4TH EDITION

E-EXTENDED ABSTRACT

INTERNATIONAL AGROTECHNOLOGY INNOVATION SYMPOSIUM (i-AIS)

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ABOUT FACULTY OF PLANTATION AND AGROTECHNOLOGY

The Faculty of Plantation and Agrotechnology was established in 2010 at Universiti Teknologi MARA (UiTM). The mission of the faculty is to play the vital role of producing well-trained professionals in all areas of plantation and agriculture-related industries at national and international levels.

Bachelor of Science (Hons) Plantation Technology and Management is a three-year program that strongly emphasizes the various aspects of Production Technology, Management, and Information Technology highly sought after by the agricultural and plantation sectors. Students in this program will be fully trained to serve as professionals in the plantation sector and related industries. They will have ample opportunities to fulfill important positions in the plantation industry such as plantation executives. This program provides a strong balance of technology and management courses essential for the plantation industry such as management of plantation crops, soil fertility, plantation management operation, plantation crop mechanization, and agricultural precision. As an integral part of the program, students will be required to undergo industrial attachment to gain managerial skills in the plantation industry.

The faculty is highly committed to disseminating, imparting, and fostering intellectual development and research to meet the changing needs of the plantation and agriculture sectors. With this regard, numerous undergraduate and postgraduate programs have been offered by the government's intention to produce professionals and entrepreneurs who are knowledgeable and highly skilled in the plantation, agriculture, and agrotechnology sectors.

PREFACE

International Agrotechnology Innovation Symposium (i-AIS) is a platform to be formed for students/lecturers/ staff to share creativity in applying the knowledge that is related to the world of Agrotechnology in the form of posters. This virtual poster competition takes place on the 1st of December 2022 and ends on the 8th of January 2023. This competition is an assessment of students in determining the level of understanding, creativity, and group work for the subject related to agrotechnology and being able to apply it to the field of Agrotechnology. The i-AIS 2022 program takes place from December 1, 2022, to January 8, 2023. The program was officiated by the Dean of the Faculty of Plantation and Agrotechnology, namely Prof. Madya Ts. Dr. Azma Yusuf. The program involves students from faculties of the Faculty of Plantation and Agrotechnology (FPA)and HEP participating in i-AIS 2022, namely, the Faculty of Education and Pre-Higher Education. This program involves the UiTM student and some of the non-UiTM students which come from the international university and the local university. Two categories are contested, namely UiTM and non-UiTM. To date, students from these programs have shown remarkable achievements in academic performance and participation in national as well as international competitions.

This competition is an open door for the students and lecturers to exhibit creative minds stemming from curiosity. Several e-content projects have been evaluated by esteemed judges and that has led to the birth of this E-Poster Book. Ideas and novelties are celebrated, and participants are applauded for displaying ingenious minds in their ideas.

It is hoped that such an effort continues to breed so that there is always an outlet for these creative minds to grow.

Thank you.

Dean
On behalf of the Organizing Committee
Conference Chair
Universiti Teknologi MARA
Faculty of Plantation and Agrotechnology
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THE UTILIZATION OF GREEN BANANA (MUSA ACUMINATA X MUSA BALBISIANA) FLOUR IN THE DEVELOPMENT OF KEROPOK LEKOR

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ABSTRACT - *Keropok lekor* a fish-based sausage is a popular traditional snack that originated in Terengganu, a state in north-eastern Malaysia. Green banana flour was used to enhance the nutritional value of *keropok lekor* since it is high in dietary fibre, bioactive components, gluten-free, low glycaemic index, and numerous other nutrients that are advantageous to human diets. The primary goal of this study is to create an innovative version of *keropok lekor* produced using green banana flour and examine its physicochemical characteristics and to evaluate consumer acceptability. The process of making green banana *keropok lekor* was the same as for traditional *keropok lekor*, except that green banana flour is used in replacement of tapioca starch. Banana flour and tapioca starch were used in varieties of ratios (15:20, 17.50:1750, 35:0) to develop the banana *keropok lekor*. The boiled samples were analyzed for moisture, crude protein, crude fat, ash, carbohydrate, color (lightness, redness, and yellowness), and texture (hardness, cohesiveness, springiness, chewiness, gumminess, and resilience). Formulation 1 (15:20) was the most preferred among all the formulations, where the moisture (57.3%), crude protein (8.65%), crude fat (1.99%), ash (0.83%), and carbohydrate content (30.66%). Formulation 3 with the highest proportion of green banana flour demonstrated a high value of hardness, chewiness, and gumminess but showed the least value of cohesiveness, springiness, and resilience. The color of the banana *keropok lekor* showed a significantly different ($p<0.05$) in redness value but demonstrated no significant different ($p>0.05$) in lightness and yellowness values.

