Production and Sensory Evaluation of Banana and Corn Beverage

Vida Commey[1] and Rita Sanful[2]

[1]Kumasi Technical University, Ghana, West Africa
[2] Department of Hospitability
Cape Coast Technical University
Correspondence e-mail: vicom3000@gmail.com

Abstract

This paper sought to evaluate the sensory attributes of three beverages produced from banana and corn extracts with different combinations. The underlying objective of the paper was to promote the consumption through diversified recipe development. The Traditional Value Chain Development model utilized by pharmaceutical firms was used as a tool for the recipe development. Product A consisted of 80% banana and 20% corn dough; Product B; 50% banana and 50% corn dough, and Product C; 40% banana and 60% corn dough. From the sensory evaluation, Product A was preferred in terms of all the sensory attributes assessed and was followed by product B and C in that order. Findings from the study revealed that Product A was the best sample in terms of colour, aroma and taste. The ANOVA results recorded significant differences among products A, B and C ($p<0.05$) in respect of all the sensory attributes assessed. It is recommended that more recipes should be developed from products A and C to minimize post- harvest losses of banana.

Keywords: *Banana, Post-harvest loss, Shelf life, Corn dough, sensory analysis*

1.0 INTRODUCTION

Banana (Musa acuminata) is one of the most common and widely consumed fruits in the world (Karmakar & De, 2019). Jain and De (2019) affirmed that banana is a likable fruit worldwide because of its aroma and flavour. Moreover, banana is nutritionally rich and has many health benefits since it contains significant amount of potassium, calcium, magnesium, and high volume of sugar as well as being used as an alternative to a full course meal (Karmakar & De, 2019). Bananas are cultivated in over 100 countries mostly in the tropical and subtropical regions of the world (Bello-Pérez et al., 2011). Although bananas are known for their economic and nutritional value, most bananas are produced by smallholder farmers mainly for domestic consumption (Esguerra & Rolle, 2018). According to the Food and Agriculture Organization (FOA) (2019), India is the leading producer of banana with total production volume of 29 million tons per year. It is a major staple fruit consumed by millions of people and serves as valuable source of income through local and international trade (Aurore et al., 2009). Banana is one of the most popular fruits and in 2018, an estimated 4.2 million tons of banana was produced in Ghana which makes it one of the leading producers in Africa (Dzomeku et al., 2009).

Similar to most fruits and vegetables, a major problem associated with the production of bananas is post-harvest losses especially in developing economies (Nayak et al., 2018). Banana has poor storage characteristics due to high respiratory rate and ethylene production after harvest, making it

highly perishable and prone to postharvest losses (Turner, 2001). This problem is worsened by lack of storage facilities in most producing areas and the postharvest loss of banana associated with storage and marketing is severe and exceeds 60% in some areas (Mebratie et al., 2015). Nayak et al., (2018) further argue that post-harvest losses that occur during harvesting, handling, transport, storage and distribution of highly perishable crops including bananas are the major problems faced by most agrarian economy.

In a bid to mitigate such losses related to banana production, processing and product development using ripe and overripe banana has been promoted in some localities to create value addition and improved returns. For instance, Soorianathasundaram et al., (2016) stressed that banana beverage production is popular in East and Central African countries like Namibia, Kenya, Uganda and Rwanda. In these areas, banana juice and beer are produced from the ripe fruit, which is processed by fermentation to produce a low-alcohol content beverage rich in vitamin B. In addition, banana is processed for chips, flour, powder, starch, jam, vinegar etc. (Lebaka et al., 2018). Soorianathasundaram et al., (2016) identified that banana is used to produce flour and powder which is added as ingredient in bread preparation, pastries, or as thickening for sauces and soups. Mouniounenpou et al. (2017) also add that alcoholic beverages that are produced from banana extract in Cameroun have higher patronage because they have good taste and aroma.

