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Formulation of Emergency Food in Flakes Form Made from Proso Millet Flour (*Panicum milliaceum*) and Snakehead Fish (*Channa striata*)-Tempeh Flour *Koya*

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Abstract: Indonesia rich in local commodity which is potential to be processed into emergency food that needed during disaster condition. The objective of this research was to determine the quality of formulated flakes emergency food flakes made from proso millet flour and snakehead fish-tempeh flour *koya* based on its sensory, chemical and physical properties. The ingredients of this product were proso millet flour, snakehead fish-tempeh flour *koya*, sugar, margarine, skim milk, and egg. The initial formulations was determined with mass balance of the ingredients. Emergency food was made from proso millet flour and snakehead fish-tempeh flour *koya* with variation composition 100:0; 60:40; 55:45; and 50:50.. Each formulation were test sensory evaluation using hedonic test, proximate analysis, calories analysis using bomb calorimetry methods and physical analysis using texture profile analyzer. The compensatory model was used to determine the best formula based on all parameters. The results of this study showed that the best formula had compositions of proso millet flour 60% and snakehead fish-tempeh flour *koya* 40%. The physical properties showed that its hardness, fracturability, crispness, and crunchiness in milk values respectively were 2.42 N; 2.27 N; 41.93; and 13.73 minutes. Chemical characteristics showed that its moisture, ash, protein, fat, carbohydrate and total calories content were 2.82 %; 3.59 %; 16.85 %, 19.74 %; 59.82 %; and 249.83 kkal/50 g respectively. The result of sensory analysis showed that its brownish color, fishy aroma, fishy taste and crunchy texture.

1. Introduction

Indonesia is a country that often experiences natural disasters such as tsunamis, landslides and earthquakes [1]. Beside natural disasters, human factors also cause disasters [2] such as fires and floods. Disasters have a negative impact on humans, especially regarding food availability. Various efforts have been made to overcome the problem of food availability during disaster conditions, one of which is by providing emergency food.

Emergency food is food that provided in an emergency circumstances, which was practical and met sufficient nutrition [3], namely 233-250 kcal / 50 grams [4]. Other important factor that needed to be considered in making emergency food is the ease of consumption. Emergency food has been widely studied in various forms such as food bars [4,5] and instant porridge (slurry) [6,7]. Emergency food forms such as food bars and slurry are suitable to use in emergencies because they are fast and easy to serve. Therefore, in this study, emergency food was made in flakes form.

Flakes are ready-to-eat foods made from flour, processed by extrusion and served with milk [8]. Flakes are usually made from oats [9], wheat, corn, and rice fortified with other ingredients [10].



Wheat flour is the most common flour used in making flakes. In Indonesia, wheat was imported and needed to reduce. Proso millet (*Panicum miliaceum* L.) is an alternative local ingredients which can be used as value added product by being made into emergency food. Millet could adapt in any weather conditions [11], so that its production in Indonesia is very high. Millet's primacy is a good source of energy because it contains carbohydrates, proteins, which contain amino acids methionine and cysteine, and contains dietary fiber [12,13]. Furthermore, millet also contains phytochemicals and antioxidants that are beneficial for health [14]. Nevertheless, millet protein content as the main ingredient in making emergency food is still low, so other ingredients are needed that could elevate the protein content.

High protein content can be found in fish, especially snakehead fish. Tan & Azhar [15] stated that protein in powdered snakehead fish fillets could reach 87-94%, while fresh snakehead fish containing protein ranged from 16.2 - 20.83% [16,17]. Other foods that have high protein content are tempeh. Tempe is a fermented soybean that cheap and easily obtained. Tempe protein content is 51.99% [18]. In addition to the high content of tempe protein, the addition of tempeh could mask the fishy smell of snakehead which could reduce consumer sensory acceptance. To facilitate the mixing process in emergency food formulations, snakehead fish and tempeh were added in dry form, which was processed into *koya*. *Koya* could increase the flavor of emergency food flakes produced.

Replenishment of snakehead fish and tempeh to millet flour affected the characteristics of the flakes produced. Therefore, this study was conducted to determine the physical, chemical and sensory characteristics offlakes, as well as knowing the best formula flakes which is expected to meet daily nutritional needs as emergency food.

