Development and Quality Evaluation of Ash Gourd and Banana Pseudo-Stem Tender Core Blended Jam Alternative

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Abstract

Ash gourd and banana pseudo-stem tender cores contain more fiber and other nutrients that benefit human health. This study was carried out to compare the formulated jam alternative with ash gourd and banana pseudo-stem tender core and to evaluate its physio-chemical content against the control. The jam alternative was produced with five treatments (T1: Ash gourd only, T2: Banana pseudo-stem tender core pulp only, T3: Ash gourd pulp 50%: Banana pseudo-stem tender core pulp 50%, T4: Ash gourd pulp 30%: Banana tender core pulp 70%, T5: Ash gourd pulp 70%: Banana tender core pulp 30%) with different formulation incorporating ash gourd and banana tender core. The moisture, ash, fiber, pH, and titratable acidity were analyzed for the different jam alternative treatments. The results ranged from 5.10-7.14 % fiber, 0.26-0.37% ash, 2.81-2.92 pH, 1.08-1.58 mg per 100g as citric acid titratable acidity, and 19.01-21.53 % moisture content. Significant differences ($p<0.05$) were observed between the treatments for moisture, ash, fiber, pH, and titratable acidity of jam alternative. Further, the sensory evaluation was conducted for the five different formulas with 20 untrained panelists using a nine-point Hedonic scale for taste, texture, color, odor, and overall acceptability. According to the sensory test, 100% banana tender core jam alternative (Treatment 2) was selected as the preferable sample out of the five samples. Conclusively, the jam alternative developed with a banana tender core was favored by the sensory panel.

Keywords: Jam alternative, Banana pseudo-stem Tender Core, Ash Gourd, Quality Evaluation, Sensory Evaluation

I. INTRODUCTION

Banana is an herbaceous plant of the family Musaceae (Ranjha, 2022). In terms of overall production, banana are in second place after citrus, accounting for about 16% of the world total fruit production. Currently, nearly 50,000 ha of land is under banana cultivation in Sri Lanka, and the annual banana production is around 450,000 metric tons (Hirimburegama et al., 2004). The stem of the banana plant, called the pseudo stem, produces a single bundle of bananas before it starts its reproductive growth. The soft core of the banana pseudo-stem is thickly pressed in the middle (core) of the banana pseudo-stem, tube-like shape with a width of roughly 5–6 cm (Hirimburegama et al., 2004).

Each banana plant produces only one bunch of bananas because this crop generates a large amount of residue. After the harvest, the stem is cut and usually left on the plantation or burned, which could ultimately cause environmental issues (Ranjha, 2022). After each cluster of developed banana natural products (usually 10-12 months), four times of banana waste (e.g., banana pseudo-stem, leaves, organic product bundle, spoiled organic product, and rhizomes) are deserted to the environment (Khatun et al., 2019). Banana waste materials are rich in minerals and nutrients. Recently, some studies on the banana pseudo-stem (*Musa acuminata* Colla and *Musa sapientum*) have been reported, focusing on the chemical contents, such as monosaccharides, fibre composition, and mineral contents (Mukhopadhyay et al., 2008; Oliveira et al., 2007). Ash gourd, also known as a *Benincasa hispida*, is in the Cucurbitaceae family. It comprises 96% water and is low in calories, fat, protein, and carbs (Pradhan, 2020). Its inner side has a thick white, delicious, and fresh tissue. It has the name ash gourd because its seeds build up a waxy matter of gray on development (Pradhan, 2020). The biochemical activity of the fruit includes antioxidative, anti-inflammatory, anti-angiogenic, detoxicant, and curative effects in treating various ailments. The essential minerals Ca, Mg, Fe, Cu, Zn, and Se are present (Gupta et al., 2019).

Natural products are critical in human nutrition. Be that as it may, due to their short-lived nature and occasional accessibility, they are prepared into more stable structures, for example, jams, juices, pickles, and some more items. Jam is a prepared natural product item with a middle-of-the-road moisture content set up by bubbling homogenized natural product mash with sugar, corrosive, and gelatin. It might have different fixings like additives, seasoning, or shading compounds. It ought to have an appropriate consistency so that it could spread without much of a stretch and should be firm enough, so it doesn't stream like a liquid (Garg et al., 2019).

