THE POTENTIAL APPLICATION OF SABA BANANA FLOUR IN BAKERY PRODUCTS

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ABSTRACT

'Saba' banana is a triploid hybrid (ABB) cultivar that is normally marketed as fresh produce and the downstream processing is limited to local dishes or chips. Bananas are rich in potassium and unripe bananas contain high resistant starch that is essential for healthy digestion and has moderate glycaemic index. Processing 'Saba' banana into flour provides a more stable storage form while reducing wastage of unmarketable fruits. The aim of this study was to examine consumers' acceptance of bakery products produced using banana flour. Green (unripe) 'Saba' bananas were obtained from local farmers and developed into banana flour. The bananas were cleaned, peeled, sliced, and dried in a fan-forced oven at 75°C. The drying process was stopped once water activity and moisture content were below 0.5 aw and 10%, respectively. The dried bananas were then ground, sieved manually, and sealed in a plastic bag. The flour was analysed for its nutritional content and used as the main ingredient in bakery products to test for consumers' acceptance. Five bakery products (layered cake, mini cake, biscuit, crepe, *bahulu*) were developed and served during Sabah's state level Farmers Day in 2017. Acceptance of the bakery products was based on a 5-points hedonic scale, where 49 respondents who tested all five products and completed the evaluation form were included in the analysis. The nutritional analysis showed that green 'Saba' banana flour contains energy (367kcal/100g), carbohydrates (87.7g/100g), protein (3.4g/100g), fat (0.3g/100g), and potassium (994mg/100g). The acceptance test showed that 'Saba' banana flour was well accepted (most scored 4 and 5) as an ingredient in bakery products. The mean score of acceptance for crepe, layered cake, biscuit, mini cake, and *bahulu* were 4.47±0.92, 4.43±0.61, 4.20±0.76, 4.14±0.82, and 4.02±0.85, respectively. Significant difference ($p<0.05$) was observed between the five tested products, where the respondents preferred the layered cake and crepe made of 'Saba' banana flour. These results demonstrated the potential of incorporating 'Saba' banana flour as the ingredient in bakery products as a healthier alternative. This healthy replacement meets the demand of consumers who seek health and taste in their food.

Keywords: 'Saba' banana, green banana flour, bakery products

1. INTRODUCTION

Banana is the fourth major fruit crop in the world and one of the most consumed fruits in tropical and subtropical regions (Alkarkhi *et al.*, 2011; Bello-Perez, 2012). There are more than 1000 varieties of bananas around the world with Cavendish being the most commercialized (about 45% of global market) and widely exported (Falcomer *et al.*, 2019; Food and Agriculture Organization, 2015). This is due to its high production per hectare and resilience to damage from environmental changes (Falcomer *et al.*, 2019). The other large variety group of bananas is the plantain which has upwards of 100 cultivars (Falcomer *et al.*, 2019).

'Saba' banana is a triploid hybrid (ABB) cultivar which originates from the Philippines. 'Saba'

is the given name for cooking bananas in the Philippines, but they are also known as 'Pisang Kepok' in Indonesia, 'Pisang Abu/Nipah' in Peninsular Malaysia and 'Kluai Hin' in Thailand (Van den Bergh, 2017). Sabah is one of the main producers for 'Saba' banana in Malaysia with the annual production of around 35,000 tonnes in 2017 (Department of Agriculture Sabah, 2017). The export of 'Saba' banana has also increased in the past five years from 6,529.47 metric tonnes with the value of RM 5,148,000 in 2014, to 15,373.55 metric tonnes with the value of RM 15,784,810 in 2018 (Federal Agricultural Marketing Authority, 2019).