Keywords: Green banana flour, banana *keropok lekor,* starch

INTRODUCTION

Plantain, also known as 'Saba' Banana or green banana (*musa acuminata x musa balbisiana*), is a hybrid triploid banana cultivar with a dense, firm, and starchy yellowish-white pulp with a sweet and sour flavor, a thick peel, and a more angular and varied form than Cavendish and also need to be cooked before eaten (Amini Khoozani et al., 2019; Kumalasari et al., 2020; Novianti & Yuniasti, 2018). Bananas are one of the most frequently grown, exported, and eaten fruits in the world. Bananas are considered to have more antioxidant components including polyphenols, carotenoids, flavonoids, biogenic amines, phytosterols, and other phytochemicals found in the flesh and skin of the banana (Amini Khoozani et al., 2019). Due to insufficient post-harvest processing, lack of marketing, and failure to offer storage facilities that can ensure long shelf life, high-quality, and quantity bananas are abandoned before reaching the intended market and customer (Anajekwu et al., 2020). Aside from that, around 20% of banana output is not marketable owing to size and appearance flows, which increases wastage (Falcomer et al., 2019).

Banana pulp, which is the edible portion of the banana, is high in nutrients and is commonly used as a food enrichment component for extracting and isolating important elements such as antioxidants, dietary fibre, phenolic compounds, and resistant starch (Amini Khoozani et al., 2019). . There are four important stages of producing whole banana flour (Bezerra et al., 2013). Firstly, the banana is washed properly to remove any dirt. Then, the banana is dipped into 0.5% (w/v) citric acid solution to reduce the enzymatic browning for about 10 minutes and drained. Next, the banana is crushed using a blender until a homogenous paste is achieved. Lastly, the paste is fed into a conical spouted bed dryer with 80º C working temperature and a fixed drying air flow rate which is $50m^3/h$. The banana flour made from green bananas is recognized as an effective intermediate product since it has a longer life span (Kumalasari et al., 2020). The flour is used in a variety of products, including edible films, infant porridge, slow-digesting biscuits, high-fiber bread, noodles and more.

On the other hand, *keropok lekor* is a Malaysian traditional snack that is also known as fish crackers or sausage. The snack is made from simple ingredients such as fish, tapioca starch, sago starch, and salt. Fish is ground into a paste and rolled into a long cylindrical shape after being mixed with other dried ingredients to produce a dough. Then, it is boiled, deep-fried, or steamed according to consumer preference and while being served with homemade sweet chili sauce. The quality of *keropok lekor* may be kept by utilizing fresh fish that has 30% more fish than starch flour (Murad et al., 2017). The use of green banana flour to replace tapioca starch in the making of *keropok lekor* makes the snacks gluten-free and also lower in calories and higher in dietary fibre than the original *keropok lekor* composition. The objectives and aims of this study are to develop an innovative version of *keropok lekor* using green banana flour and to determine the physicochemical and sensory analysis of *keropok lekor* made with green banana peel flour.

MATERIAL AND METHOD

MATERIAL

Chubs mackerel are also known as *ikan kembung*, green banana flour (Meges Tropical Borneo), tapioca flour (Jati), wheat flour (Cap Sauh), fine salt (Adabi), coarse sugar (CSR), refined cooking oil (Buruh), ice (Atlas), baking powder (Royal) and pure monosodium glutamate (Aji-no-moto).

DESCRIPTION OF METHODS

Preparation of fish flesh

Fresh chub mackerels (*Rastrelliger kanagurta*) and other ingredients were obtained from a local supermarket (Shah Alam, Selangor). The fish was cleaned by removing the unwanted parts including heads, bones, and internal organs and only the fish flesh was used in the making of *keropok lekor*. Evisceration was necessary to limit and prevent the penetration of dangerous germs and pathogens from the intestines and gills of fish into the meat. A sharp knife was used to remove any scales and deboned the fish by slicing it on both sides.

Preparation of keropok lekor

The preparation of formulation 1, formulation 2, and formulation 3 were using the same ingredients but different proportion of green banana flour were involved as shown in ***Table 2.1***.

