ORIGINAL ARTICLE

Production of Banana Cake Premix from Banana (*Musa acuminata* Colla) By-Products via Foam Mat Drying Process

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ABSTRACT

Introduction: Banana is a perishable fruit and rapidly overripe which can cause food waste problems to occur if not used to prepare other foods. Drying would be useful to overcome this problem by converting the overripe banana into a value-added product. Therefore, this study aims to evaluate the effect of different temperatures for foam mat drying on overripe banana puree. Besides, the sensory attributes and acceptability of banana cakes produced will be evaluated. **Methods:** The overripe banana puree was subjected to foam mat drying and the dried powder was subjected to banana cake production. Physical analysis, chemical analysis, and sensory evaluation were carried out for the banana cakes. **Results:** A significant different ($p<0.05$) was observed for the sucrose content, pH value, moisture content, and colour. For the final weight and colour, there is no significant different ($p\geq0.05$) was observed for all of the overripe banana powder. The sensory evaluation showed that banana cake prepared from overripe banana powder and added with banana essence in the cake batter had significant difference ($p<0.05$) for the attributes of aroma, appearances, flavour, and after taste. In contrast, all the banana cakes samples showed no significant difference ($p\geq0.05$) for the attribute of texture. **Conclusion:** This study showed that overripe banana powder has the potential to produce banana cake premix.

Keywords: Overripe banana, Banana puree, Banana powder, Foam mat drying, Banana cake

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INTRODUCTION

Musa acuminate Colla (AA Group) known as *Pisang Berangan* in Malay, *Lakatan* or *Mapang* in Philippines, and *Kluai Hom Maew* or *Kluai Ngang Phaya* in Thailand. One of the most popular fruits across the globe is banana (*Musa spp.*) which is a climacteric fruit cultivated in many countries (1, 2). Asian countries are the main producers including India, China, and the Philippines which account for about 45% of global production. The production of banana in Philippines is dramatically increasing and it was estimated at 2.9 million tonnes in 2018 (3). Banana is unique that can be consumed directly or as an ingredient in other cuisines. Banana diversity promoted it is applications in a broad range of foods (4). Unripe green colour can be used to make fried banana, ripe yellow colour can be consumed directly and overripe yellow with brown spots is a desirable food ingredient for confectionaries.

Banana cakes are a type of traditional sweet dessert prepared using wheat flour, eggs, sugar, baking powder, and also natrium bicarbonate ($NaHCO_3$). In the Malay culture, several varieties use banana as ingredients and they are known as *kuih* (5). The preparation of the traditional Malay sweets heavily uses banana cake as it is easier, more convenient, and less time-consuming. Modern food technologies promoted the production of ready to use a premix such as banana powder premix. Premix is a product that contains a blended of two or more ingredients and is commercialized as a ready to use the product. Food premix determined premix is a mixture of food additives or mixtures of food materials that can be dissolved in water which is used as carriers (6).

The global rejected banana was estimated at 106 million tons for 2013 and this represents 20% of all bananas harvested become culls (7). The improper disposal of rejected bananas caused great economic loss and environmental issues. However, new products can be developed from the rejected bananas using advanced food processing techniques such as banana powder via foam mat drying technique. This foam mat drying process is a cost-effective technique for drying several foods such as fruits and vegetables. It is considered a productive alternative for heat drying since fruit powders can be produced on a large scale (8). The foam mat drying process was reported in several studies as a cost-effective method compared to vacuum, freeze, and spray drying methods (9, 10). Foam mat drying is now extensively applied for drying several food materials and produce high-quality commercial products including milk, juices, coffee, and tea beverages (11). Foam mat application is extended to liquids to stable powders via air drying (12). Therefore, this study aims to evaluate different foam mat drying temperatures on overripe banana powder properties. Besides, to determine the sensory attributes and the consumer acceptability for the produced banana cakes.

MATERIALS AND METHODS

2.1 Banana puree preparation

The overriped banana (*Pisang Berangan* or *Musa acuminata* Colla) was obtained from the supplier at the local market located at Malaysia Agro Exposition Park Serdang (MAEPS). The banana skin was removed and blended by using a commercial blender (Hamilton Beach, United States).

2.2 Foam mat drying process

The foam mat drying method (13) with slight modification was used to determine the temperature of foam mat drying on overriped banana powder properties. The 200 g of overriped banana puree was added with 5 g/100 g soy protein inducer (Bob's Red Mill, United States). The mixture was whipped for 5 minutes. The overriped banana puree then is poured to a tray and put in the oven (Memmert, Europe) at the condition of 60˚C for 20 hours and 70˚C for 80˚C.

