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Research Article

Nutritional and Sensory Enrichment of Biscuit and Cake Formulations using Guava Leaf Powder

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ABSTRACT

This study investigates the feasibility of incorporating guava leaves powder into biscuits and cakes to enhance their nutritional value and evaluate their physical, chemical, and sensory properties. Biscuits and cakes were prepared with guava leaves powder at 0% (control), 2%, 4%, and 6% levels, substituting wheat flour. Results showed that as the incorporation level of guava leaves powder increased, the moisture content (2.1–3.0% in biscuits, 23.4–30.7% in cakes), protein content (6.74–6.91% in biscuits, 6.0–7.0% in cakes), and ash content (0.76–0.91% in biscuits, 1.1–1.3% in cakes) significantly increased, while carbohydrate and fat content decreased in both products**.** Physical properties, such as spread ratio of biscuit and specific volume of cake, decreased with higher level of incorporation. Among all formulations, the sample with 2% incorporation showed optimal functional properties, achieving the highest biscuit spread ratio (6.02) and cake specific volume (1.971 cm^3/g). Sensory evaluation by a 10- member panel revealed that biscuits and cakes with 2% guava leaves powder received the highest overall acceptability scores (7.4 for biscuits and 6.7 for cakes on a 9-point hedonic scale), with significantly lower scores observed at 4% and 6% incorporation levels due to unfavorable changes in texture and flavor. These findings highlight guava leaves powder as a promising functional ingredient for bakery products where 2% incorporation provides the best balance of nutritional enhancement and consumer acceptability.

Introduction

Guava (*Psidium guajava*), a fruit from the Myrtaceae family, is widely cultivated in tropical regions like India, Indonesia, Pakistan, Bangladesh, and South America (Barbalho et al., 2012). Beyond its fruit, guava leaves are valued for their rich phytochemical composition, including phenolic compounds, flavonoids, quercetin, tannins, and pentacyclic triterpenoids, which provide antioxidant, anti-inflammatory, anti-microbial, anti-diabetic properties and cardiovascular benefits (Gutiérrez et al., 2008; Kumar et al., 2021). These health benefits have been substantiated by studies demonstrating efficacy of guava leaves in reducing oxidative stress and managing chronic diseases (Díaz-de-Cerio et al., 2017b). Due to these therapeutic effects, guava leaves have been widely used as a traditional treatment in Africa, East Asia, and Japan for diabetes and gastrointestinal disorders (Díaz-de-Cerio et al., 2017a; Luo et al., 2019). However, their potential use in food sectors, especially as a functional ingredient in bakery products, remains underexplored (Kafle et al., 2018).

The bakery sector has shown growing interest in developing functional foods that boast health benefits without sacrificing sensory acceptability (Dachana et al., 2010). Biscuits and cakes have gained global popularity as convenient snack options, making them ideal platforms for incorporating nutrient-rich ingredients (Martínez-Monzó et al., 2013). The incorporation of plant-based ingredients like guava leaf powder could enhance the nutritional value of bakery products by increasing their protein, dietary fiber, and mineral content while reducing dependence on synthetic additives, which are often associated with potential health risks (Nanditha et al., 2009). Existing studies have explored the use of plant materials, such as moringa leaves and sweet potato flour, in bakery products, demonstrating significant nutritional enhancement and

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acceptable sensory properties (Dachana et al., 2010; Milla et al., 2021; Srivastava, 2012).
However, limited research exists on the use of guava leaves powder in bakery sectors, despite its considerable potential to provide both nutritional and bioactive benefits.

This study aims to investigate the feasibility of incorporating guava leaves powder into biscuits and cakes at varying levels to assess its impact on physical, chemical, and sensory properties. The specific objectives are: (1) to evaluate the effects of guava leaves powder on the proximate composition, physical characteristics, and sensory attributes of biscuits and cakes and (2) to determine the optimal incorporation level for consumer acceptability.

Materials and Methods

The study was conducted at the laboratories of the Department of Food Engineering and Technology, Bangladesh Agricultural University, Mymensingh. Fresh guava leaves were collected from guava trees of the university campus. Commercial wheat flour, sugar, baking powder, vegetable oil, salt, eggs, butter, milk powder, and vanilla essence were procured from the local market. Analytical-grade chemicals and solvents were used from the laboratory stock and guava leaves powder was prepared in the laboratory. High-density polyethylene (HDPE) bags were used for packaging and storage of samples.