Jam is thought to contain 68.5% absolute dissolvable solids (TSS) at any rate, and the organic product ought to contribute 45% of the all-out weight of jam. Sugar in a jam decreases its water action, bringing about longer rack life. Around the world, a few kinds of organic products have been utilized for making jams. Since customer decisions provide the food items, improving new things is significant for the natural product businesses (Garg et al., 2019). Therefore, this study aims to develop jam from underutilized plant products such as banana tender core and ash gourd.

II. METHODOLOGY

A. Experimental site

The experiment was carried out in the Food Science and Technology laboratory, Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka.

B. Procurement of raw materials

Fresh and matured ash gourd was collected from the local market in Akkaraipattu. The banana pseudo-stem was collected from an Embul banana cultivar at the stage before the fruiting stage, nearby the University premises. Pectin and citric acid were purchased from Colombo, and other ingredients were purchased from local stores in Oluvil.

C. Extraction of pulps

1) Extraction of ash gourd pulp

Undamaged ash gourd fruit was selected, and the peel was removed. Then it was cut into small pieces and washed using potable water. Afterward, ash gourd pieces were boiled for 2 hours at the ratio of 1:1 ash gourd and water. And 0.5g citric acid was added to the ash gourd to prevent the enzymatic browning. After heating, it was kept for cooling, and then it was blended to make pulp. The pulp was strained through a 100-mesh strainer.

2) Extraction of banana pseudo-stem tender core pulp

The fresh banana pseudo-stem was collected, and the outer layer was removed to collect the core of the banana. Then, it was cut into sliced and washed using potable water. The sliced banana core was boiled for two and half hours at 1 cup of the sliced core: 1 cup of water. Then, 0.5g of citric acid was added to the sliced core. After heating, it was kept for cooling, and then it was blended to make pulp. The pulp was strained through a 100-mesh strainer.

D. Experimental design

Treatments:
Treatment 1 (T1); Ash gourd pulp only
Treatment 2 (T2); Banana tender core pulp only
Treatment 3 (T3); Ash gourd pulp 50%: Banana tender core pulp 50%
Treatment 4 (T4); Ash gourd pulp 30%: Banana tender core pulp 70%
Treatment 5 (T5); Ash gourd pulp 70%: Banana tender core pulp 30%

E. Preparation of jam alternative

For the preparation of the jam alternative, the pulp mixture was heated at 100 ℃. When the pulp mixture reached 100 ℃, it was turned off, and sugar and pectin were added to it while stirring it continuously to prevent the pectin from clotting. The pectin powder was mixed with a small amount of sugar taken out of the total sugar in the recipe.

Table 1. Ingredients of the different jam alternative treatments per 100 g

Ingredients (g)	T1	T2	T3	T4	T5
Ash gourd pulp	35.00	-	17.5	10.5	24.5
Banana core pulp	-	35.00	17.5	24.5	10.5
Sugar	60.00	60.00	60.00	60.00	60.00
Pectin	3.00	3.00	3.00	3.00	3.00
Citric acid	2.00	2.00	2.00	2.00	2.00

Then, again mixture was allowed to boil, and the temperature was increased to 100 ℃, and the mixture was allowed to cook for several minutes while stirring occasionally. The heat was turned off, and citric acid was added. The endpoint of jam alternative preparation was determined by cooling a small amount of sample and testing for its TSS (62-650Brix) pH (3.1-3.5 pH) and skin wrinkle. Upon reaching the consistency of 65o Brix value and pH 2.9-3.00, the heat was turned on and allowed to cool down for a few minutes. The jam alternative sample was immediately filled into clean and pre-sterilized glass jars and was allowed to cool at ambient temperature. The jars were closed with their lids and were stored at room temperature.

F. Proximate characteristics of jam alternative

The sample's crude fiber and ash content were determined by the methods described by AOAC (2000).