Bananas are highly convenient and affordable snacks and are well known for their abundant source of health benefits such as potassium, dietary fibre, and vitamin B6 (Hark & Deen, 2007). Unripe (green) bananas seem to be a good source of fibres, vitamins (Vitamin C, B6, and provitamin A), minerals (potassium, phosphorus, magnesium, zinc), bioactive compounds such as phenolic compounds, and high resistant starch (Falcomer *et al.*, 2019). Resistant starch is not digested in human small intestines and is fermented by bacterial microflora in the large bowel (Juarez-Gracia *et al.*, 2006). This affects a number of physiological functions and thus having effects on health such as reduction in glycaemic and insulinemic response to food, hypocholesterolemic action, and protective effects against colorectal cancer (Juarez-Gracia *et al.*, 2006).

Bananas are typically marketed as fresh produce and the downstream processing is limited to local dishes or chips. The new economic strategy in increasing the utilisation of banana includes production of banana flour using unripe fruits and incorporating the flour into various innovative food products (Alkarkhi *et al.*, 2011). Additionally, the conversion of fresh bananas into flour provides a more stable storage form and avoids wastage of unmarketable fruits. Banana is a climacteric fruit, prone to mechanical damage when ripe and perishable during the maturation process (Falcomer *et al.*, 2019). Furthermore, almost 20% of banana production is not commercialized due to appearance flaws leading to the increase in wastage. Thus, banana processing can reduce the production of the waste and improve bioavailability and utilization of nutrients available in this fruit (Falcomer *et al.*, 2019).

There are vast studies on unripe banana flour conducted for plantain (Agama-Acevedo *et al.*, 2012; Juarez-Garcia *et al.*, 2006) and 'Cavendish' (Campuzano *et al.*, 2018; Loong & Wong, 2018; Alkharkhi *et al.*, 2011; Bezerra *et al.*, 2013) bananas. As one of the main producers of 'Saba' banana in Malaysia, there is a big potential for developing products from a locally grown food source. Additionally, promotion is also required since food products made from unripe 'Saba' banana flour is quite new to Sabahan consumers. Therefore, the aims of this study were to develop unripe 'Saba' banana flour and its bakery products; and to promote and examine their acceptance among local consumers.

2. MATERIALS AND METHODS

Green (unripe) 'Saba' bananas were obtained from local farmers in Tenom, Sabah and processed into flour in the Agriculture Research Station, Lagud Seberang, Tenom.

2.1. Sample Preparation and Flour Production

The bananas were cleaned, peeled, and sliced using an automated slicer. The sliced bananas were then arranged on stainless-steel trays, before being loaded into a fan-forced oven and dried at 75°C. The drying process was stopped once the water activity and moisture content were below 0.5 aw and 10% respectively. The water activity was determined with a water activity meter (Pawkit, decagon Devices Inc. Pullman, WA, USA), while moisture content was determined

using oven method at 105 °C until a constant weight is reached. The dried bananas were then ground using an automated grinder and sieved manually before being sealed in a plastic bag and placed in the refrigerator until further processing.

2.2. Preparation of Bakery Products

'Saba' banana flour was used as the main ingredient in the development of five bakery products, namely layered cake, mini cake, biscuit, crepe, and *bahulu*. The recipes of all bakery products, except *bahulu* were developed by the Agro-Based Industry Development Section (Industri Asas Tani – IAT). 'Saba' banana *bahulu* were produced by one of the IAT entrepreneurs. The recipes used in developing bakery products are listed in Table 1. All products were baked at the IAT testing kitchen, Tuaran. The baking ingredients were purchased from the local supermarket, while existing utensils and equipment such as measuring spoons, bowls, sifter, weighing scale, mixer, baking tins, trays, and oven were used for baking.