2. Research Methods

2.1. Material

Material that used in this study were proso millet, snakehead fish, tempeh, margarine, skim milk, refined sugar, eggs and *koya* (onion, garlic, galangal, ginger, lemongrass, bay leaves, orange leaves, coriander, coconut milk, candlenut, brown sugar, salt), obtained from local markets in Surakarta, Central Java, Indonesia.

2.2. Making millet flour

Millet seeds were cleaned and separated from the aromatic skin, then blended to reduce the size. Millet flour then sieved with 80 mesh sieve.

2.3. Making tempeh flour

Tempe flour was made based on Gunawan-Puteri *et al.*, [19] with a modification of thinly sliced tempeh with a thickness of 0.3 - 0.5 cm, then the tempeh was dried using a cabinet dryer at 60°C for 6 - 7 hours. The dried sliced-tempeh was grounded using a flour machine and sieved with a 60 mesh sieve.

2.4. Making of snakehead fish-tempeh koya

The making of snakehead fish-tempeh *koya* was made based on Anandito *et al.*, [20]. Red sugar was mixed with coconut milk and heated, then added with spices (shallots, garlic, candlenut, and coriander), ginger, galangal, crushed lemongrass leaves, bay leaves, orange leaves, and salt until boiling. After boiling, the meat of the snakehead fish was added and stirred until dry for an hour. After drying, the tempeh flour was put and mixed until mixed until had brownish color. The mixture then mashed until the *koya* was formed.

2.5. Flakes formulation

Flakes made based on Sukasih & Setyadjit [21] with modifications. Addition of snakehead-tempeh flour to millet flour formula flakes were 0%, 40%, 45%, and 50%. Flakes formula can be seen in Table 1. All ingredients (millet flour, *koya* snakehead fish and tempeh flour, skim milk, refined sugar, eggs,

margarine, and water) were mixed until smooth and homogeneous and then flattened in a baking sheet 1-2 thickness mm. The dough was steamed for 10 minutes. The steamed dough was cut in 2x2 cm and then baked in an oven for 10 minutes at 150°C.

Table 1. Flakes Formulation

| Composition | A1 | A2 | A3 | A4 |
|---|----|----|----|----|
| Proso millet flour (g) | 40 | 24 | 22 | 20 |
| Snakehead fish-tempeh flour <i>koya</i> (g) | 0 | 16 | 18 | 20 |
| Margarine (g) | 7 | 7 | 7 | 7 |
| Sugar (g) | 4 | 4 | 4 | 4 |
| Egg (g) | 4 | 4 | 4 | 4 |
| Skim milk (g) | 5 | 5 | 5 | 5 |
| Water (g) | 8 | 8 | 8 | 8 |

2.6. Analysis

Texture Analyzer Universal Testing Machine (hardness, breaking power, crispness) is used to analyze the texture and the crispy resistance used milk to test it [22]. Chemical analysis, namely the water content used thermogravimetric method, ash content by direct method, protein content used Kjeldahl-Micro method, and fat content used Soxhlet extraction method [23], while carbohydrates used by difference methods [24], total calories with calorimeter bombs [25]. Sensory analysis test used scoring hedonic test method [26].

2.7. Statistical Analysis

Sensory, physical and chemical analysis data were analyzed statistically by the one way ANOVA method. If show significant results then proceed with Duncan's Multiple Range Test (DMRT) at a significance level of $\alpha = 5\%$.

3. Results and Discussions

Table 2. Flakes Physical Characteristics

| No | Sample | Hardness (N) | Fracturability (N) | Crispiness | Resilience Crunchy in Milk (minutes) |
|----|--------|------------------------|------------------------|--------------------------|---|
| 1 | A1 | 3.54±0.28 ^b | 3.89±0.65 ^b | 56.78±4.15 ^a | 10.53±0.47 ^a |
| 2 | A2 | 2.42±0.05 ^a | 2.27±0.10 ^a | 41.93±17.44 ^a | 13.73±0.36 ^b |
| 3 | A3 | 2.47±0.11 ^a | 2.37±0.15 ^a | 38.78±11.06 ^a | 17.70±0.35 ^c |
| 4 | A4 | 2.30±0.30 ^a | 1.93±0.43 ^a | 43.63±8.72 ^a | 21.24±0.76 ^d |