However, in the Ghanaian context, little is known about the uses of banana in agro-processing activities. Thus, although Ghana is the 4th largest producer of banana in Africa after Cameroun, DR Congo and Uganda (FAO, 2018), there remains scanty documentation and research regarding product development using banana. Loos et al. (2019) suggested that all banana species may have potentials as fiber sources and bulk production of other industrial products in Ghana. Therefore, the purpose of this study was to promote banana as a consumer good for food and beverage processing with the aim of adding value to banana by developing a new product and minimize its post-harvest losses. The Traditional Value Chain Development model which focuses on the processing, distribution, marketing and consumption of products to create business value (Gelli et al., 2015; Straková et al., 2020) was used as a tool for recipe development using banana and corn as main ingredients. Three Products were made from different proportions of banana and corn dough.

2.0 MATERIALS AND METHODS

This section shows the materials, proportions, principles, methods and processes used for the banana/corn drink. The methodology describes the set of methods and principles that were used in this paper. It also gives a summary of the source of raw materials, proportion of ingredients used, sample preparations, sensory evaluation and analysis of data.

2.1 Raw Materials

The primary materials used in this study included; *Banana* and corn extracts. Control materials used for the recipe development included sugar, ginger and cloves. All the materials were obtained from Kumasi Asafo market in the Ashanti region.

Table 1: Cost of Materials Ingredients

Materials/Component	**Unit**	**Unit cost (GHS)**	**Quantity**	**Total cost (GHS)**
Banana	Fingers	0.5	20	10.00
Corn dough	Kilogram (kg)	5.0	1	5.00
Sugar	Kilogram (kg)	3.0	0.750	2.25
Ginger	Kilogram (kg)	1.0	4	1.00
Clove	Kilogram (kg)	2.00	0.500	1.00
Miscellaneous				6.00
Total				**25.25**

Source: (Field Data, 2020)

Yield: 14 bottles

Cost per bottle= 25.25/14 = GHS 1.808 ≈ GHS 1.80

Product A – (800 ml banana extract and 200 ml corn dough extract)

Product B – (400 ml banana extract and 600 ml corn extract)

Product C – (500 ml corn dough extract and 500 ml banana extract)

Table 2: Quantity of ingredients in formulating samples

Ingredients:	**Sample A**	**Sample B**	**Sample C**
Banana extract	800ml	400ml	500 ml
Corn dough extract	200ml	600ml	500mls
Clove	25 g	25 g	25 g
Ginger	5 g	5 g	5 g

Source: (Field Data, 2020)

2.2 Treatment of Materials

All equipment and tools were washed and sterilized with hot water whereas the bottles for packaging were also washed and sterilized with hot water before being used. The fruits were also washed in salted water and rinsed thoroughly before peeling.

2.3 Preparation

The ripped banana was peeled re-washed, mashed and put in a stainless-steel saucepan with 3litres of water and boiled for 10 minutes to extract the juice. It was then left to cool. The corn dough was dissolved in 3litres of water and left for 8hr.

The water was then poured from the corn dough and put in a stainless-steel saucepan and brought to boil. It was also left to cool. The two extracts were now ready to be mixe in different quantities for the drinks. Figure 1 shows the Flow chart used in the preparation of the banana/corn drink samples.