1) Determination of ash content

The crucible was placed in an oven at 105℃ for 30 minutes. The crucible was cooled in the desiccators for 30 minutes and weighed. The sample (5.0 g) was weighed into the crucible (W1). The crucible was placed in a muffle furnace and heated at 600℃ for 5 hours. Then, it was cooled in the desiccators. The ash with crucibles was weighed after cooling (W2).

$$Ash\ content\ \% = \frac{Weight\ of\ the\ ash(g)}{Initial\ sample\ weight(g)} \times 100$$

2) Determination of crude fiber

The samples (5.0g) were taken into the beakers, and 0.2 M H2SO4 solution 200ml were added to the samples, and the mixture was boiled under reflux for 30 minutes. The hot solution was filtered using a muslin cloth, and insoluble matter was washed with hot water until free of acid and transferred into the beaker. Then, 0.2 M NaOH solution 200ml was added and boiled under reflux for 30 minutes, and the solution was filtered, washed with hot water, weighed, and dried in an oven for 2 hours, cooled in a desiccator, and weighed in a crucible (W1). The crucible and its content were incinerated in a muffle furnace at 550℃ for 3 hours and the crucible was cooled in a desiccator and weighed.

$$\text{Fiber } (\%) = \frac{\text{Wt of insoluble matter (g)} - \text{Wt of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

3) Determination of moisture content

The empty dish was dried in an oven at 105℃ for 3 hours, transferred to desiccators to cool, and then weighed. The sample (5g) was put into the dish. The sample was dried in an oven for 3 hours at 105℃. After drying, the dish was transferred to desiccators to cool and weighed (AOAC 2000).

$$Moisture\ content\ \% = \frac{Initial\ weight(g) - Final\ weight(g)}{Initial\ weight(g)} \times 100$$

4) Determination of pH

The pH of the jam alternative was measured using calibrated digital pH meter (PHS-25, China).

5) Determination of titratable acidity

The sample (5.0g) was mixed with 100ml of distilled water. Estimating the titratable acidity of the jam alternative was done by the Automatic Titrator (WT-TT-3A, China).

$$\text{Titrable acidity } = \frac{S * N * 90}{V * 1000} \times 100$$

Where:
S = ml 0.1 NaOH used
N = Normality of 0.1 N NaOH
V = ml solution used

G. Sensory evaluation

The samples were evaluated for sensory attributes, including color, flavor, texture, taste, odor, and overall acceptability. The ranking of the samples

using a nine-point hedonic scale from 1 (dislike extremely) to 9 (like extremely). Sensory evaluation was carried out with 20 untrained panelists.

H. Statistical analysis

The Analysis of Variance (ANOVA) was used to find significant differences and means were compared using Tukey's range test at 95% significant level using SPSS (IBM SPSS Statistics Version 25).

III. RESULTS AND DISCUSSION

1) Moisture content

The moisture content of the jam alternative had a significant difference ($p < 0.05$) within the treatments. According to the results, the moisture content of different jam alternative treatments ranges from 19.01 % to 21.53 %. Treatment 4 had the lowest moisture content of 19.01 %, while the highest content (21.53 %) was that of the T1 control sample. It is prominent that the higher the banana tender core content, the lower the moisture content. The jam is considered a self-stable food, so the moisture content is low in jams. James et al. (2015) reported that mixed fruit jam moisture content was 18.64 to 22.14 %. Therefore, we can argue that the moisture content of the developed jam alternative is in the standard range.

Treatment	Moisture	Ash	Fiber	pH	Titratable Acidity
1	21.52±0.55b	0.21±0.02a	6.16±0.05b	2.83±0.02a	1.28±0.04bc
2	19.59±0.50ab	0.59±0.03b	7.14±0.07c	2.92±0.03a	1.08±0.02a
3	20.05±0.31ab	0.19±0.03a	5.10±0.04a	2.81±0.02a	1.58±0.03d
4	19.01±0.46a	0.16±0.01a	6.18±0.02b	2.83±0.02a	1.16±0.06ab
5	20.93±0.21ab	0.18±0.02a	6.16±0.04b	2.83±0.06a	1.43±0.03cd
F, (DF)	5.69, (4)	60.11, (4)	258.49, (4)	1.382, (4)	27.52, (4)
	*	*	*	NS	*

Table 2. Physio-chemical composition of each jam alternative treatments
Different letters below the mean values within the column indicate the significant difference, *= significant and NS= non-significant at 0.05.