Note: Data ± Standard deviation

The same superscript on the same column indicates not significant different ($\alpha > 0.05$)

3.1. Flakes physical characteristics

3.1.1. Hardness

Hardness is the ability of a material to hold a load or pressure and expressed in Newton (N). The greater the force given to destroy the product, the harder the product becomes. In Table 2 it was known that A1 (control) produces a hardness value of 3.54 N which was the highest hardness and significantly different from the other three formulas, while A4 was the lowest hardness of 2.30 N and not significantly different from A2 and A3. This result was lower than Kosutic *et al.*, [27] which added oregano residue to corn flake. Higher results were also shown by Alam *et al.*, [28] in cereal flakes

products. Hardness was affected by water content. Ansari *et al.*, [29] stated that the moisture content of a material below 18% will have an effect on the texture, especially hardness.

3.1.2. Fracturability

Fracturability is the ability of a food to break into pieces when pressed or bitten. A1 had fracturability value of 3.89 N. It was the highest with fracturability values and was significantly different from the other formulas, while A4 was the lowest fracture value of 1.93 N and not significantly different from A2, A3, and A4. The results of this study were almost the same as Paula *et al.*, [30] which stated that extrusion snacks have a fracture power ranging from 2.6 to 4.2 N. Thickness was a factor that affects the breaking power. If a product gets thicker, then the fracturability value will be higher, so that it can cause flakes hard and less crisp textured [31].

3.1.3. Crispiness

Crispiness was affected by fracturability. The results of the analysis in Table 2 show that the value of crispiness was not significantly different in all formulas. The value of crispiness was inversely proportional to the value of violence. The more crisp the ingredients, the lower the fracturability.

3.1.4. Resilience crunchiness in milk

The principle of testing crunchiness resistance in milk was to keep the flakes in milk and calculated the amount of time until the crispness disappears. It aimed to determine the resistance of flakes when served with milk in a state that was still quite crispy when consumed [22]. Crisp resistance in milk was the time for flakes to be able to floating on the surface of milk until the texture was not crispy. The crisp resistance in milk of flakes were more than three minutes. flakes was instant products that have preparation estimated less than three minutes. The average crunch resistance time in A1-A4 milk was between 10.53 minutes to 21.24 minutes. This means that A1, A2, A3, and A4 meet the crispiness resistance time in milk which is more than three minutes.

Table 3. Flakes Chemical Characteristics

| No | Sample | Moisture (% wb) | Ash (% db) | Fat (% db) | Protein (% db) | Carbohydrate (% db) | Total Calories (kcal/50 grams) |
|----|--------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|---|
| 1 | A1 | 2.23±0.15 ^a | 192±0.01 ^a | 13.31±0.21 _a | 10.16±0.02 _a | 74.62±0.23 _d | 229.76±2.35 ^a |
| 2 | A2 | 2.82±0.10 ^b | 3.59±0.07 ^b | 16.85±0.10 _b | 19.74±0.06 _b | 59.82±0.13 _c | 249.83±2.79 ^b |
| 3 | A3 | 3.23±0.12 ^c | 3.81±0.03 ^c | 17.38±0.21 _c | 21.35±0.10 _c | 57.47±0.20 _b | 251.00±1.19 ^b |
| 4 | A4 | 3.27±0.14 ^c | 4.11±0.01 ^d | 17.93±0.14 _d | 21.96±0.08 _d | 55.99±0.17 _a | 255.10±4.68 ^b |

Note: Data ± Standard deviation

The same superscript on the same column indicates not significant different ($\alpha > 0,05$)

Table 4. Energy Sufficiency Formula Flakes

| No | Sample | Macronutrien (% dari Total Calories) | | | Total Calories (kcal/50 grams) |
|----|--------|--------------------------------------|-------|---------|-----------------------------------|
| | | Carbohydrate | Fat | Protein | |
| 1 | A1 | 65.05 | 26.10 | 8.85 | 229.76±2.35 ^a |
| 2 | A2 | 50.92 | 32.28 | 16.80 | 249.83±2.79 ^b |
| 3 | A3 | 48.73 | 33.16 | 18.10 | 251.00±1.19 ^b |
| 4 | A4 | 47.33 | 34.11 | 18.56 | 255.10±4.68 ^b |