2.3 Grinding of the overriped banana powder

The overriped banana puree was took out from tray and ground for 10 seconds with a commercial blender (Hamilton Beach, United States) and is repeated with a time of 20 seconds and 30 seconds.

2.4. Banana cake preparation

The batter was produced by mixing the ingredients using the stand mixer (Pensonic, Malaysia) and steamed for one hour by using an electric steamer (Trio, Malaysia). Three types of banana cakes were produced which were overriped banana powder without banana essence (Sample 1), fresh mashed banana (Sample 2) and overriped banana powder with banana essence (Sample 3). The banana cake formulation was 24.36% wheat flour (Cap Sauh, Malaysia), 24.36% banana (mashed or powder), 22.25% palm oil (Buruh, Malaysia), 20.13% castor sugar (Prai, Malaysia), 7.42% egg (Nutriplus, Malaysia), 0.85% natrium bicarbonate (King, Malaysia) and 0.64% baking powder (King,Malaysia). The processes of preparation of banana cakes are shown in Figure 1.

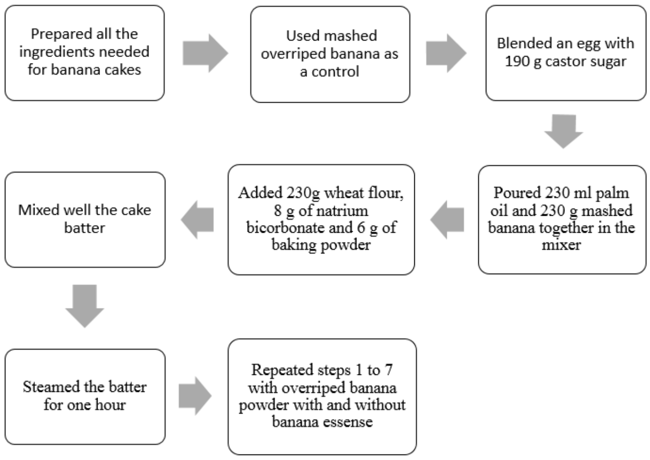

Figure 1 : The processes of preparation of banana cakes

Sample analysis

Physical analysis

The physical analysis was conducted for banana puree properties and overriped banana powder. The instrument used to analyzed were refractometers (˚Brix meter) for sucrose content, pH meter (JENWAY 3505, England) for pH value, Moisture analyzer (Precisa XM 120, Switzerland) for moisture content and Chromameter (Konica Monilta CR-400, United States) for colour. Each analysis was repeated three times to obtain an accurate reading and result.

Chemical analysis – Proximate analysis

Moisture content analysis

The banana puree and the best selected overriped banana powder were used to determine the moisture content using the oven method (14). The temperature of the oven was set at a constant temperature which is 105°C and the crucible was placed in the oven for at least 30 minutes then, cooled in a desiccator until it reached room temperature. Weighed 2 - 5 g of sample into the crucible and the cover is placed then left for 7 hours. After cooled, the crucible with cover and sample was weighed and the results were noted. The moisture content was determined as follow (15):

$$\text{Moisture (\%)} = \frac{w_1 - w_2 \times 100}{w_1} \quad \text{(Eq.1)}$$

where w_1 = Before dried sample weight
w_2 = After dried sample weight

Ash content analysis
The ash content was determined using the furnace incineration method (16). In the oven at a temperature of 105°C, placed crucibles approximately for one hour followed by in the desiccator to cool down. Next, 3 to 5 g of sample was weighed into the crucible and placed into the muffle furnace at 550°C for 2 hours until the traces of black particles were disappeared. The crucibles with ash were cooled in the desiccators and were weighed then calculated the ash content as follows (17):

$$\text{Ash (\%)} = \frac{(w_2) \times 100}{w_1} \quad \text{(Eq.2)}$$

where w_1 = Before dried sample weight
w_2 = After dried ash weight

Protein analysis
Protein analysis was carried out following Kjedhal method (18). The sample (0.15 g) was of mixed catalyst (0.8 g) and dissolved in 2.5 mL of concentrated sulphuric acid (H_2SO_4) at boiling temperature and heated slowly until the solution change to a clear blue-green colour. Added 10 mL distilled water into the tube and transferred the digested materials to the distillation tube. Ten mL of 45% sodium hydroxide solution (NaOH) was slowly added to the solution and two layers of solution were formed followed by 10 mL of 2% boric acid (H_3BO_3) and few drops of indicator. The boric acid with distillate was titrated with 0.05 N sulphuric acid until neutral and the estimation of crude protein was based on the formulation as below:

$$\text{Crude protein (\%)} = \frac{(V_2 - V_1) \times 1.401 \times 6.38 \times N}{W} \quad \text{(Eq. 3)}$$

where V_1 = Blank titrate volume
V_2 = Sample titrate volume
N = normality of H_2SO_4
W = sample weight

Crude fibre analysis
Crude fibre analysis was conducted by using sulphuric acid followed by sodium hydroxide to hydrolyze the food sample (19). The crucible and ashless filter paper were dried in the oven for one hour and being cooled in the desiccator. Then, 2 g of a sample being weight into 500 mL conical flask and 200 mL of boiled sulphuric acid was added. After attached the conical flask to the reflux condenser, boiled the sample for 30 minutes then, filter the hydrolyzed mixture through filter paper Whatman No. 541. Rinsed the residue with boiled distilled water to remove the acid from the filtrate, placed back the residue in its conical flask. Added 200 mL boiled sodium hydroxide and attached it to the condenser and boiled for another 30 minutes. Next, filtered the hydrolyzed mixtures and rinsed the residue with boiled distilled water until the filtrate is free from alkaline and rinsed gain with a small amount of alcohol. The residue and the filter paper were placed into the crucible and dried in oven at 105°C. Placed the crucible into desiccator followed by muffle furnace at 550°C and after burning completely, placed in the crucible again into a desiccator and crude fibre (%) was calculated:

$$\text{Crude fibre (\%)} = \frac{(S - K) - A}{W} \times 100 \quad \text{(Eq. 4)}$$

where S = Crucible, filter paper and dried residue weight
K = Filter paper without ash weight
A = Crucible with ash weight
W = Sample weight

Sensory evaluation
Sensory evaluation was carried out by a total of 62 untrained panellists who were consists of undergraduate students and postgraduate students in University Putra Malaysia. Each panellist was given three types of banana cakes which were the ingredient for the first sample was made from overriped banana powder, the second sample from mashed banana which acted as a control and the third sample from overriped banana powder that being added with banana essence in the cake batter.

Descriptive analysis - Quantitative Description Analysis (QDA)
Quantitative Description Analysis (QDA) was carried out to describe the sensory attributes for three samples of banana cakes which are aroma, appearances, texture (mouth feel), flavour and lastly, aftertaste according to the Stanford Research Institute (20). This method also involves the application of interval scaling techniques in which a 15 cm scale was used for each of the attributes. The terms weak and strong were placed both ends of the line to measure the intensity of the attribute. A third anchor point was often placed at the centre of the scale. This test was carried out as the panellists place a vertical mark across the line at the position that reflects the intensity perceived by the panellists on each of the attributes or characteristics (21).

Affective Test – Hedonic Scale
Hedonic Scale was used to measure the acceptability of three samples of banana cakes. The scale used was the 9-point hedonic scale that ranges from 9 for "like extremely" to 1 for "dislike extremely" (22).

Statistical analysis of data
The intensity ratings for each attribute was converted to numerical scores by measuring the distance of the vertical line from the 0 point. These values were analyzed statistically by ANOVA to determine judges' performance as well as product differences.