Table 2. 1 **The Formulation Of *Keropok Lekor.***

Ingredients	Formulation		
	1	2	3
Minced fish flesh	50.00	50.00	50.00
Green banana flour	15.00	17.50	35.00
Tapioca flour	20.00	17.50	0.00
Salt	1.26	1.26	1.26
Sugar	0.50	0.50	0.50
Baking powder	0.40	0.40	0.40
Monosodium glutamate (MSG)	0.15	0.15	0.15
Crushed ice	12.69	12.69	12.69
Total	100.00	100.00	100.00

*Values in percentage (%)

The mixing process was carried out by using a mixer (Model PM-214, Pensonic Brand). The fish flesh was ground along with salt, sugar and monosodium glutamate using an intermittent mixed method. The method was carried out by 2 minutes of mixing and 2 minutes breaks for 6 minutes. A study conducted by Murad et al. (2017) stated that the intermittent mixed-method able to provide higher protein content, better water holding capacity, texture, color and the most preferable features during a sensory evaluation. This method involved three stages. The first stage was the mixing of fish flesh along with salt, sugar, and MSG, for the second stage, crushed ice was added, and the last stage was the addition of tapioca starch, and green banana flour to form dough.

Before shaping and rolling the dough, the dough was split into small balls of around 200g each to ensure each *keropok lekor* was the same size. The tapioca starch was sprinkled all over a clean and dry rolling surface to keep the balls from sticking together. The ball was rolled into a cylindrical form with a diameter of 2cm and a length of 5cm.

Cooking method

The rolled and shaped *keropok lekor* was preboiled which a standard method in the processing of *keropok lekor* for 10 minutes in 100º C water until it floats (Tamsir et al., 2021). To keep the fish fresh and the product enduring, the *keropok lekor* was cooked immediately after rolling and shaping. Next, drained and chilled the *keropok lekor* to room temperature (25-28 º C). A sharp tool was used to inspect the interior of the dough and to ensure the starch was gelatinized. Following that, the boiled *keropok lekor* was re-boiled for 10 min at 100 º C and any excess water was drained and the *keropok lekor* was chilled to room temperature.

Proximate analysis

Proximate analysis of boiled *keropok lekor* made with green banana flour was to determine the moisture, ash, crude protein, crude fat, and carbohydrate content. All measurements will be done in triplicate (n=3).

Moisture content

The moisture content of banana *keropok lekor* was analyzed using a drying oven (Memmert, UNE 400, Germany). An aluminium dish with cover was dried for 3 hours in an oven at 105°C. Then, the dish was cooled in the desiccator. The dried dish with cover was labelled and weighed accurately after achieved room temperature. 5g of homogenized sample was placed into the dish. The dish with sample uncovered was transferred in 105°C oven overnight. The cover of dish was replaced before removing it from oven. The dish was cooled in the desiccator and weighed soon after achieved room temperature. The drying process was repeated until constant weight was achieved. The percentage of moisture was calculated as described below:

$$\%\ moisture = \frac{(Weight\ of\ wet\ sample - Weight\ of\ dried\ sample)}{Weight\ of\ wet\ sample} \times 100$$

Ash content

Next, the ash content was analyzed using a dry-ashing method by utilizing a muffle furnace (Cober, Daihan Scientatic, South Korea). A shallow porcelain dish was dried in an oven at 105°C for 3 hours. The dish was cooled in the desiccator and weighted soon after achieved room temperature. 5g of homogenized sample was placed into the dish and transferred in the oven at 105°C overnight. The dried sample was burnt gently over Bunsen burner until no smoke evolved when heated strongly. After that, the dish was transferred into muffle furnace and heated for 3 hours at 550°C until a whitish ash is obtained. The dish was cooled in the desiccator and weighed soon after achieved room temperature. The ash content was calculated following the formula below:

$$ash(g)per\ 100g = \frac{weight\ of\ ash(g)}{weight\ of\ sample\ (g)}\ X\ 100$$

Crude protein

Crude protein in the green banana keropok lekor was observed using a Kjeldahl Method Digestion instrument (TUEBOSOG, Gerhardt, Malaysia) and Kjeldahl Method Distillation instrument (Vapodest 45s, Gerhardt, Malaysia). For digestion process, a clean and dry Kjedahl digestion flask was labelled clearly. The digestion tube was placed in the digestion tube holder on the rack. 0.6g of sample was placed into the digestion tube and 2 pills of catalyst mixture (5g potassium sulphate + 5mg selenium) was added along with 20ml concentrated sulphuric acid. The rack was transferred into digestion block machine and the suction module was placed with the fitted gaskets on the digestion tube holder. The scrubber unit machine and water supply were switched on. The samples were heat up (digestion process) from 150 ° C for 30 minutes and increased to 300° C for 60 minutes and then to 420 ° C for 5 hours. After the digestion process completed, the digestion machine was switched off and cooled down. The sample should be clear with no charred material remaining. The digestion tube holder rack was removed from the block machine.