Note: Data ± Standard deviation

The same superscript on the same column indicates not significant different ($\alpha > 0,05$)

3.2. Flakes chemical characteristics

3.2.1 Moisture

Table 3 shows that the average water content values of A1, A2, A3, and A4 were between 2.23% to 3.27%. Flakes referred to the quality requirements of cereal with maximum moisture content about 3,0% according to the Indonesian National Standard (SNI 01-4270-1996). Based on the results, it was known that A1 (control) and A2 with moisture content about 2.23% and 2.82% meet the maximum requirement of moisture content (3,0%). However, A3 and A4 had amount of moisture content about 3.23% and 3.27% exceeding the maximum limit of 3.0% water content. This showed that the more *koya* snakehead-tempeh was added, the higher the water content of flakes.

3.2.2 Ash

Ash content of millet flake is shown in Table 3. It showed that the mean ash values of A1, A2, A3, and A4 are between 1.92% to 4.11%. Based on the Indonesian National standard (SNI 01-4270-1996), Flakes refers to the requirements for the quality of cereal with maximum ash content of 4.0%. Based on the results obtained, it was known that A1 (control), A2, and A3 with ash content respectively 1.92%, 3.59%, and 3.81% meet the maximum ash content requirement of 4.0%. However, A4 with ash content of 4.11% exceeds the requirement of maximum ash content. Table 3 showed that the more snakehead-tempeh *koya* added, the higher the ash flakes content because the mineral content in the main raw material, namely snakehead fish contains ash content about 4-5% [15]. The main ingredients of snakehead fish minerals were Zn, Cu, and Fe [16].

3.2.3 Fat

Fat content of millet flake ranged from 13.31 – 17.93%. Based on the Indonesian National standard for SNI 01-4270-1996 concerning the requirements for the quality of cereal, Flakes had a minimum fat content of 7.0%. Millet flakes had a fat content of more than 7% in all formulas. Formula A4 has the highest fat content and was significantly different from other formulas. This showed that the more fish snakehead-tempeh *koya* was added, the higher the fat content of flakes. The fat content of the ingredients affected the level of fat flakes produced.

Emergency food fat requirements were 35 - 45% of total calories [32]. The results of the energy sufficiency analysis in Table 4 showed that the composition values of the fat content of A1, A2, A3, and A4 were 26.10 – 34.11% of total calories, not fulfill the requirement level of the total calories (35 - 45%), so as not to meet emergency food requirements.

3.2.4 Protein

The results of protein content analysis were shown in Table 3. Millet flake protein levels ranged from 10.16 to 21.96%. The quality requirements flakes referred to cereal with a minimum protein content of 5,0% in SNI 01-4270-1996. The highest protein levels were found in A4 and significantly different from other formulas. The more fish and tempeh flour added, the higher the protein flakes level. The protein content of the basic ingredients for making flakes affected the level of protein flakes.

The protein content of emergency food was 15% of total calories at max [32]. The results of the energy adequacy analysis in Table 4 showed that the composition value of A1 protein content was 8.85% of the total calories, thus fulfilling emergency food requirements. However, the protein content of A2, A3, A4 were 16.80 – 18.56% of total calories, thus exceeding the maximum protein level of emergency food, which was 15% of the total calories determined.

3.2.5 Carbohydrate

The average carbohydrate content of millet flake formula ranged from 55.99 – 74.62%. The minimum requirement of levels of carbohydrate flakes in SNI 01-4270-1996 was 60%. Table 3 shows that A1 had met the requirements of carbohydrate levels of at least 60%, while A2, A3, A4 did not meet the

requirements because they had carbohydrate levels less than 60%. The more snakehead-tempeh *koya* added, the lower the carbohydrate contained in the flakes.

Carbohydrate requirements for emergency food were 40 - 50% of total calories [32]. The results of energy sufficiency analysis in Table 4 showed that the composition value of A3 and A4 carbohydrate levels were 48.73% and 47.33% of total calories, reached levels of 40-50% of total calories and met the requirements. However, A1 and A2 had 65.05% and 50.92% carbohydrate levels of total calories, thus exceeding emergency food requirements.