RESULTS

Physical analysis

The physical analysis was conducted for banana puree properties before and after being added with a foaming agent; Soy Protein Inducer (SPI) before foam mat drying. The characteristics that being analyzed were sucrose content, pH value, moisture content and colour. The same physical analysis was carried out for the overripe banana powder obtained by the foam mat drying process (23). Based on Table I, there is no significant different at P<0.05 for each of the analysis of ˚Brix value, pH and moisture content (%) before or after the banana puree was being added with Soy Protein Inducer (SPI) for foam mat drying. Based on Table II there was no significant different at P<0.05 for final weight (g) for all of the overriped banana powder (46.983 ± 3.516 to 56.030 ± 3.656) as the yield was approximately one fourth of the actual weight of banana puree (200 g) before undergoes foam mat drying. There was significant difference at P<0.05 for ˚Brix value between the samples with temperature at 60˚C (7.067 ± 0.116 to 7.533 ± 0.231) and at 70˚C (7.067 ± 0.116 to 7.533 ± 0.231) to the sample with the temperature at 80˚C (5.933 ± 0.231 to 6.067 ± 0.231). There was significant different for the pH value at P<0.05 for the samples at temperature of 60˚C (5.543 ± 0.015 to 5.593 ± 0.021), at 70˚C (5.367 ± 0.015 to 5.397 ± 0 .038) and lastly at 80˚C (5.147 ± 0.081 to 5.180 ± 0.044). There was significant different for the moisture content percentage (%) at P<0.05 for the samples at temperature of 60˚C (5.473 ± 0.074 to 6.577 ± 0.470), at 70˚C (4.877 ± 1.078 to 4.980 ± 1.327) and lastly, at 80˚C (2.123 ± 0.882 to 3.100 ± 0.641).

Based on Table I, there was no significant different at P<0.05 for each of the L* value, the a* value and the b* value for the banana puree before or after being added with Soy Protein Inducer (SPI) for foam mat drying. Referring to Table II, there was no significant different at P<0.05 for the L* value for the overriped banana powder at the temperature 60˚C (50.040 ± 0.830 to 51.410 ± 1.250), 70˚C (49.620 ± 0.620 to 51.73 ± 0.630) and 80˚C (47.700 ± 0.780 to 50.500 ± 1.310). The L* value for all of the samples was higher than the banana puree that being added with SPI before undergoes foam mat drying (38.390 ± 10.560). The a* value for all of the samples showed positive values (5.010 ± 0.220 to 8.810 ± 0.660) which indicated that all of the samples were showed to be red colour. Then, the b* value for all of the samples were showed positive values (9.960 ± 1.040 to 13.030 ± 0.930) which indicated that the samples were to be blue colour.

Overall, the best selected overriped banana powder was banana puree that undergoes foam mat drying at 70˚C and being ground at 30 seconds. The ˚Brix value of the sample was 7.267 which the total soluble solid was more than overriped dried banana powder at 80˚C. The total soluble solid of overriped banana powder that being dried at 80˚C (5.933 ± 0.231 to 6.067 ± 0.231) was the least compared to samples that being dried at 70˚C (7.067 ± 0.116 to 7.267 ± 0.231) and 60˚C (7.067 ± 0.116 to 7.533 ± 0.231).

Table I : Properties and colour of banana puree before / after added Soy Protein Inducer (SPI)

Banana Puree	Properties			Colour		
	°Brix Value	pH Value	Moisture Content (%)	L*	a*	b*
Before added SPI	25.02 ± 1.06 [a]	5.86 ± 0.97[a]	71.66 ± 2.28[a]	37.31 ±10.09 [a]	5.56 ± 0.33 [a]	32.04 ± 32.72 [a]
After added SPI	25.53 ± 1.33 [a]	6.07 ± 1.00 [a]	69.40 ± 1.69[a]	38.39 ± 10.56 [a]	5.37 ± 0.50 [a]	30.99 ± 32.83 [a]

*Means that do not share a letter in the column are significantly different.
Where L* is the degree of lightness, a* is the degree of redness or greenness while *b is the degree of yellowness or blueness.

Table II : The effect of different temperature and grinding time

Temperature °C	Grind Time (s)	Final Weight (g)	°Brix Value	pH Value	Moisture Content (%)
	10	47.467±7.180[a]	7.533±0.231[a]	5.550±0.046[a]	5.473±0.074[a]
60	20	46.983±3.516[a]	7.067± 0.116[a]	5.543±0.015[a]	6.560±0.254[a]
	30	50.493±0.142 [a]	7.267±0.116 [a]	5.593±0.021[a]	6.577±0.470[a]
	10	55.137±2.092 [a]	7.200±0.200 [a]	5.390±0.044[b]	4.877±1.078[ab]
70	20	51.940±1.306 [a]	7.067± 0.116 [a]	5.397 ±0.038[b]	4.980±1.327[ab]
	30	56.030±3.656 [a]	7.267± 0.231[a]	5.367 ± 0.015[b]	4.907±0.282[ab]
	10	48.777±3.527 [a]	6.067±0.231 [b]	5.147±0.081[c]	2.123±0.882[c]
80	20	50.177±1.802 [a]	5.933±0.306[b]	5.180±0.044[c]	3.100±0.641[bc]
	30	51.247±2.609 [a]	5.933±0.231[b]	5.180±0.000[c]	2.740± 0.269[c]