Preparation of Guava Leaves Powder

Fresh guava leaves were thoroughly inspected to discard diseased and insect bitten ones. The leaves were washed with potable water to remove dirt and impurities. The leaves were dried in a cabinet dryer at 60°C for 4.5 hours. After cooling to ambient temperature, the dried leaves were ground into a fine powder using a laboratory grinder (mesh size: 0.5 mm) to ensure uniformity. The guava leaves powder was packed in airtight HDPE bags, sealed, and stored at room temperature (25 ± 2°C) until use.

Experimental Design

Biscuits and cakes were prepared with guava leaves powder incorporated at 0% (control), 2%, 4%, and 6% levels, substituting wheat flour. The biscuit samples were designated as B_0 (control), B_1 (2%), B_2 (4%), and B_3 (6%), and the cake samples as C_0 (control), C_1 (2%), C_2 (4%), and C_3 (6%). Each formulation was prepared in triplicate to ensure reproducibility.

Formulation and Preparation of Biscuits and cakes

The basic formulation for biscuits was adapted from Hoseney (1986) and Kent (1983), and cakes was adapted from Rajchel et al. (1975), as shown in Table 1. Wheat flour was partially replaced with guava leaves powder at the specified levels, while other ingredients remained constant.

Table 1. Formulation for biscuit and cake

Ingredients	Biscuit				Cake			
	B_0	B_1	B_2	B_3	C_0	C_1	C_2	C_3
Wheat flour (g)	100	98	96	94	100	98	96	94
Guava leaves powder (g)	0	2	4	6	0	2	4	6
Oil (ml)	40	40	40	40	60	60	60	60
Sugar (g)	50	50	50	50	90	90	90	90
Vanilla essence (drops)	2	2	2	2	2	2	2	2
Salt (g)	1	1	1	1	2	2	2	2
Egg (piece)	1	1	1	1	2	2	2	2
Baking powder (g)	1	1	1	1	4	4	4	4
Milk powder (g)	-	-	-	-	25	25	25	25
Butter (g)	-	-	-	-	20	20	20	20

For biscuit making, wheat flour, guava leaves powder, sugar, salt, and baking powder were accurately weighed and mixed thoroughly in a stainless-steel bowl. Then vegetable oil and vanilla essence were added, and the mixture was kneaded to form a uniform dough. The dough was rested for 10 minutes, rolled to a thickness of 4 mm, and cut into circular shapes of 5 cm diameter. The biscuits were placed on a greased baking tray, brushed with egg yolk, and baked in a preheated oven at 180°C for 15–20 minutes. After baking, biscuits were cooled to ambient temperature, packed in HDPE bags, and stored for analysis.

For cake, wheat flour, guava leaves powder, milk powder, baking powder, and salt were weighed accurately. In a separate bowl, eggs and sugar were whisked until light and fluffy, followed by the addition of vegetable oil and melted butter. The dry ingredients were gradually folded into the wet mixture. Milk (prepared by dissolving milk powder in warm water) and vanilla essence were added, and the batter was mixed until smooth. The batter was poured into a greased cake mold (diameter: 20 cm) and baked in a preheated oven at 170°C for 40–45 minutes. After baking, cakes were cooled to ambient temperature, demolded, packed in HDPE bags, and stored for analysis.

Chemical Analysis

The proximate composition, including moisture, ash, protein, fat, and carbohydrate content of guava leaves powder, wheat flour, biscuits, and cakes was determined in triplicate following standard AOAC methods (AOAC, 2023). Moisture content was analyzed using the oven-drying method at 105°C. Ash content was determined by dry ashing at 550°C in a Muffle furnace. Protein content was quantified using the Kjeldahl method with a nitrogen-to-protein conversion factor of 6.25. Fat content was measured by Soxhlet extraction. Carbohydrate content was calculated by subtraction method using the formula: %Carbohydrate content = 100 − (%moisture + %ash + %protein + %fat).

Physical Analysis

For biscuits, four biscuits per sample were analyzed for weight (g), diameter (cm), thickness (cm), volume (cm^3, measured by rapeseed displacement according to AACC method (10-05-01)), spread ratio (diameter/thickness), and density (weight/volume).

For cakes, four slices per cake sample were analyzed for weight (g), volume (cm^3, by rapeseed displacement), specific volume (volume/weight, cm^3/g), and crumb characteristics (color, texture, air cell size, and presence of large air cells) using qualitative assessment.