3.2.6 Total Calories

Table 3 showed that the total calories value ranged from 229.76 - 255.10 kcal per 50 grams. The more snakehead-tempeh *koya* added, the higher the total calories of flakes. Zoumas *et al.* [32] stated that the weight of emergency food recommended for adequate 2,100 kcal total calories was 450 grams equivalent to 233 kcal per 50 grams. In Table 4 it could be seen that the total calorie of A1 was 229.76 kcal per 50 grams so it did not meet the total calorie requirements in emergency food, while A2, A3, and A4 with a total calories value of 249.83 – 255.10 kcal per 50 grams, met the total calorie requirements in emergency food.

Table 5. Sensory Characteristics of Flakes

| No | Sample | Color | Aroma | Taste | Texture | Overall |
|----|--------|------------------------|--------------------------|------------------------|------------------------|--------------------------|
| 1 | A1 | 4.58±0.84 ^c | 3.58±0.87 ^a | 3.58±1.11 ^a | 4.45±0.71 ^b | 3.98±0.89 ^b |
| 2 | A2 | 3.80±1.04 ^b | 4.05±0.93 ^b | 3.70±1.11 ^a | 3.73±0.99 ^a | 3.80±0.85 ^b |
| 3 | A3 | 3.80±0.91 ^b | 3.90±0.98 ^{a,b} | 3.58±1.06 ^a | 4.03±0.95 ^a | 3.65±0.92 ^{a,b} |
| 4 | A4 | 2.45±1.13 ^a | 3.68±1.12 ^{a,b} | 3.20±1.31 ^a | 3.98±1.00 ^a | 3.35±1.00 ^a |

Note: Data ± Standard deviation

The same superscript on the same column indicates not significant different ($\alpha > 0,05$)

3.3. Sensory characteristics of flakes

3.3.1 Color

The results of sensory analysis of color parameters could be seen in Table 5. The results of the analysis showed that the average values in the parameters colors range from 2.45 to 4.58. The highest value was 4.58 in A1 and significantly different from the other formulas. This showed the addition of snakehead-tempeh *koya* to millet flakes affecting panelist acceptance. The more snakehead-tempeh *koya*, the panelist's preference for the color of the product flakes was decreasing. The result could be seen in Figure 1.

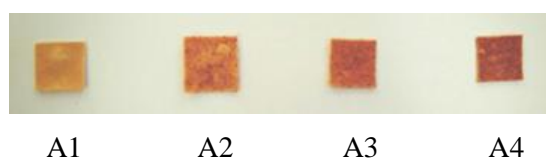


Figure 1. The color of the Millet Flake

The more addition of snakehead-tempeh *koya* produces a darker color because it is affected by caramelization reaction when the mixture contains sugar through a heating process (steaming the dough sheet and roasting in the oven) and Maillard reaction, which is the reaction between amino groups of proteins and carbohydrates, especially the reducing carbonyl groups which produce dark melanoidin compounds [24].

3.3.2 Aroma

Table 5 shows that the average value of aroma parameters was 3.58– 4.05. The most preferred aroma was A2 with the highest value of 4.05 and significantly different from other formulas. The lowest value was 3.58 in A1. The results of statistical analysis indicated that there was an impact of the addition of

snakehead-tempeh *koya* to the panelist's acceptance of the aroma of products. Table 5 showed that the panelists accepted the aroma of flakes A2, A3, A4 which were added by snakehead-tempeh *koya* rather than A1 or without the addition of *koya*.

The used ingredients could affect the aroma of flakes produced. The aroma of mixing ingredients, such as refined sugar, skim milk, eggs, and margarine were expected to cover the distinctive aroma of millet flour and the fishy aroma of *koya*. In making *koya*, garlic and other seasonings were used to reduce the fishy smell of snakehead fish but cannot eliminate the fishy odor. Beside the ingredients, the Maillard reaction also affected the aroma of flakes.