Next, the power system of distillation unit (Vapordest) was switched on and warmed up at least 15 minutes before the first run of the distillation process. The titroline was switched on. Next, the tube was filled with 20ml boric acid. Then, the probe was calibrated using pH 7 indicator and pH 4 indicator, respectively where the probe was rinsed and wiped with tissue before undergoes calibration process. Once the “Calibration OK” appeared, the probe was rinsed and wiped, then placed into the tube flask. Next, the instrument was cleaned before run the distillation of sample. After that, the blank sample and the samples were analyzed separately. The pH and the 0.1M hydrochloric acid (HCl) used was record once the distillation process completed. The crude protein in the sample was calculated as the following formula:

$$1ml\ 0.1M\ HCl\ = 1.4\ mg\ N$$

$$\boldsymbol{Total\ Nitrogrn(g)per\ 100g} = \frac{\boldsymbol{(titre - blank)X\ 1.4X100}}{\boldsymbol{1000Xsample\ weigh(g)}}$$

$$Crude\ protein\ (g)per\ 100g = total\ nitrogen \times conversion\ factor$$

Crude fat

Crude fat was analyzed using a Soxhlet Extraction instrument utilizing the solvent extraction system (M Tops, FAM 9209-06, UK). A clean and dry bottom flask was labelled. 2g of sample was transferred into an extraction thimble or a piece of filter paper. The thimble containing sample was placed into a Soxhlet extractor. A clean and dry bottom flask was labelled and 180ml petroleum ether was added. The apparatus was connected to the condenser, the water supply was switched on. The extraction process was done for 8 hours on an electrothermal extraction unit. The flask containing petroleum ether extract was removed after the extraction complete. The round bottom flask was transferred on a steam bath to remove the residual petroleum ether. When all the solvent has been removed, the outside of the flask was wiped with tissue paper and the flask was placed in an oven at 105°C for one hour. The flask was cooled in desiccator and weighed soon after achieved room temperature. The percentage of crude fat in sample was calculated as follows:

$$\text{Weight of fat in sample } = \frac{(\text{Weight of flask } + \text{ fat}) - \text{ Weight of flask}}{Weight\ of\ sample\ taken\ (g} X100$$

Carbohydrate content

Total carbohydrate content of sample was calculated as follows:

$$Total\ carbohydrate\ (\%) = 100 - (moisture + ash + crude\ protein + crude\ fat)\%$$

Texture analysis

The hardness, cohesiveness, springiness, chewiness, gumminess, and resilience of the keropok lekor will be measured using a texture analyzer (TA-XT2i, Stable Micro System, UK) and will be equipped with probe P/75. Pre-test speed will be at 1.0mm/sec, post-test speed was 5.0 mm/sec, distance was 10.0 mm, and time was 5.0 sec on the texture analyzer.

Color analysis

The color of the prepared keropok lekor will be measured using a Calorimeter (Chroma Meter CR- 400, Konica Minolta, Europe) and will be represented by lightness level (L*), redness level (a*), and yellowness level (b*).

RESULTS AND DISCUSSION

PROXIMATE ANALYSIS

Based on *Table 4.1,* the mean moisture content of formulation 1 recorded the highest moisture content (57.33%), followed by formulation 2 which was 56.06% and the lowest moisture content was found in formulation 3 which was 52.70%. The moisture percentage of banana *keropok lekor* in all formulations was similar to the studies conducted by Murad et al., (2017) and Zim et al., (2019) who stated that the moisture of original *keropok lekor* ranged from 50-60%. This is because the process of boiling the *keropok lekor* allows the absorption or uptake of water into the *keropok lekor* (Tamsir et al., 2021). The change in water absorption or moisture content of *keropok lekor* was caused by banana flour addition and/or substitution resulting in the difference *of water molecules incorporated in the keropok lekor.*