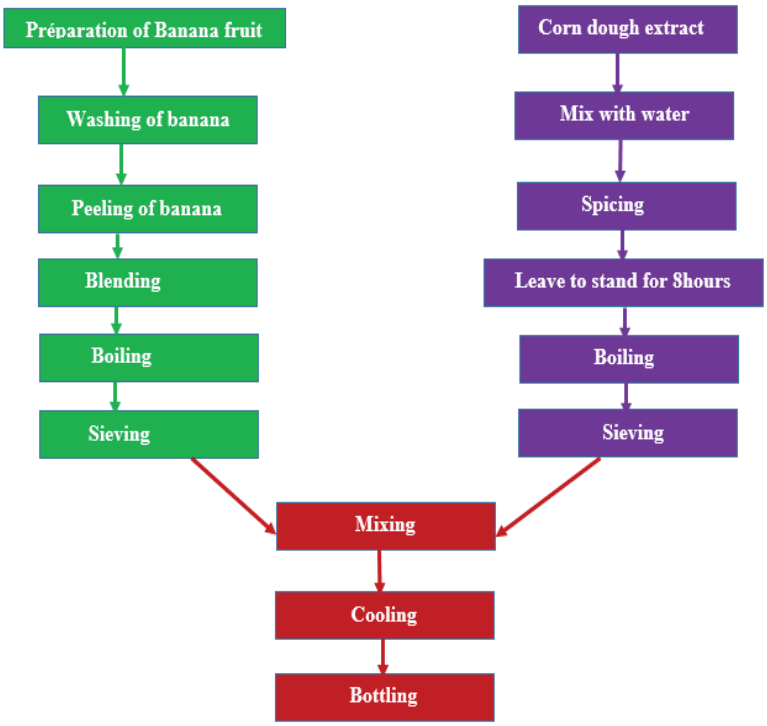

Fig 1: Flow chart for the preparation of banana/corn drink (Author, 2020)

2.4 Analysis of Sensory attributes

Respondents were asked to rank the variables that were denoted as the sensory attributes of the three product categories on a Likert Scale of 1 to 5 points. The variables denoted as the sensory attributes of the product were; taste, aroma, colour, consistency after taste and overall acceptability.

3.0 RESULTS

This section captures the results from the study conducted.

3.1 Demographic characteristics

The demographic features of respondents who assessed the sensory attributes of the samples are shown in Table 3.

Table 3: Demographic characteristics

Demographic Features	Frequency (N=30)	Percentage (%=100)
Gender		
Male	17	56.67
Female	13	43.33
Age Distribution		
18-30 years	10	33.33
31-40 years	14	46.67
41-50 years	4	13.33
51+ years	2	6.67
Occupation		
Student	20	66.67
Lecturer	3	10.00
Trader on Campus	7	23.33
Level of Students		
Level 100	7	35.00
Level 200	5	25.00
Level 300	4	20.00
Level 400	4	20.00

Source: (Field Data, 2020)

The data in table 3 shows that 56.67% of the respondents were males while 43.33% were females. It can also be in table 3 seen that, 46.67% of the respondents were within the age bracket of 31-40 years. Table 3 also shows that 33.33% were also within the age bracket of 18-30 years while 13.33% as well as 6.67% were within the age bracket of 41 years as well as 51 and above years respectively. The data further shows that 66.67% out of the respondents were students while 23.33% and 10% were traders on campus as well as lecturers respectively. The statistics on the level or grade of students can be inferred from Table 3.

3.2 Ranking of the sensory attributes of Product A

The statistics on the ranking of the sensory attributes of product A per the responses of the respondents are summarized in Table 4.

Table 4: Ranking of the sensory attributes of Product A

Scale: 1 Poor; 2 Average; 3 Good; 4 Very Good; 5 Excellent				
Sensory Attribute	**Frequency (N)**	**Mean**	**Std. Deviation**	**% Score**
Taste	30	4.733	0.913	94.66
Aroma	30	4.537	0.887	90.74
Colour	30	4.689	0.973	93.78
Consistency	30	4.735	0.903	94.70
After Taste	30	4.783	0.926	95.66
Overall Acceptability	30	4.892	0.710	97.84

Source: Field Data (2020)

3.3. Ranking of the sensory attributes of Product B

The statistics on the ranking of the variables that were denoted as the sensory attributes of product B from the data gathered from the respondents are presented in Table 5.

Table 5: Ranking of the sensory attributes of Product B

Scale: 1 Poor; 2 Average; 3 Good; 4 Very Good; 5 Excellent				
Sensory Attribute	**Frequency (N)**	**Mean**	**Std. Deviation**	**% Score**
Taste	30	3.238	0.780	64.76
Aroma	30	4.018	0.827	80.36
Colour	30	4.281	0.851	85.62
Consistency	30	3.792	0.799	75.84
After Taste	30	3.982	0.802	79.64
Overall Acceptability	30	3.782	0.821	75.64

Source: Field Data (2020)

3.4 Ranking of the sensory attributes of Product C

The analysis on the ranking of the variables that were denoted as the sensory attributes of product C from the data gathered from the respondents are presented in Table 6.