Sensory Evaluation

Sensory evaluation was performed by 10 panelists (aged 20–45, gender-balanced). Biscuit and cake samples were coded and presented in a randomized order under controlled conditions (25°C temperature, white light, and odor-free environment). Panelists evaluated color, texture, taste, aroma, and overall acceptability using a 9-point hedonic scale (1=dislike extremely, 9=like extremely). Samples were served with water for proper evaluation.

Statistical Analysis

Data were analyzed using Analysis of Variance (ANOVA) followed by Fisher's Least Significant Difference (LSD) test to identify significant differences ($p<0.05$) among samples. Statistical analyses were performed using "R programming" (version 4.3.0). Results were expressed as mean ± standard deviation.

Results and Discussion

Proximate Composition of Guava Leaves Powder and Wheat Flour

The proximate composition of guava leaves powder and wheat flour is presented in Table 2. Guava leaves powder exhibited significantly lower moisture (2.70±0.07%) and carbohydrate (48.58±0.04%) contents compared to wheat flour (14.37±0.02% and 73.02±0.05%, respectively) ($p<0.05$). In contrast, guava leaves powder had higher protein (22.87±0.05% vs. 11.46±0.04%), fat (5.01±0.02% vs. 0.64±0.09%), and ash (20.84±0.03% vs. 0.51±0.02%) contents ($p<0.05$). These results are consistent with Pawar et al. (2024), who reported comparable values for guava leaves powder (moisture: 2.77%, protein: 22.29%, ash: 20.84%). The increased protein and ash contents in guava leaves powder indicate its potential as a nutrient rich ingredient, with the high ash content reflecting a rich mineral profile (Kumar et al., 2021). The compositional differences between guava leaves powder and wheat flour likely influenced the physical, chemical, and sensory properties of the bakery products.

Table 2. Proximate composition of wheat flour and guava leaves powder

Components	Wheat flour	Guava leaves powder
Moisture (%)	14.37±0.02	2.7±0.067
Protein (%)	11.46±0.036	22.87±0.05
Fat (%)	0.64±0.09	5.01±0.015
Total Carbohydrate (%)	73.02±0.052	48.58±0.04
Ash (%)	0.51±0.015	20.84±0.026

Values are mean±standard deviation (n = 3). Significant differences ($p < 0.05$) were determined by ANOVA and Fisher's LSD test.

Physical Properties of Biscuits and cakes

The physical properties of biscuits, including weight, diameter, thickness, volume, spread ratio, and density, are summarized in Table 3. Biscuit weight increased significantly with higher guava leaves powder incorporation, from 8.9±0.08 g (B_0) to 9.4±0.09 g (B_3) ($p<0.05$). This increase could be due to the elevated fiber content in guava leaf powder, which improves water absorption and dough density (Dachana et al., 2010). Diameter and spread ratio decreased with increasing level of guava leaves powder, with B_0 showing the highest spread ratio (6.30±0.01) and B_3 the lowest (5.43±0.02) ($p<0.05$). The reduction in spread ratio is likely due to the lower gluten content and increased fiber, which restrict dough expansion during baking (Hoseney, 1986). Volume and density followed similar trends, with B_0 showing the highest volume (14.23±0.04 cm³) and lowest density (0.626±0.003 g/cm³), while B_3 had the lowest volume (13.91±0.10 cm³) and highest density (0.675±0.004 g/cm³) ($p<0.05$). These findings suggest that guava leaves powder influences biscuit structure, potentially limiting its incorporation at higher levels for maintaining desirable physical characteristics.

The physical properties of cakes, including weight, volume, specific volume, and crumb characteristics, are shown in Tables 4. Cake weight increased with guava leaves powder incorporation, from 174±0.36 g (C_0) to 180±0.34 g (C_3) ($p<0.05$), likely due to increased fiber and moisture retention (Rajchel et al., 1975). Volume and specific volume decreased significantly with higher incorporation levels, with C_0 exhibiting the highest specific volume (1.994±0.005 cm³/g) and C_3 the lowest (1.889±0.006 cm³/g) ($p<0.05$). This reduction may result from the dilution of gluten and increased batter viscosity caused by guava leaves powder, which hinders air incorporation during baking (Dachana et al., 2010). Crumb characteristics (Table 4) showed that C_0 had a light-yellow color and silky-smooth texture, while increasing guava leaves powder levels darkened the crumb color to greenish-brown (C_1 to C_3) and slightly reduced texture smoothness, particularly in C_3. The darker color is attributed to the natural pigments (e.g., chlorophyll) in guava leaves (Pawar et al., 2024). Air cell size remained small across all samples, with very few large air cells, indicating consistent batter mixing and baking conditions.