The mean protein of banana *keropok lekor* largely depends on the protein content of fish flesh. The protein content of banana *keropok lekor* was increased in the following order: formulation 1 (8.65%), formulation 2 (8.71%), and formulation 3 (9.06 %). The protein content in banana *keropok lekor* shows a similar amount of protein to the original *keropok lekor* which ranged from 8-10% (Murad et al., 2017). Formulation 3 of banana *keropok lekor* showed the highest fat and ash content with 3.63% and 1.64% compared to formulation 2 (2.15% fat and 1.16% ash) and formulation 3 (1.99% fat, 0.83% ash). The flesh fish (*Rastrelliger kanagurta)* used in all formulations of banana *keropok lekor* was contain the lowest number of saturated and unsaturated fatty acids compared to other types of marine fish (Devadason et al., 2019). The fat values in all three formulations showed similar values of fat in the original *keropok lekor* with values of 1- 2% (Zim et al., 2019). Besides, the slight increase of ash in banana *keropok lekor* could be due to the addition and/or substitution of banana flour, as banana flour is notably enriched with minerals such as sodium, potassium magnesium, and calcium (Amini Khoozani et al., 2019).

Furthermore, the carbohydrate content increased with the increased of banana flour utilized in banana *keropok lekor*. The carbohydrate content of banana *keropok lekor* for formulation 1, formulation 2, and formulation 3 were 30.66%, 32.48%, and 32.97%, respectively. The carbohydrate content of banana *keropok lekor* showed a higher amount of carbohydrate compared to the original *keropok lekor* with a carbohydrate content of 20.81% (Zim et al., 2019). On the other hand, Edirisighe et al., (2000) stated that marine fish mainly has a lower content of carbohydrate. Hence, it confirms that the source of carbohydrates in banana *keropok lekor* was banana flour. However, there was no significant difference ($p>0.05$) between the formulations in moisture, crude protein, crude fat, ash, and carbohydrate of banana *keropok lekor* (*Table 4.1*).

TEXTURE ANALYSIS

Texture profile analysis (TPA), commonly referred to as the "two bites test," is a scientific procedure that was first created in 1963 at the Technical Centre of the General Foods Corporation to give objective measures of texture parameters, a key determinant of food acceptability (Trinh & Glasgow, 2012). The TPA test is a simplified form of the first two bites done throughout the complex oral processing process. It simulates human mouth activity and operates at a speed similar to that of the human jaw (Jonkers et al., 2022; Rosenthal, 2010). Based on *Table 4.2*, formulation 3 with the highest proportion of banana flour showed the highest significant hardness ($p<0.05$) among all the formulations. Formulation 2 had a medium significant ($p<0.05$) hardness level, while formulation 3 showed the least significant hardness ($p<0.05$) compared to other formulations. The hardness of foods product is strongly influenced by the structural changes of their protein fractions and the gelation of starch after being introduced to the thermal process (Acosta *et al*.,2021). Formulation 3 had low starch composition since only used banana flour and hence the gelation of starch lowered resulting in the hardest texture of banana *keropok lekor* compared to other samples. Interestingly, the hardness of a food product was related to chewiness and gumminess. The harder the food product the firmer its structure will be and hence the food product will be gummier and chewier (Mahat et al., 2020). Based on *Table 4.2*, the chewiness and gumminess of banana *keropok lekor* among all samples were increased as the hardness of banana *keropok lekor* were increased among all samples. The chewiness and gumminess of all formulations of banana *keropo lekor* presented significant differences ($p<0.05$).

Furthermore, springiness is considered the tendency of the *keropok lekor* to return to its original shape after the force applied to it, and the springiness was influenced by the quality of the protein (Murad et al., 2017). The banana *keropok lekor* showed a significantly different ($p<0.05$) springiness value among all the samples. However, the result springiness value presented among all samples could be considered low value might be due to the protein network of the dough not being mixed well during the mixing process and resulting insufficient springiness value of keropok lekor. Tamsir et al., (2021) stated that the springiness of the original keropok lekor using the boiling method was 0.96%. No significant changes ($p>0.05$) in the cohesiveness and resilience of banana keropok lekor with different proportions of banana flour were observed.

COLOR ANALYSIS

The color of banana *keropok lekor* developed with different proportions of banana flour was presented in ***Table 4.3***. The overall results showed significant different ($p<0.05$) in redness (a*) of 15% to 35% banana *keropok lekor*. Formulation 3 showed the highest value of a* followed by formulation 2 and formulation 3. In contrast, no significant differences ($p>0.05$) in lightness (L*) and yellowness (b*) of formulation 1, formulation 2, and formulation 3. The L* and b* of banana *keropok lekor* demonstrated lighter color and lower b* values as the proportion of banana flour increased and thus, resulting darker color of banana *keropok lekor*.