*Means that do not share a letter in the column are significantly different

Table III : Colour of Overriped Banana Powder (After Foam Mat Drying)

Temperature °C	Grind Time (s)	L*	a*	b*
	10	50.04±0.83[ab]	5.01±0.22[d]	10.29±0.09[bc]
60	20	51.41±1.25[a]	5.20±0.12[d]	11.46±0.93[abc]
	30	50.33±1.88[ab]	5.35±0.27[cd]	11.30±1.25[abc]
70	10	49.62±0.62[ab]	5.45±0.14[cd]	10.31±0.25[bc]
	20	51.73±0.63[a]	6.11±0.24[c]	12.44[a]±0.49[bc]
	30	51.21±0.76[a]	5.81±0.27[cd]	12.07±1.05[abc]
80	10	47.70±0.78[b]	7.51±0.19[b]	9.96±1.04[c]
	20	50.50±1.31[ab]	8.46±0.19[a]	12.84±1.24[ab]
	30	50.36±0.30[ab]	8.81±0.66[a]	13.03±0.93[a]

*Means that do not share a letter in the column are significantly different

Table IV : Mean value (%) of Proximate Analysis

Components	Fresh Banana (%)	Banana Powder (%)
Moisture	75.624 ± 0.306	5.288 ± 0.350
Ash	3.369 ± 1.185	5.746 ± 0.968
Protein	2.9120 ± 0.243	12.214 ± 1.821
Crude Fibre	0.267 ± 0.176	0.317 ± 0.475

Chemical analysis

The fresh mashed banana and the best selected overriped banana powder (powder that being dried at 70°C during foam mat drying and ground at 30 seconds) were used to figure the moisture content, ash content, protein content and crude fiber content in this analysis. From the results shown in Table IV, the fresh mashed banana had higher moisture content as compared to banana powder value respectively.

Sensory evaluation

The banana cake Sample 3 had a significant difference between the banana cakes of Sample 1 and Sample 2 for the attributes of aroma, appearances, flavour (both of banana flavour and sweet taste) and after taste. Then, between Sample 1 and Sample 2, only attributes of brownness and sweet taste had significant different. In contrast, there was no significant difference in texture (both hardness and moistness) for all of the three samples of banana cakes. Based on Figure 2, the banana aroma of Sample 3 (11.185 ± 3.590) was the most aromatic with the highest mean score followed by Sample 1 (8.785 ± 3.181) and Sample 2 (7.560 ± 4.074). The brownness of banana cakes, the highest mean score was Sample 3 (11.185 ± 3.590), followed by Sample 1 (9.956 ± 2.411) and Sample 2 (6.426 ± 3.502). The banana flavour, the highest mean score was Sample 3 (12.019 ± 3.212), followed by Sample 1 (8.908 ± 3.224) and Sample 2 (8.021 ± 4.052). The sweetness of the banana cake, the highest mean score was Sample 3 (10.355 ± 3.240), followed by Sample 1 (8.837 ± 3.095) and Sample 2 (6.924 ± 3.367). The aftertaste of banana cake, the highest mean score was Sample 3 (10.802 ± 3.771), followed by Sample 2 (8.816 ± 3.603) and Sample 1 (8.334 ± 3.571).

Figure 2 : The spider-web effect which represents the product attributes. Overriped banana powder without banana essence (Sample 1), fresh mashed banana (Sample 2) and overriped banana powder with banana essence (Sample 3).

For Sample 1 and Sample 2, there were significant different for brownness and sweet taste attributes while there was no significant different for banana aroma, hardness, moistness, banana flavour and aftertaste attributes. Sample 1 (9.956 ± 2.411) was more brownness than Sample 2 (6.426 ± 3.502) while Sample 1 (8.837 ± 3.095) was sweeter than Sample 2 (6.924 ± 3.367). Based on Figure 3, it can be concluded that Sample 1 was the most acceptable banana cake followed by Sample 2 and Sample 3. Statistically, there is no significant different for the acceptance of banana cake Sample 1 (6.968 ± 1.280) and Sample 3 (6.952 ± 1.787) while there is significant different for both Sample 1 and Sample 3 between Sample 2 (5.887 ± 1.494) at $P<0.05$. For Sample 1 and Sample 2, there were significant different for brownness and sweet taste attributes while there was no significant different for banana aroma, hardness, moistness, banana flavour and aftertaste attributes.