Table 3. Effects of guava leaves powder on Physical properties of biscuits

Sample	Weight (g)	Diameter D (cm)	Thickness T (cm)	Volume (cm³)	Spread ratio D / T	Density (g/cc)
B_0	8.9±0.076	4.75±0.025	0.75±0.025	14.226±0.04	6.3±0.006	0.626±0.003
B_1	9±0.040	4.7±0.005	0.78±0.042	14.18±0.06	6.02±0.072	0.635±0.005
B_2	9.2±0.052	4.5±0.040	0.8±0.040	14.03±0.073	5.62±0.068	0.656±0.05
B_3	9.4±0.085	4.4±0.033	0.81±0.02	13.91±0.0104	5.43±0.02	0.675±0.004

Values are mean±standard deviation (n=4). Means with different superscripts in the same column differ significantly ($p<0.05$) by Fisher's LSD test. B_0: 0% guava leaves powder; B_1: 2%; B_2: 4%; B_3: 6%.

Table 4. Effects of guava leaves powder on Physical properties and on crumb characteristics of cake

Sample	Physical properties of cakes			Crumb characteristics of cake			
	Weight (g)	Volume (cm³)	Specific volume (cm³/g)	Color	Texture	Presence of large air cell	Air cell size
C_0	174±0.36	347±0.305	1.994±0.0045	Light Yellow	Silky smooth	Very few	Small
C_1	175±0.416	345±0.529	1.971±0.0031	Light Greenish brown	Silky smooth	Very few	Small
C_2	178±0.55	342±0.5	1.921±0.0047	Greenish brown	Smooth	Very few	Small
C_3	180±0.34	340±0.36	1.889±0.006	Dark Greenish brown	Smooth	Very few	Small

Values are mean±standard deviation (n = 4). Means with different superscripts in the same column differ significantly ($p < 0.05$) by Fisher's LSD test. C_0: 0% guava leaves powder; C_1: 2%; C_2: 4%; C_3: 6%.

Chemical Properties of Biscuits and Cakes

The chemical composition of biscuits and cakes is presented in Tables 5. For biscuits, moisture content increased, ash, and protein content increased significantly with guava leaves powder incorporation ($p<0.05$), while fat and carbohydrate content decreased. Moisture ranged from 2.1±0.04% (B_0) to 3.0±0.09% (B_3), ash from 0.76±0.01% to 0.91±0.01%, and protein from 6.74±0.01% to 6.91±0.01%. Fat content decreased from 19.0±0.15% (B_0) to 18.1±0.05% (B_3), and carbohydrates from 71.40±0.05% to 71.09±0.01%. These trends align with the higher protein and ash contents of guava leaves powder (Table 2) and the hygroscopic nature of its fiber, which increases moisture retention (Adeola & Ohizua, 2018).

For cakes, similar trends were observed. Moisture content increased from 23.40±0.22% (C_0) to 30.70±0.15% (C_3), ash from 1.10±0.05% to 1.30±0.04%, and protein from 6.0±0.15% to 7.0±0.15% ($p<0.05$). Fat content decreased from 23.0±0.53% to 18.0±0.36%, and carbohydrates from 46.50±0.05% to 43.00±0.34%. The increased moisture in cakes compared to biscuits is due to the higher liquid content in cake formulations (Rajchel et al., 1975). The nutritional enhancement, particularly in protein and ash, supports the potential of guava leaves powder as a functional ingredient, though the reduction in fat and carbohydrates may affect energy density.

