]	10.40± 0.1[b]	6.65±0.32[b]	9.80±0.1[b]
T2 (80:20)	6.92±0.20[b]	9.70±0.3[b]	6.96±0.43[b]	10.41±0.3[b]	6.77±0.25[b]	9.90±0.1[b]
T3 (60:40)	6.92±0.21[b]	9.90±0.2[b]	6.97±0.34[b]	10.50±0.1[b]	6.82±0.25[b]	10.10±0.1[b]
T4 (40:60)	6.93±0.15[b]	10.20±0.1[a]	6.98±0.21[a]	11.10±0.4[a]	6.84±0.23[b]	10.30±0.1[b]
T5 (20:80)	7.20±0.14[a]	10.50±0.1[a]	7.23±0.24[a]	11.20±0.2[a]	7.24±0.12[a]	10.50±0.2[a]
T6 (0:100) (control)	7.24±0.21[a]	10.80±0.1[a]	7.24±0.21[a]	11.60±0.1[a]	7.24±0.15[a]	11.00±0.2[a]

The values in a table are the arithmetic mean of three replicates with standard deviation (±) BF:WF-Banana Flour: Wheat Flour, SR-Spread Ratio. Same letters in the column did not show any significant difference at $p > 0.05$ level.

5.0 References

Adeola, A.A. and Ohizua, E.R., 2018. Physical, chemical, and sensory properties of biscuits prepared from flour blends of unripe cooking banana, pigeon pea, and sweet potato. *Food Science & Nutrition*, 6(3), pp.532-540.

AOAC. Official method of analysis,2000 16th ed. Washington, DC: Washington Association of Official Analytical Chemist.

Arise, A.K., Akeem, S.A., Olagunju, O.F., Opaleke, O.D. and Adeyemi, D.T., 2021. Development and Quality Evaluation of Wheat Cookies Enriched with Bambara Groundnut Protein Isolate alone or in Combination with Ripe Banana Mash. *Applied Food Research*, 1(1), p.100003.

Bala, A., Gul, K. and Riar, C.S., 2015. Functional and sensory properties of cookies prepared from wheat flour supplemented with cassava and water chestnut flours. *Cogent Food & Agriculture*, 1(1), p.1019815.

Cahyana Y, Wijaya E, Halimah T S, Marta H, Suryadi E and Kurniati D 2019. The effect of different thermal modifications on slowly digestible starch and physicochemical properties of green banana flour (Musa acuminata colla). *Food Chemistry.* 274, pp 274–280

Chavan S. M. Raviteja and Shivprasad. 2020. Qualities of biscuit prepared with banana flour. 52nd Annual Convention of ISAE and National Symposium on Doubling Farmers' Income through Technological Interventions. AAU, Anand.

Elhassaneen, Y., Ragab, R. and Mashal, R., 2016. Improvement of bioactive compounds content and antioxidant properties in crackers with the incorporation of prickly pear and potato peels powder. *International Journal of Nutrition and Food Sciences*, 5(1), pp.53-61.

Fida, R., Pramafisi, G. and Cahyana, Y., 2019. Application of Banana Starch and Banana Flour In Various Food Product: a review. *Journal of Triton*, 10(2), pp.38-53.

Fida, R., Pramafisi, G. and Cahyana, Y., 2020, Application of banana starch and banana flour in various food product: A review. In IOP Conference Series: *Earth and Environmental Science* IOP Publishing. (Vol. 443, No. 1, pp. 012057).

Hathurusinghe, C.P., Vidanapathirana, R., Rambukwella, R. and Somarathne, T.G., 2012. A Study on value chain of Pineapple and Banana in Sri Lanka. Hector Kobbekaduwa Agrarian Research and Training Institute: Colombo.

Karki, R., 2016. Study on the Preparation of Biscuit and Cake from Amaranthus and Sorghum. Journal of Food Science and Technology Nepal, 9, pp.79-84.

Lau, B.F., Kong, K.W., Leong, K.H., Sun, J., He, X., Wang, Z., Mustafa, M.R., Ling, T.C. and Ismail, A., 2020. Banana inflorescence: Its bio-prospects as an ingredient for functional foods. Trends in Food Science & Technology, 97, pp.14-28.

O. L. Sanni, A. A. Adebeowale, T. A. Filani, O. B. Oyewole, and A. Westby, "Quality of flash and rotary dryer dried fufu flour," Journal of Food

Agriculture and Environment, vol. 4, no. 3, pp. 74–78, 2006.

Qadri, T., Hussain, S.Z., Rather, A.H., Amin, T. and Naseer, B., 2018. Nutritional and storage stability of wheat-based crackers incorporated with brown rice flour and carboxymethyl cellulose (CMC). International Journal of Food Properties, 21(1), pp.1117-1128.

Sagar, M. Chavan., Anupriya Gupta and Vishal Kumar., 2020. Processing technology for Preparation of Banana Flour Supplemented Biscuit. International Journal of Current Microbiology and Applied Science. SSN: 2319-7706 Special Issue-11 pp. 1360-1366.

Sanni, L.O., Adebowale, A.A., Filani, T.A., Oyewole, O.B. and Westby, A., 2006. Quality of flash and rotary dried fufu flour. *Journal of Food Agriculture and Environment*, 4 Vol 4, pp.74-78.

Sitthiya, K., Devkota, L., Sadiq, M.B. and Anal, A.K., 2018. Extraction and characterization of proteins from banana (Musa Sapientum L) flower and evaluation of antimicrobial activities. Journal of Food Science and Technology, 55(2), pp.658-666.

SUN, J., He, X., Tang, Y., Tang, J. and Li, Z., 2020. Research Progress of Banana Processing. Chinese Journal of Tropical Crops, 41(10), p.2022.

Agrahar-Murugkar, D., Gulati, P., Kotwaliwale, N. and Gupta, C., 2015. Evaluation of nutritional, textural and particle size characteristics of dough and biscuits made from composite flours containing sprouted and malted ingredients. *Journal of Food Science and Technology*, *52*(8), pp.5129-5137.