Table 1: Recipes of four bakery products made from unripe 'Saba' banana flour

Ingredients	Preparation Method
A. Layered Cake	
1. Unripe banana flour (280g) 2. Butter (250g) 3. Castor sugar (230g) 4. Egg (3) 5. Milk (1 tablespoon) 6. Mashed banana (200g) 7. Sliced banana (2) 8. Salt (1/4 teaspoon) 9. Baking Powder (1/4 teaspoon)	1. Mix salt and mashed banana 2. Sieve banana flour and baking powder, place aside 3. Beat butter and sugar until fluffy, and add eggs gradually 4. Add in milk and mashed banana 5. Add in sieved banana flour gradually and mix well 6. Pour batter into baking tin, alternate with sliced banana 7. Steam for 7 minutes
B. Mini Cake	
1. Unripe banana flour (250g) 2. Egg (3) 3. Sugar (100g) 4. Corn oil (200 ml) 5. Mashed banana (200g) 6. Bicarbonate soda (1 tablespoon) 7. Baking powder (1 tablespoon)	1. Sieve banana flour, bicarbonate soda, and baking powder, place aside 2. Beat sugar and egg 3. Add in corn oil, mashed banana and mix well 4. Add in sieved banana flour and mix well 5. Pour batter into cupcake tins 6. Bake in an oven at 150°C to 180°C for 15 to 20 minutes
C. Biscuit	
1. Unripe banana flour (180g) 2. Egg (2) 3. Icing sugar (150g) 4. Butter (130g) 5. Corn flour (20g)	1. Beat butter and icing sugar 2. Add in eggs and mix well 3. Add in banana flour, corn flour and mix well 4. Roll the dough into even thickness and cut out using cookie cutter 5. Bake in an oven at 150°C to 180°C for 20 minutes
D. Crepe	
1. Unripe banana flour (80g) 2. Tapioca flour (80g) 3. Corn flour (40g) 4. Custard flour (20g) 5. Egg (4) 6. Corn oil (4 tablespoon) 7. Castor sugar (200g) 8. Milk (160mL) 9. Water (600mL)	1. Mix all ingredients in a bowl 2. Coat the pan with butter to avoid crepe from sticking 3. Pour in the batter and swirl the pan into an even thin layer at the bottom of the pan 4. Apply low heat and until the crepe is cook 5. Fill the crepe with any desired filling, fold and serve cold

2.3. Nutritional Analysis

'Saba' banana flour was sent to the accredited laboratory for nutritional content analysis. Analysis conducted include energy, carbohydrate, protein, fat, and potassium.

2.4. Promotion and Acceptance Test

The promotion of unripe Saba banana flour bakery products was conducted during the launching of Sabah's state level Farmers Day 2017 in Tuaran. In order to determine the acceptance of the products, visitors who tested all five bakery products were given forms for evaluation.

The acceptance of the products was based on 5 points hedonic scale, ranging from 1 – dislike extremely to 5 – like extremely. Respondents who completed the evaluation forms were included in the analysis. Mean (± S.D.) scores for the acceptability of all 5 bakery products were presented. Analysis of variance (ANOVA) was performed using IBM SPSS version 26, where statistical significance was defined at $p<0.05$.

3. RESULTS AND DISCUSSION

The nutritional values of unripe Saba banana flour are presented in Table 2. The responses received during the promotion of bakery products made of Saba banana flour were overwhelming. Forty-nine (49) respondents who tested all five products and completed the evaluation forms were included in the analysis. The majority of the respondents were female and within the age group of 26 to 35 years old and 46 to 55 years old.

Table 2: Nutritional content of unripe Saba banana flour

Nutrient	Amount (per 100g)
Energy	367 kcal
Carbohydrates	87.7 g
Protein	3.4 g
Fat	0.3 g
Potassium	994 mg

Based on the acceptance test results presented in Figure 1, the products were well accepted by the respondents during the state level's Farmers Day. Most of the respondents (> 80%) scored 4 (like slightly) and 5 (like extremely) on all products except for *bahulu* (< 80%). Only 6.1% respondents scored 2 (dislike slightly) for mini cake and *bahulu* respectively, 2% respondents for biscuit and 4.1% respondents for crepe; while 2% respondent scored 1 (dislike extremely) for crepe product.