2) Ash content

Ash content of the jam alternative treatments had a significant difference ($p<0.05$) within the treatments. The lowest ash content was that of (T4) 0.16 %, and the highest ash content was T2, 0.59 %. Garg et al. (2019) reported that the Ash content of mixed fruit jam alternatives ranged from 0.26% to 0.37%. This present study had ash content varied between 0.16 % and 0.59 %. The mineral content of both ash gourd and banana tender core is contributed to the total ash content of the developed jam alternative.

3) Fiber content

Crude fiber contents ranged from 5.10 % to 7.14 %. Treatment 3 had the lowest fiber content (5.10%), while Treatment 2 had the highest one (7.14 %). Garg et al. (2019) reported that the crude fiber content of the mixed fruit jam alternatives was in the range of 0.44 to1.61%. The present study had the highest fiber content compared to the other jams. We may argue that the fiber content of jam is higher due to the incorporation of tender banana core since tender banana core has a higher amount of fiber content (Aziz et al., 2011).

4) pH content

pH is an important factor in the formation, jelling property, and stabilization of jams (Awolu et al., 2018). The pH value of the jam alternatives varied between 2.81 and 2.92.

5) Titratable acidity

Acidity is one of the physicochemical properties responsible for a longer shelf-life of food products as it associates with a certain degree of acidity and prevents the food products from microorganism growth (Tifani et al., 2018). In the present study, titratable acidity varied from 1.08 to 1.58 mg per 100g as citric acid.

6) Sensory properties of jam alternative

The mean scores for consumer preference in terms of color, texture, taste, order, and overall acceptability are presented below (Figure 1). According to the sensory panel response, the overall acceptability of jam alternative in T2 was the highest. The jam alternative developed with the 100 % banana tender core secured higher

scores for all the sensory attributes, including color, texture, taste, order, and overall acceptability.