3.3.3 Taste

Table 5 showed that the average value of the taste parameter was 3.20-3.70. The most preferred taste with the highest value of 3.70 was in A2. The lowest value was 3.20 in A4. The results of statistical analysis showed that there was no effect of the addition of snakehead-tempeh *koya* to the panelist's acceptance or preference of product taste. However, Table 5 showed that the more snakehead-tempeh *koya* is added, the panelists' preference for product taste was decreasing. This was caused by tannin content in millet flour and caramelization reaction on flakes.

3.3.4 Texture

Table 5 showed that the average values in texture parameters were 3.73 – 4.45. The most preferred texture with the highest value was 4.45 in A1. The lowest value was 3.73 in A2. The results showed that A1 texture was significantly different from A2, A3, and A4. The roasting process occurred if there was evaporation of water in the product so that reduced the water content and affected the texture of the resulting flakes. When the water flakes level was low, it would produce a crisp texture.

3.3.5 Overall

Table 5 showed that the average value in the parameter overall was 3.35 – 3.98. The highest value was 3.975 in A1, while the lowest value was 3.35 in A4. The results of statistical analysis showed that there was an impact of the addition of snakehead-tempeh *koya* to the panelist's acceptance of the whole product.

3.3.6 Determination of the Best Formula

Determination of the best formula for flakes made from millet flour snakehead-tempeh *koya* flour was done to find out the best formula between A2 and A4. A1 was not analyzed because A1 was only used as a comparison (control) for A2, A3, and A4. The best formula was determined by the results of physical, chemical, and sensory analysis flakes by weighting test or effectiveness index test by using De Garmo *et al.* (1984) methods. The principle of weighting test was to give weight or score according to the contribution of a characteristic and parameters to each formula.

Table 6. Weighting Formula Flake Test Results

| Characteristics | BV | BN | A2 | | A3 | | A4 | |
|--------------------------|----|------|------|------|------|------|------|------|
| | | | NE | NH | NE | NH | NE | NH |
| Hardness | 1 | 0.07 | 0.30 | 0.02 | 0.00 | 0.00 | 1.00 | 0.07 |
| Fracturability | 1 | 0.07 | 0.22 | 0.02 | 0.00 | 0.00 | 1.00 | 0.07 |
| Crispness | 1 | 0.07 | 0.65 | 0.04 | 0.00 | 0.00 | 1.00 | 0.07 |
| Resistance crisp in milk | 1 | 0.07 | 0.00 | 0.00 | 0.53 | 0.04 | 1.00 | 0.07 |
| Air | 1 | 0.07 | 1.00 | 0.07 | 0.09 | 0.01 | 0.00 | 0.00 |
| Abu | 1 | 0.07 | 1.00 | 0.07 | 0.58 | 0.04 | 0.00 | 0.00 |
| Fat | 1 | 0.07 | 0.00 | 0.00 | 0.48 | 0.03 | 1.00 | 0.07 |
| Protein | 1 | 0.07 | 1.00 | 0.07 | 0.26 | 0.02 | 0.00 | 0.00 |
| Carbohydrate | 1 | 0.07 | 0.00 | 0.00 | 0.61 | 0.04 | 1.00 | 0.07 |
| Total Calories | 1 | 0.07 | 0.00 | 0.00 | 0.22 | 0.02 | 1.00 | 0.07 |

| | | | | | | | | |
|---------|----|------|------|-------------|------|------|------|------|
| Color | 1 | 0.07 | 1.00 | 0.07 | 1.00 | 0.07 | 0.00 | 0.00 |
| Aroma | 1 | 0.07 | 1.00 | 0.07 | 0.60 | 0.04 | 0.00 | 0.00 |
| Flavor | 1 | 0.07 | 1.00 | 0.07 | 0.75 | 0.05 | 0.00 | 0.00 |
| Texture | 1 | 0.07 | 0.00 | 0.00 | 1.00 | 0.07 | 0.00 | 0.00 |
| Overall | 1 | 0.07 | 1.00 | 0.07 | 0.67 | 0.04 | 0.00 | 0.00 |
| Total | 15 | | | <u>0.55</u> | | 0.45 | | 0.47 |

Description: BV = Variables weight, BN = Normal Weight, NE = Effectiveness value, NH = Result

Determination of the highest and lowest values of each parameter was based on the quality of the desired flakes. The best formula had the highest NH among other NH formulas. In Table 5, the best formula was A2 with NH of 0.55, while A3 has the lowest NH of 0.45. It could be concluded that A2 was the best flakes formulawith of 60% ratio of millet flour : 40% snakehead-tempeh *koya*.