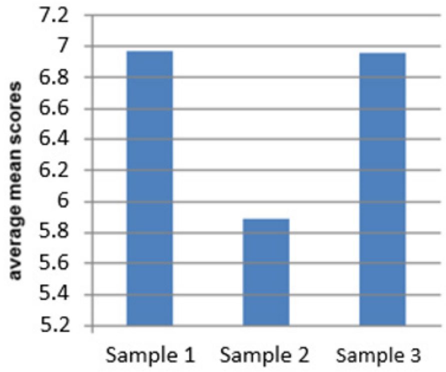

Figure 3 : Sensory acceptability of banana cakes. Overriped banana powder without banana essence (Sample 1), fresh mashed banana (Sample 2) and overriped banana powder with banana essence (Sample 3).

DISCUSSION

Physical analysis

The ˚Brix Value increased slightly after being added with Soy Protein Inducer (SPI) as the total soluble solid increased in the banana puree. The pH value increased slightly after being added with SPI as the alkalinity of the banana puree increased. The moisture content decreased slightly after being added with SPI as the solid contained in the banana puree increased. Temperature at 80˚C that being used during foam drying was too high and it can harm the nutrient contained in the banana puree. In order to avoid overheating and spoilage of the fruit during drying process, the temperature should be controlled and commonly are dried at 60˚C to 70˚C (24). The higher the temperature, the lower the pH value. This can be related to Le Châtelier's Principle which when there was a changed to the conditions of a reaction in dynamic equilibrium, it will lead the position of equilibrium moved to counter the change that is made. High the temperature contributes to lower the moisture content because the rate of drying increased as the temperature increased (25). This resulted in the water content in the banana puree being evaporated faster during the foam mat drying. High drying temperatures makes the foam low density and easy to be evaporated (26).

The colour analysis was determined as (*L**) is the degree of lightness, (*a**) is the degree of redness or greenness while (*b**) is the degree of yellowness or blueness (27). For many food ingredients, the degree of lightness (*L**) is used for darkness evaluation ranging from white to black with a scale of 100 to 0 (28). It can be concluded that the foaming agent did not affect the colour of the banana puree. The *L** value indicated darkness (L*=0) to lightness (L*=100), positive *a** value indicated red shades while negative values indicated green shades, and positive *b** value indicated yellow shades while negative values indicated blue shades (29). The two chromatic components for both *a** value and *b** value is range from -120 to 120. A previous study reported that at 60˚C, the banana that undergoes foam mat drying forms a brown colour cream-like texture before the osmotic treatment using sugar solutions (30).

The best selected overriped banana powder was banana puree that undergoes foam mat drying at 70˚C and being ground at 30 seconds. It was because the moisture content (%) of this sample was 4.907 ± 0.2818. The sample's moisture content was reduced to 2 – 4% of wet basis via continued drying process (31). The powder that is ground at 30 seconds was finer and helped in absorbing liquid in the banana cake preparation better. In contrast, the overriped banana powder at 60˚C was not selected as the moisture content is 5.473 ± 0.074% to 6.577 ± 0.470% which is not in the range of desirable moisture content which in the range of 2% to 4%. Even though the moisture content for overriped banana powder that being dried at 80˚C (2.123 ± 0.882 to 3.100 ± 0.641) was between the range of 2% to 4%, it was not being selected as the best powder in this research as this sample had a little burnt smell. It was scared that this sample did not suitable for the production of the banana cake. Flavour intensity was reduced as some volatile constituent losses during drying (32). In addition, the total soluble solid of dried overripe banana powder at 80 ˚C was very low because a decrease in sugar content resulted from the Maillard reactions (9).

Chemical analysis

Banana powder had higher ash content, protein content and crude fibre content as compared to the mashed banana. In conclusion, banana powder was high in protein and fibre as the nutrient became compact after drying. The dried fruits acted as a good source of energy as contain concentrated fruit sugars and as healthy food choices. (33).