The results were similar to the previous research on green banana flour which illustrated that a higher proportion of banana flour led to a darker color of gluten-free pasta, cookies, bread, and yellow noodle (DETCHEWA et al., 2021; Khoozani et al., 2020; Rachman et al., 2019; Saifullah et al., 2009). A previous study indicated that the original *keropok lekor* had variable color characteristics ranging from 55.79-62.61 L* value, 1.47 to 2.69 a* value, and 7.31-11.61 b* value (Murad et al., 2017). The difference in color characteristics between the original *keropok lekor* and banana *keropok lekor* could be due to different techniques and mediums of cooking, as well as the composition and types of ingredients used. Moreover, a large number of carbohydrates in the entire green banana flour promotes the Millard reaction, which also contributes to the browning of the *keropok lekor*. As a result, the *keropok lekor* gets darker as more green banana flour is used as shown in ***Figure 4.1***.

Table 4. 1 Proximate Composition Of The Banana Keropok Lekor

Parameter (%)	Formulation		
	1	2	3
Moisture	57.33 ± 6.042^{a}	56.06 ± 0.877^{a}	52.70 ± 6.409^{a}
Crude protein	8.65 ± 0.318^{a}	8.71 ± 0.145^{a}	9.06 ± 0.150^{a}
Crude fat	1.99 ± 1.310^{a}	2.15 ± 1.023^{a}	3.63 ± 0.733^{a}
Ash	0.83 ± 0.283^{a}	1.16 ± 0.572^{a}	1.64 ± 0.569^{a}
Carbohydrate	30.66 ± 7.467^{a}	32.48 ± 0.594^{a}	32.97 ± 6.354^{a}

Means ± standard deviation. Values within a column followed by the same superscript letter are not significantly different from each other ($p<0.05$)

Table 4. 2 Texture Of Banana Keropok Lekor

Analysis	Formulation		
	1	2	3
Hardness (g)	4539.25 ± 739.425^{b}	4857.98 ± 645.009^{b}	11497.79 ± 895.690^{a}
Cohesiveness (%)	0.76 ± 0.058^{a}	0.75 ± 0.106^{a}	0.68 ± 0.085^{a}
Springiness (%)	0.94 ± 0.006^{a}	0.93 ± 0.009^{ab}	0.91 ± 0.009^{a}
Chewiness (J)	3200.82 ± 237.544^{b}	3406.64 ± 413.942^{b}	7080.91 ± 379.888^{a}
Gumminess (N)	3416.08 ± 275.218^{b}	3663.26 ± 476.065^{b}	7766.54 ± 409.437^{a}
Resilience	0.40 ± 0.036^{a}	0.39 ± 0.015^{a}	0.07 ± 0.074^{a}

Means ± standard deviation. Values within a column followed by the same superscript letter are not significantly different from each other ($p<0.05$)

Table 4. 3 Color Of Banana Keropok Lekor

Analysis	Formulation		
	1	2	3
Lightness (L*)	43.19±1.199[a]	41.81±2.333[a]	40.03±0.679[a]
Redness (a*)	2.68±0.264a	2.95±0.140[a]	3.21±0.124[a]
Yellowness (b*)	8.79±0.456[a]	8.22±0.860[a]	7.30±0.563[a]

Means ± standard deviation. Values within a column followed by the same superscript letter are not significantly different from each other ($p<0.05$)

*Formulation 1(F1), Formulation 2(F2), Formulation 3(F3)

Figure 4.1 The Appearance Of Banana Keropok Lekor

CONCLUSION

In conclusion, the different proportions of banana flour had different effects on the physicochemical and sensory properties of the *banana keropok lekor*. However, the proximate analysis of the banana keropok lekor demonstrated no significant difference ($p>0.05$) between the formulations in terms of moisture, crude protein, crude fat, ash, and carbohydrate content. Different proportions of banana flour gave significantly different textural quality among all formulations of banana keropok lekor. Banana *keropok lekor* with the highest proportion of banana flour demonstrated a high value of hardness, chewiness, and gumminess but showed the least value of cohesiveness, springiness, and resilience. A higher proportion of green banana flour in the development of *keropok lekor* showed the darker color of the banana *keropok lekor*. Thus, these findings can be used to develop *keropok lekor* from green banana flour with some further improvement to achieve better nutritional value with desirable quality to conventional *keropok lekor* made with tapioca starch or sago starch.

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