4. Conclusion

The best formula of flakes was A2 with a ratio of 60% flour millet : 40% snakehead fish-tempeh *koya*, with physical characteristics such as: hardness value 2.42 N, fracturability value 2.27 N, crispiness 41.93, and crisp resistance value in milk for 13.73 minutes. The chemical characteristics including moisture content 2.82%, ash content 3.59%, fat content 16.85%, protein content 19.74%, carbohydrate content 59.82%, and total calories by 249.83 kcal per 50 grams, and the highest value of sensory characteristics flakes were A2 in the best color, aroma, taste, and overall values that the panelists liked, while the A2 texture could still be accepted by the panelists.

The best total calory of the flakes formulawas A2 of 249.83 kcal per 50 grams met the total required calories of emergency food at 233 kcal per 50 grams.

References

- [1] Kastolani W and Mainaki R 2018 *Does educational disaster mitigation need to be introduced in school?.SHS Web of Conferences*. 42 1-6.
- [2] Hapsari R I and Zenurianto M 2016 *View of flood disaster management in Indonesia and the key solutions American Journal of Food Engineering Research*. 5 140-151
- [3] Aini N, Prihananto V, Wijonarko G, Sustriawan B, Dinayati M and Aprianti F 2018 *Formulation and characterization of emergency food based on instan corn flour supplemented by instan tempeh (or soybean) flour International Food Research Journal*. 25 287-292
- [4] Kusumastuty I, Ningsih L F and Julia A R 2015 *Formulation of rice bran flour and corn flour as emergency food product. Indonesian Journal of Human Nutrition* 2 68-75. [Bahasa Indonesia]
- [5] Anandito R B K, Siswanti, Nurhartadi E and Hapsari R 2016 *Formulation of food bars made from white millet flour (Panicum miliaceum L) and red bean flour (Phaseolus vulgaris L). Agritech* 36 23-29. [Bahasa Indonesia]
- [6] Pramesta L D, Rahmawanti D, Kawiji and Anandito B K 2012 *Characterization of instant baby porridge based on millet flour (Panicum sp) and kidney bean flour (Phaseolus vulgaris L) with ambon banana (Musa paradisiacal var. sapientum L) natural flavor. Jurnal Teknosains Pangan* 1 32-40. [Bahasa Indonesia]
- [7] Anandito R B K, Siswanti and Kusumo D T 2016 *Sensory evaluation and chemical characteristics of instant porridge made from white millet flour and red beans flour. Jurnal Teknologi Hasil Pertanian* IX 17-23. [Bahasa Indonesia]
- [8] Carvalho A V, Mattietto R A, Bassinello P Z, Koakuzu S N, Rios A O, Maciel R A and Carvalho R N 2012 *Processing and characterization of extruded breakfast meal formulated with broken rice and bean flourCiencia e Tecnologia de Alimentos*. 32 515-524
- [9] Darwish S M and Darwish A Z M 2017 *Preparation and evaluation of oat-kishk flakes as a new product. World Journal of Dairy & Food Sciences*. 12 19-24