Table 5. Chemical composition of guava leaves incorporated biscuits and cakes

Sample		Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Biscuits	**B_0**	2.1±0.04	0.76±0.005	6.74±0.005	19±0.15	71.4±0.05
	B_1	2.4±0.034	0.82±0.003	6.80±0.009	18.7±0.04	71.28±0.025
	B_2	2.8±0.035	0.87±0.004	6.85±0.0039	18.3±0.035	71.18±0.09
	B_3	3±0.093	0.91±0.0025	6.91±0.004	18.1±0.05	71.09±0.005
Cakes	**C_0**	23.40±0.217	1.10±0.05	6±0.15	23±0.529	46.5±0.05
	C_1	26±0.15	1.21±0.035	6.3±0.05	21.1±0.473	45.39±0.055
	C_2	28.53±0.06	1.23±0.02	6.9±0.064	18.6±0.35	44.74±0.045
	C_3	30.70±0.145	1.3±0.04	7±0.153	18±0.363	43±0.34

Values are mean±standard deviation (n = 3). Means with different superscripts in the same column differ significantly (p<0.05) by Fisher's LSD test.

Sensory Evaluation

Sensory attributes of biscuits and cakes were evaluated by a trained panel, with mean scores for color, texture, taste, aroma, and overall acceptability presented in Tables 6. For biscuits, B_0 (control) received the highest scores across all attributes, followed closely by B_1 (2% guava leaves powder) with scores of 7.2–7.5 ($p<0.05$). B_2 and B_3 showed significant declines, particularly in taste (6.7 ± 0.9 and 5.9 ± 1.0, respectively) and overall acceptability (6.7 ± 0.8 and 6.1 ± 0.9) ($p<0.05$). The lower scores for B_2 and B_3 may be due to the denser texture imparted by higher guava leaves powder levels (Pawar et al., 2024).

For cakes, C_0 achieved the highest scores, while C_1 (2%) was the most acceptable among guava leaves powder-incorporated samples ($p<0.05$). Scores decreased significantly for C_2 and C_3, with C_3 receiving the lowest taste and overall acceptability scores ($p<0.05$). The darker color and slightly grainy texture in C_2 and C_3 could be the reason of reduced acceptability, as panelists preferred the lighter, smoother texture of C_0 and C_1 (Adeola & Ohizua, 2018). These results indicate that 2% guava leaves powder offers the best balance of sensory appeal and nutritional enhancement.

Table 6. Mean score for color, texture, taste, aroma and overall acceptability of prepared biscuits and cakes

Quality Factors / Sample Code	Mean Scores*				
	Color	Texture	Taste	Aroma	Overall acceptability
B_0	7.9^a	7.4^a	7.8^a	7.5^a	7.5^a
B_1	7.5^a	7.2^a	7.4^a	7.5^a	7.4^a
B_2	7.4^a	6.7^{ab}	6.7^{ab}	6.9^a	6.7^{ab}
B_3	7.2^a	6.4^b	5.9^b	6.3^a	6.1^b
LSD	**0.841**	**0.738**	**1.111**	**1.231**	**1.035**
C_0	8.1^a	7.7^a	7.7^a	7.6^a	7.8^a
C_1	6.8^b	7.1^{ab}	6.9^b	6.8^b	6.7^b
C_2	6.7^b	6.8^b	6.4^b	6.5^b	6.6^b
C_3	6.3^b	6.3^b	5.4^c	6.1^b	5.6^c
LSD	**0.749**	**0.883**	**0.753**	**0.715**	**0.671**

Values are mean±standard deviation (n=10). Means with different superscripts in the same column differ significantly (p<0.05) by Fisher's LSD test.

Conclusion

This study explored the feasibility of incorporation of guava leaves powder into biscuits and cakes. The findings shows that incorporation of guava leaves powder at 2% level significantly enhanced the nutritional profile by increasing protein and ash content while decreasing fat and carbohydrates. At this level physical properties remained optimal. Sensory evaluation indicated high consumer acceptability for the 2% samples. However, higher incorporation levels (4% and 6%) compromised sensory appeal due to changes in texture and flavor. Thus, guava leaves powder at a 2% level is a promising functional ingredient for improving the nutritional and sensory qualities of bakery products.

References

AACC method. (2001, October 5). *10-05-01 Guidelines For Measurement of Volume by Rapeseed Displacement*. Scribd. https://www.scribd.com/document/556520757/10-05-01-Guidelines-for-Measurement-of-Volume-by-Rapeseed-Displacement.

Adeola, A. A., & 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), 532–540. https://doi.org/10.1002/fsn3.590.