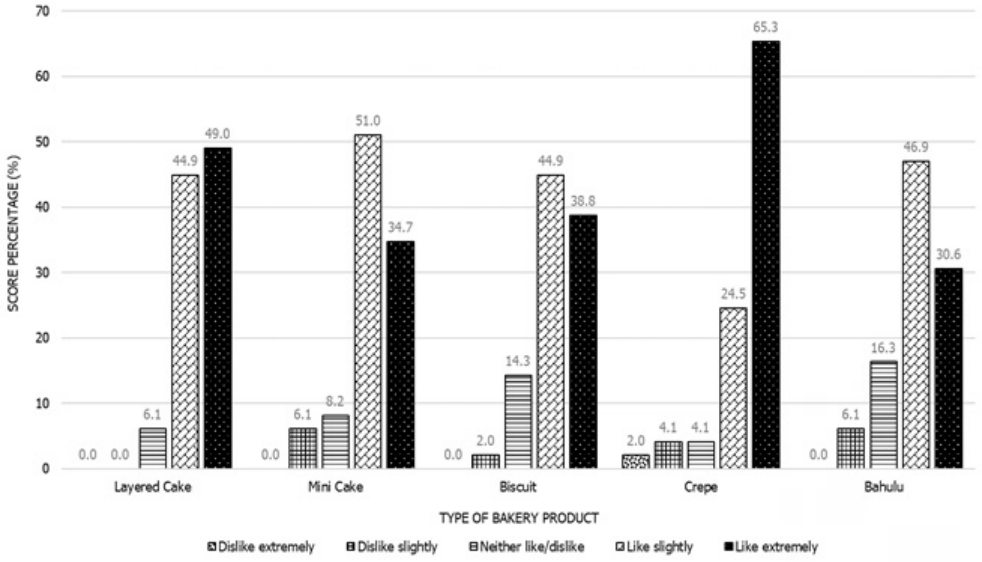

Figure 1: Percentage of consumers' acceptance score for five bakery products made of Saba banana flour (n = 49)

The mean scores for all five bakery products made of 'Saba' banana flour are displayed in Table 3. There was a statistically significant difference in the overall acceptability of the products as determined by one-way ANOVA ($F(4,240) = 2.808$, $p = 0.026$). A Tukey post-hoc test revealed that there is a statistical significance between the preference for crepe and *bahulu*. The respondents favored 'Saba' banana crepe followed by layered cake, biscuit and mini cake, while *bahulu* is the least favored among the five tested products. This was due to the reported dry and brittle texture.

Table 3: . Mean scores for the acceptability of all five bakery products made of Saba banana flour

Type of Product	Mean Score
Crepe	4.47 ± 0.92 [a]
Layered cake	4.43 ± 0.61 [ab]
Biscuit	4.20 ± 0.76 [ab]
Mini cake	4.14 ± 0.82 [ab]
Bahulu	4.02 ± 0.85 [b]

- **Acceptability scores are based on a 5 -point hedonic scale where: 5 = like extremely, 4 = like slightly, 3 = neither like nor dislike, 2 = dislike slightly, 1 = dislike extremely**
- **Value represented the mean ± S.D, where n = 49**
- **Different superscripts indicated significant differences ($p<0.05$) among samples at the 5% by Tukey HSD**

This preliminary acceptability test showed that utilization of unripe 'Saba' banana flour in bakery products create promising value addition that could potentially compete with other wheat-based products in the market. Furthermore, the high content of functional ingredients in unripe bananas can provide health benefits for humans. The data from this project can help in guiding the alternative replacement of wheat flour and diversifying the uses of 'Saba' banana in food product development. This diversification will continue to enhance its utilization and market potential. However, higher number of respondents and detailed sensory evaluation are required in the future to further verify this preliminary findings, and more detailed nutritional analyses on 'Saba' banana flour are required to further understand the health benefits of this product.

CONCLUSIONS

The overall purposes of this study were to develop green (unripe) Saba banana flour and its products, evaluate its nutritional properties and test their acceptance among local consumers. The study indicates that nutritious flour can be produced from green (unripe) Saba bananas and bakery products can be developed utilizing the flour. Additionally, acceptance test results demonstrate good acceptability among consumers. Therefore, there is a potential of incorporating Saba banana flour as an ingredient in bakery products as a healthier alternative. This healthy replacement meets the demand of consumers who seek health and taste in their food consumption.

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