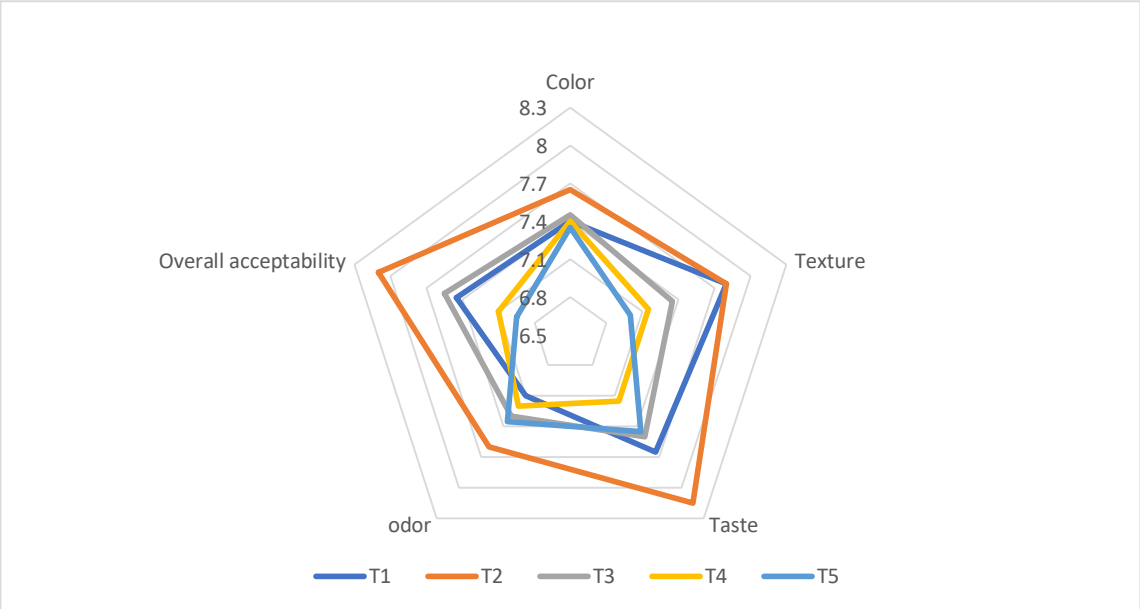

Figure 1. Sensory profile of different jam alternative formulations

IV. CONCLUSION

The banana tender core and ash gourd are underutilized agricultural by-products and produce. The jam alternative was produced with a different formulation of banana tender core and ash gourd. According to the results, the moisture, ash content, fiber content, pH value, and titratable acidity of the jam alternative aligned within the range of standard range. Further, the sensory analysis resulted in the panelists favoring a jam alternative developed with 100 % banana tender core. Therefore, in the future, jam alternatives could be produced with tender banana core alone.

REFERENCES

Awolu, O. O., Okedele, G. O., Ojewumi, M. E., & Oseyemi, F. G. (2018) 'Functional jam production from blends of banana, pineapple and watermelon pulp', *International Journal of Food Science and Biotechnology*, 3(1), 7-14.

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 acuminata× balbisiana Colla cv. Awak) pseudo-stem and pseudo-stem tender core flours', *Food chemistry*, 128(3), 748-753.

Garg, S., Ghosh, P., Rana, S. S., & Pradhan, R. C. (2019) 'Preparation and Quality Evaluation of Nutritionally Enriched Jam Made from Blends of Indian Blackberry and Other Fruits', *International Journal of Fruit Science,* 19(1), 29–44. https://doi.org/10.1080/15538362.2018.1536872

Hirimburegama, W. K., Dias, W. K. G., & Hirimburegama, K. (2004) 'Banana improvement through gamma irradiation and testing for banana bract mosaic virus in Sri Lanka. In Banana improvement: cellular, molecular biology, and induced mutations', *Proceedings of a meeting held in Leuven, Belgium*, 24-28 September 2001 (pp. 79-85). Science Publishers, Inc..7

James, S., Usman, M., Ojo, S., Ohuoba, E., Lillian, N., Sanni, H., & Amuga, S. (2016) 'Quality Evaluation and Consumer Acceptability of Mixed Fruit Jam from Blends of Pineapple (Ananas sativa Lindl.), Tomato (Lycopersicon esculentum Mill.) and Pawpaw (Carica papaya)', *British Journal of Applied Science & Technology*, 12(4), 1–8. https://doi.org/10.9734/bjast/2016/21123

Khatun, S., Hossain, M. A., Akter, T., Banu, M. R., & Kawser, A. Q. M. R. (2019) 'Replacement of Sodium Bicarbonate and Micronutrients in Kosaric Medium with Banana Leaf Ash Extract for Culture of Spirulina Platensis', *Annals of Bangladesh Agriculture*, 23(1), 37-47.

Mukhopadhyay, S., Fangueiro, R., Arpaç, Y., & Şentürk, Ü. (2008) 'Banana fibers–variability and fracture behaviour', *Journal of Engineered Fibers and Fabrics,* 3(2), 155892500800300207.

Oliveira, L., Cordeiro, N., Evtuguin, D. V., Torres, I. C., & Silvestre, A. J. D. (2007) 'Chemical composition of different morphological parts from 'Dwarf Cavendish' banana plant and their potential as a non-wood renewable source of natural products', *Industrial Crops and Products,* 26(2), 163-172.

Pradhan, K., Nandi, A., Rout, S., & Tripathy, B. (2020) 'Ash gourd-an under exploited potential crop', *Dogo Rangsang Research Journal*, 10(06), 142-151.

Prerna Gupta, Sivanand Chikkala & Priyanka Kundu (2019) 'Ash gourd and its applications in the food, pharmacological and biomedical industries', *International Journal of Vegetable Science*, DOI: 10.1080/19315260.2019.1699222

Ranjha, M. M. A. N., Irfan, S., Nadeem, M., & Mahmood, S. (2022) 'A comprehensive review on nutritional value, medicinal uses, and processing of banana', *Food Reviews International*, 38(2), 199-225.

Tifani, K. T., Nugroho, L. P. E., & Purwanti, N. (2018) 'Physicochemical and sensorial properties of durian jam prepared from fresh and frozen pulp of various durian cultivars', *International Food Research Journal*, 25(2).