Table 6: Ranking of the sensory attributes of Product C

Scale: 1 Poor; 2 Average; 3 Good; 4 Very Good; 5 Excellent				
Sensory Attribute	**Frequency (N)**	**Mean**	**Std. Deviation**	**% Score**
Taste	30	2.019	1.012	40.38
Aroma	30	2.970	1.281	59.40
Colour	30	3.029	0.901	60.58
Consistency	30	2.788	1.211	55.76
After Taste	30	2.742	1.287	54.85
Overall Acceptability	30	2.082	1.370	41.64

Source (Field Data, 2020)

3.5 Analysis of Variance (ANOVA)

The results of the Analysis of Variance between the three products on the premises of the respondents' choice based on their sensory attributes is presented in Table 7.

Table 7: Analysis of Variance (One-Way ANOVA)

Sensory Attributes		Sum of Squares	df	Mean Square	Sig.
Taste	Between Groups	18.000	2	9.000	.001
	Within Groups	.000	0	.	
	Total	18.000	2		
Aroma	Between Groups	4.667	2	2.333	.000
	Within Groups	.000	0	.	
	Total	4.667	2		
Colour	Between Groups	8.667	2	4.333	.000
	Within Groups	.000	0	.	
	Total	8.667	2		
Consistency	Between Groups	8.000	2	4.000	.001
	Within Groups	.000	0	.	
	Total	8.000	2		
After Taste	Between Groups	12.667	2	6.333	.003
	Within Groups	.000	0	.	
	Total	12.667	2		
Overall acceptability	Between Groups	24.667	2	12.333	.000
	Within Groups	.000	0	.	
	Total	24.667	2		

Source (Field Data, 2020). Significant at p<0.05

The data presented in table 4-6 shows that; product A with composition of 80% banana consistent and 20% corn dough consistent scored higher percentages in terms of all assessed sensory attributes. This implied that the sensory attributes of product A were consistently preferred. The data also shows that, product B scored relatively higher percentages in all the assessed sensory attribute more than that of product C. Moreover, the data showed that, the overall acceptability score of product A was higher than that of products B and C. It can be inferred from tables 6 that the overall acceptability score of product A was 97.84% which was higher than the 75.64% and 41.64% of products B and C respectively. The results of the One-Way Analysis of Variance which is summarized in table 9 shows that at $p<0.05$ all the variables that were denoted as the sensory attributes of the three product categories were statistically different per the significant values show in table 7. Although little empirical studies have been carried out to examine the sensory attributes to establish the preference

of banana with corn extract beverage, the findings of few ones are consistent to that of this current study. For example, the study of Mouniounenpou *et al.* (2017) that sought to examine the production techniques and sensory evaluation of three different composition of banana and maize extract alcoholic beverages revealed that, product 3 which had higher composition of (70%) of banana had consistent preference on all the sensory attributes. Also, in the current study, the respondents preferred product 'A' category because it had good taste, aroma, texture and colour which affirms the study of Lebaka *et al.* (2018) that, products made from banana extract such as cookies, pastries and beverages have higher patronage in Netherland due to their taste and aroma.