- [10] Varsha K R and Pavani S 2016 *Protein enriched ragi flakes. Research & Reviews : Journal of Food and Dairy Technology*. 4 13-33
- [11] Amadou I, Gbadamosi O S and Le G W 2011 *Millet-based traditional processed foods and beverages-a review. Cereal Foods World*. 56 115-121
- [12] Amadou I, Gounga M E and Le G W 2013 *Millets : nutritional composition, some health benefits and processing – a review Emir J Food Agric*. 25 501-508
- [13] Chauhan E S and Sarita 2017 *Antioxidant properties of germinated millets (Eleusine coracana & Pennisetum glaucum) : a comparative study International Journal of Food Science and Nutrition*. 2 75-78
- [14] Sarita and Singh E 2016 *Potential of millets : Nutrients composition and health benefits Journal of Scientific and Innovative Research*. 5 46-50
- [15] Tan B H and Azhar M E 2014 *Physicochemical properties and composition of snakehead fish (Channa striatus) whole fillet powder prepared with pre-filleting freezing treatments International Food Research Journal*. 21 1255-1260
- [16] Mustafa A, Widodo M A and Kristianto Y 2012 *Albumin and zinc content of snakehead fish (Channa striata) extract and its role in health International Journal of Science and Technology*. 1 1-8
- [17] Firlianty, Suprayitno E, Nursyam H, Hardoko and Mustafa A 2013 *Chemical composition and amino acid profile of Channidae collected from Central Kalimantan, Indonesia International Journal of Science and Technology*. 2 25-29
- [18] Bavia A C F, da Silva C E, Ferreira M P, Santos Leite R, Mandarino J M G and Carrao-Panizzi M C 2012 *Chemical composition of tempeh from soybean cultivars specially developed for human consumption Ciencia e Tecnologia de Alimentos*. 32 613-620
- [19] Gunawan-Puteri M D P T, Hassanein T R, Prabawati E K, Wijaya C H and Mutukumira A N 2015 *Sensory characteristics of seasoning powders from overripe tempeh, a solid state fermented soybean. Procedia Chemistry*. 14 263-269
- [20] Anandito R B K, Siswanti, Purnamayati L and Sodiq H 2017 *Shelf-life determination of fish koya using critical moisture content approach. Proceedings of Pakistan Academy of Sciences*. 54 201-206
- [21] Sukasih E & Setyadjit 2012 *Formulation of flakes based on talas for high energy breakfast meal with oven method. J. Pascapanen*. 9 70-76. [Bahasa Indonesia]
- [22] Papunas M E, Djarkasi G S S and Moningga J S 2013 *Physicochemical and sensory characteristics of flakes from corn flour (Zea mays L), Goroho banana (Musa acuminata, sp) and green bean (Phaseolus radiates). Cocos 3* [Bahasa Indonesia]
- [23] Association of Official Analytical Chemist 2002 *Official Methods of Analysis AOAC*. Washington, United States
- [24] Winarno F G 2004 *Food Chemical and Nutrition* Gramedia Pustaka Utama. Jakarta, Indonesia [Bahasa Indonesia]
- [25] Mulyaningsih Y and Rosida J 2002 *Comparison of total energy analysis using bomb calorimeter with the proximate analysis result. Temu Teknis Fungsional Non Peneliti* 93-9 [Bahasa Indonesia]
- [26] Setyaningsih D, Apriyantono A and sari M P 2010 *Sensory analysis for food and agro industry* IPB Press. Bogor, Indonesia. [Bahasa Indonesia]
- [27] Kosutic M, Filipovic J, Pezo L, Plavsic D and Ivkov M 2016 *Physical and sensory properties of corn flakes with added dry residue from wild oregano distillation Journal of the Serbian Chemical Society*. 81 1013-1024
- [28] Alam S A, Pentikainen S, Narvainen J, Holopainen-Mantila U, Poutanen K and Sozer N 2017 *Effect of structural and textural properties of brittle cereal foams on mechanisms of oral breakdown and in vitro starch digestibility Food Research International*. 96 1-11
- [29] Ansari S, Maftoon-Azad, Farahmaky A, Hossein E and Badii F 2014 *Effect of moisture content on textural attributes of dried figs International Agrophysics*. 28 403-412

- [30] Paula A M, Conti-Silva A C 2014 *Texture profile and correlation between sensory and instrumental analysis on extruded snacks* *Journal of Food Engineering*. 121 9-14
- [31] Rahmawati W, Erliana U D, Habibie I Y and Harti L B 2014 *Food Security of toddler family after eruption of Mount Bromo, Probolinggo, Indonesia. Indonesian Journal of Human Nutrition*. 1 35-49. [Bahasa Indonesia]
- [32] Zoumas BL, Armstrong LE, Backstrand JR, Chenoweth WL, Chinachoti P, Klein BP, Lane HW, Marsh KS and Tolvanen M 2002 *High-Energy, Nutrient-Dense Emergency Relief Product*. Food and Nutrition Board: Institute of Medicine National Academy Press. Washington DC, United States
- [33] De Garmo E P, Sullivan W Gand Canada J R 1984 *Engineering Economy, Seventh Edition* Macmillan Publishing Company. New York, United States