AOAC. (2023). Official Methods of Analysis: 22nd Edition (2023). In *Official Methods of Analysis of AOAC INTERNATIONAL* (22nd ed.). Oxford University Press. https://doi.org/10.1093/9780197610145.002.001

Barbalho, F.-M. F., Farinazzi-Machado, & de Alvares Goulart R. (2012). Psidium Guajava (Guava): A Plant of Multipurpose Medicinal Applications. *Medicinal & Aromatic Plants*, *01*(04). https://doi.org/10.4172/2167-0412.1000104

Dachana, K. B., Rajiv, J., Indrani, D., & Prakash, J. (2010). Effecr of Dried Moringa (*Moringa Oleifera*) Leaves on Rheological, Microstructural, Nutritional, Textural and Organoleptic Characteristics of Cookies. *Journal of Food Quality*, *33*(5), 660–677. https://doi.org/10.1111/j.1745-4557.2010.00346.x

Díaz-de-Cerio, E., Rodríguez-Nogales, A., Algieri, F., Romero, M., Verardo, V., Segura-Carretero, A., Duarte, J., & Galvez, J. (2017). The hypoglycemic effects of guava leaf (Psidium guajava L.) extract are associated with improving endothelial dysfunction in mice with diet-induced obesity. *Food Research International*, *96*, 64–71. https://doi.org/10.1016/j.foodres.2017.03.019

Díaz-de-Cerio, E., Verardo, V., Gómez-Caravaca, A., Fernández-Gutiérrez, A., & Segura-Carretero, A. (2017). Health Effects of Psidium guajava L. Leaves: An Overview of the Last Decade. *International Journal of Molecular Sciences*, *18*(4), 897. https://doi.org/10.3390/ijms18040897

Gutiérrez, R. M. P., Mitchell, S., & Solis, R. V. (2008). Psidium guajava: A review of its traditional uses, phytochemistry and pharmacology. *Journal of Ethnopharmacology*, *117*(1), 1–27. https://doi.org/10.1016/j.jep.2008.01.025

Hoseney, R. C. (with American Association of Cereal Chemists). (1986). *Principles of cereal science and technology*. Am. Ass. of Cereal Chemists, Inc.

Kafle, A., Mohapatra, S. S., & Reddy, I. (2018). *A review on medicinal properties of Psidium guajava*.

Kent, N. L. (1983). *Technology of cereals: An introduction for students of food science and agriculture* (3rd ed.). Pergamon.

Kumar, M., Tomar, M., Amarowicz, R., Saurabh, V., Nair, M. S., Maheshwari, C., Sasi, M., Prajapati, U., Hasan, M., Singh, S., Changan, S., Prajapat, R. K., Berwal, M. K., & Satankar, V. (2021). Guava (Psidium guajava L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. *Foods*, *10*(4), 752. https://doi.org/10.3390/foods10040752

Luo, Y., Peng, B., Wei, W., Tian, X., & Wu, Z. (2019). Antioxidant and Anti-Diabetic Activities of Polysaccharides from Guava Leaves. *Molecules*, *24*(7), 1343. https://doi.org/10.3390/molecules24071343

Martínez-Monzó, J., García-Segovia, P., & Albors-Garrigos, J. (2013). Trends and Innovations in Bread, Bakery, and Pastry. *Journal of Culinary Science & Technology*, *11*(1), 56–65. https://doi.org/10.1080/15428052.2012.728980

Milla, P. G., Peñalver, R., & Nieto, G. (2021). Health Benefits of Uses and Applications of Moringa oleifera in Bakery Products. *Plants (Basel, Switzerland)*, *10*(2), 318. https://doi.org/10.3390/plants10020318

Nanditha, B. R., Jena, B. S., & Prabhasankar, P. (2009). Influence of natural antioxidants and their carry-through property in biscuit processing. *Journal of the Science of Food and Agriculture*, *89*(2), 288–298. https://doi.org/10.1002/jsfa.3440

Pawar, S., Pawar, Dr. V., Bidwe, Dr. A., Pachankar, S., & Warkad, P. (2024). Determination of nutritional constituents of guava (Psidium guajava) leaves powder. *International Journal of Advanced Biochemistry Research*, *8*(1), 434–437. https://doi.org/10.33545/26174693.2024.v8.i1f.493

Rajchel, J. L., Zabik, M. E., & Walker, C. E. (1975). Effects of cellulosic materials on cake volume and sensory properties. *Cereal Chemistry, 52(1),* 1–10.

Srivastava, S. (2012). Preparation and Quality Evaluation of Flour and Biscuit from Sweet Potato. *Journal of Food Processing & Technology*, *03*(12). https://doi.org/10.4172/2157-7110.1000192