Sensory evaluation

Quantitative Description Analysis (QDA) was used to describe sensory attributes. Each panellist was given three types of banana cakes which were overriped banana powder without banana essence (Sample 1), fresh mashed banana (Sample 2) and overriped banana powder with banana essence (Sample 3). Sample 3 was the most aromatic as the sample being added with banana essence in the cake batter which contained ester named isoamyl acetate ($C_7H1_4O_2$). The aroma of processed bananas including esters of short-chain fatty acids such as butanoates ($C_4H_8O_2$), acetates ($C_2H_3O_{2-}$), and 3-methylbutyl esters ($C_9H_{18}O_2$) (34). Acetate such as ethyl acetate ($C_4H_8O_2$) and butyl acetate ($C_6H_{12}O_2$) majorly contributed to the aroma (35). Sample 3 was the most brownness as the banana puree had been exposed to oxygen during foam mat drying and it was being added with banana essence which yellow in colour during the preparation of banana cakes. Bananas colour changes to brown very fast as a result of enzymatic oxidation by polyphenol oxidase (PPO) in the presence of oxygen. Therefore, banana powder samples with high sugar content will form a darker colour (36).

The banana flavour, the highest mean score was Sample 3 as being affected by the acetate that contained in banana essence. Due to the characteristic fragrance and flavour of acetates from primary alcohols, it possesses wide application (37). This ester was one of the most crucial flavour used in the food industries which around 74,000 kg per year (38). The sweetness of banana cake, the highest mean score was Sample 3 because the sweetness of banana cake contributed by the isomyl acetate that has only six carbons, so its smell is distinctly sweet. A sweet fruity flavour *ginjo* bouquet (*ginjo-ka*) like a banana comes largely from isoamyl acetate (39).

The aftertaste of the banana cake Sample 3 was the highest as it contained isomyl aceate. The flavour of isomyl aceate was strong and it can be tasted in concentration as low as two parts per millions which was roughly a single drop for every 50 liters of water. As all of the samples of banana cakes does not have significant difference of attributes which was for texture (hardness and moistness) at P<0.05, it can be concluded that different raw materials that was used in this research do not affect the texture for both hardness and moistness of the banana cake. This was because the water added to Sample 1 and Sample 3 were relatively similar to the moisture content of mashed banana for Sample 2. Sample 1 was more brownness than Sample 2 as the banana puree for this sample undergoes foam mat drying first before banana cake preparation while Sample 2 did not undergo this process. Then, Sample 1 was sweeter than Sample 2 as dried overriped banana powder contained compact sugar than mashed banana in Sample 2.

Strengths and limitations

The quality of the overriped banana decreased as the condition is more favourable to the growth of the microorganism that affects the food quality and food safety. The rejected bananas are normally improperly disposed and when does not transform into another food product, it will be discarded and lead to food waste. In order to enhance its present and future prospects, new products by using foam mat drying can be produced. The technological advancement such as drying help to overcome this problem which transforms the potential food waste into value added products. Furthermore, to make the preparation of banana based food products such as banana cakes and banana fritters easier, convenience and less time consuming, several pre-prepared ingredients such as food premix available in the market. Thus, making human life easier and the food wastes from food preparation can be minimized globally.

The limitations are not all the type of banana species being explored as premix ingredients such as for *Musa acuminata* or known as '*pisang emas*'. Moreover, the colour of the overripe banana powder that being produced was brown which is a very undesirable colour for the consumer preferences and the powder looks like sand at the first sight. This is because the enzymatic browning occurs rapidly in the banana puree so that; the factors that can improve the colour of the overripe banana powder should be carried out in the future study. The quality of overripe banana powder should be improved by determined the factors that lead to the optimization banana puree drying conditions. Another food product can also be produced by using this powder such as banana fritters or known as *jemput jemput* pisang in Malay Language.

CONCLUSION

This study indicated that there was no significant different in the final weight for all of the overriped banana powder in foam mat drying as when the temperature increased, the yield was approximately one fourth from the actual weight of banana puree. The higher the temperature, the lower the °Brix value, pH value and moisture content of the overriped banana powder. In terms of colour, the foaming agent did not affect the colour of the banana puree before or after being added with Soy Protein Inducer (SPI) before undergoes foam mat drying. In general, The *L** value for all the samples of overriped banana powder was higher than the banana puree that indicated that the overriped banana powder was lighter in colour as compared to the banana puree. The different time of grinding for overriped banana in this study does not show significant results. For the sensory evaluation, banana cake (Sample 3) that was prepared from overriped banana powder with banana essence in the cake batter had significant difference at P<0.05 for attributes of aroma, appearances, flavour and after taste. In contrast, all of the samples of banana cakes do not have significant difference at P<0.05 for attribute of texture. This study showed that the overripe banana powder has potential in banana cake premix preparation.

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