4.0 DISCUSSION

While several studies provide an empirical basis on the post-harvest losses of banana which is considered as one of the perishable agricultural products, this study experimented and assessed the sensory attributes of three product categories made from banana and corn extracts with different compositions to help reduce the post-harvest losses of banana. Although little empirical studies have been carried out to examine the sensory attributes to establish the preference of banana with corn extract beverage, the findings of few ones are consistent to that of this current study. For example, the study of Mouniounenpou *et al.,* (2017) that sought to examine the production techniques and sensory evaluation of three different composition of banana and maize extract alcoholic beverages revealed that, product 3 which had higher composition of (70%) of banana had consistent preference on all the sensory attributes. Also, in the current study, the respondents preferred product 'A' category because it had good taste, aroma, texture and colour which affirms the study of Lebaka *et al.,* (2018) that, products made from banana extract such as cookies, pastries and beverages have higher patronage in Netherland due to their taste and aroma.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The sensory attributes of the three products were assessed among 30 students, lecturers and traders of Kumasi Technical University. At the end of the experiment, it can be concluded, product A which contained 80% banana constituent and 20% corn constituent was the most preferred sample with 97.84% overall acceptability score among three products. Product B which had 50% each of banana and corn dough (overall acceptability score of 75.65%) was preferred more than product C which had 20% banana and 80% corn dough with overall acceptability score of 41.64%. The study recommends that, more recipes should be made from product A and B, which had relatively good acceptability scores (97.84%, 75.65%) to reduce the post-harvest loss of banana. Further work will study the shelf life of the product and also conduct proximate analysis to determine the compounds contained in the banana and corn drink.

REFERENCES

Aurore, G. Parfait, B. and Fahrasmane, L. (2009). Bananas, Raw Materials for Making Processed Food Products. J. Trends in Food Sci & Tech. 20(2): 78–91.

Dzomeku, B. M., Armo-Annor, F., Adjei-Gyan, K., Ansah, J. and Nkakwa, A. (2009). Improving Crop Protection on Banana Farms in Ghana. *J. Acta. Horti.* 828: 89-394.

Food and Agriculture Organization 2019. Banana Facts and Figures. Available at http://www.fao.org/economic/est/est-commodities/bananas/bananafacts/en/#.X0I6s9z7SvG Accessed 21 August 2020.

Gelli, A., Hawkes, C., Donovan, J., Harris, J., Allen, S. L., De Brauw, A., Henson, S. and Ryckembusch, D. (2015). Value Chains and Nutrition: A Framework to Support the Identification, Design, and Evaluation of Interventions. A paper presented to International Food Policy Research Institute. Held in Washington, DC. USA, March 2015.

Karmakar, S. and De, S. (2019). Pectin Removal and Clarification of Juices; Separation of Functional Molecules in Food by Membrane Technology. Available at https://www.researchgate.net/publication/330339132_Pectin_Removal_and_Clarification_of_Juices/citation/download Accessed 14 September 2020

Lebaka, V. R., Wee, Y. J., Narala, V. R. and Joshi, V. K. (2018). Development of New Probiotic Foods; A Case Study on Probiotic Juices. In *Therapeutic Probiotic Unconv.* Foods; Elsevier: Amsterdam, The Netherlands.

Mebratie, M. A., Haji, J., Woldetsadik, K. and Ayalew, A. (2015). Determinants of Postharvest Banana Loss in the Marketing Chain of Central Ethiopia. *J. Food Sci & Quality Mgtt*. 37: 52 – 63.

Mounjouenpou P., Okouda A., Bongse K. A., Maboune T. S. A. & Tanya A. (2017) Production technique and sensory evaluation of traditional alcoholic beverage based maize and banana. Int. J. Gast. & Food Sci. 10: 11-15.

Nayak, A. K., Singh, N. and Kumar, D. (2018). An Economic Study of Post-harvest Losses of Banana in Durg District of Chhattisgarh. *Int. J. of Agric. Eco. & Stat.* 9: 82- 89.

Soorianathasundaram, K. Narayana, C. K. and Paliyath, G. (2016). Bananas and Plantains. In *Encyclopedia of Food and Health*, p. 320, vol. 6. Academic Press, Oxford, UK.

Straková, J., Rajiani, I. Pártlová, P. Váchal, J. and Dobrovic, J. (2020). Use of the Value Chain in the Process of Generating a Sustainable Business Strategy on the Example of Manufacturing and Industrial Enterprises in the Czech Republic. *Int. J. Sust.* 12:1520-1535

Turner, D. W. (2001). Bananas and Plantains, p. 45-77. In: Mitra, S. K. (eds.). Postharvest Physiology and Storage of Tropical and Subtropical Fruits, vol. 7. CABI Publishing, UK.