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Level of acceptance and nutritional value of milkfish (*Chanos chanos*) and mocaf flour food bars as local food-based emergency food alternatives

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ABSTRAK

Latar Belakang: *Indonesia sering mengalami bencana alam yang menyebabkan korban mengalami keterbatasan makanan dan asupan makan berkurang. Pangan darurat kaya protein dan karbohidrat, dari bahan lokal dapat dikembangkan.*
Tujuan: *Mengembangkan produk alternatif pangan darurat berbasis pangan lokal berbentuk food bar dari ikan bandeng dan tepung mocaf dan tinjauannya dari tingkat kesukaan dan nilai gizi.*
Metode: *Penelitian ini berjenis eksperimental dengan rancangan acak lengkap. Sampel yaitu food bar berbahan dasar ikan bandeng dan tepung mocaf dengan rasio konsentrasi 1:1 (F1), 3:2 (F2), dan 2:3 (F3). Sampel diuji tingkat kesukaannya menggunakan 30 panelis semi terlatih. Tingkat kesukaan terbaik ditentukan dari analisis statistik Kruskal-Wallis dan Mann-Whitney untuk warna, aroma, rasa, dan tekstur. Perlakuan terbaik diuji nilai gizi makro dengan analisis proksimat. Data kemudian dianalisis dengan uji independent sample t-test untuk mengetahui perbedaan nilai gizi pada kelompok kontrol dan kelompok perlakuan.*
Hasil: *Perbedaan formula food bar memengaruhi secara signifikan tingkat kesukaan rasa, tekstur, dan warna ($p<0,05$), namun tidak memengaruhi aroma ($p>0,05$). Tingkat kesukaan terbaik dipilih F3 karena memiliki nilai skor kesukaan tertinggi dibanding formula lainnya. Nilai gizi abu (mineral), air, lemak, protein, dan kalori pada formula F3 lebih tinggi signifikan dibanding dengan F0 (kontrol), sementara kadar karbohidrat lebih rendah dibanding F0.*
Kesimpulan: *Ada pengaruh variasi rasio konsentrasi ikan bandeng dan tepung mocaf terhadap tingkat kesukaan rasa, tekstur, dan warna. Perlakuan juga meningkatkan nilai gizi abu (mineral), air, lemak, protein, dan kalori. Food bar ini dapat dikembangkan menjadi pangan darurat lokal.*

KATA KUNCI: *food bar; nilai gizi; pangan darurat; pangan lokal; tingkat kesukaan*

ABSTRACT

Background: *Indonesia often experiences natural disasters that cause victims to suffer from food shortages and reduced food intake. Emergency food supplies rich in protein and carbohydrates can be developed from local ingredients.*

Objectives*: Developing alternative emergency food products based on local foods in the form of food bars made from milkfish and mocaf flour, and evaluating their level of acceptability and nutritional value.*

Methods: *This study was experimental in nature with a completely randomized design. The samples were fish-based food bars made from milkfish and mocaf flour with concentration ratios of 1:1 (F1), 3:2 (F2), and 2:3 (F3). The samples were tested for palatability using 30 semi-trained panelists. The best level of preference was determined from the Kruskal-Wallis and Mann-Whitney statistical analyses for color, aroma, taste, and texture. The best treatment was tested for macro nutritional value using proximate analysis. The data were then analyzed using an independent sample t-test to determine the difference in nutritional value between the control group and the treatment group.*

Results: *Differences in food bar formulas significantly affect taste, texture, and color preferences ($p<0.05$), but do not affect aroma ($p>0.05$). The best preference level was selected for F3 because it had the highest preference score compared to other formulas. The nutritional values of ash (minerals), water, fat, protein, and calories in formula F3 were significantly higher than in F0 (control), while the carbohydrate content was lower than in F0.*

Conclusions: *There is an effect of the variation in the ratio of milkfish concentration and mocaf flour on the level of preference for taste, texture, and color. The treatment also increases the nutritional value of ash (minerals), water, fat, protein, and calories. This food bar can be developed into local emergency food.*

KEYWORDS*:* *ALT; AST; diabetes; liver histopathology; kefir*

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INTRODUCTION

Indonesia is located in the Ring of Fire, which is prone to natural disasters (1). When natural disasters occur, most residents must stay in evacuation centers with limited access to food. If this situation persists for a long time, it can lead to nutritional problems, especially malnutrition, marasmus, and kwashiorkor. Therefore, emergency food supplies are needed to meet nutritional intake and adequacy requirements (2).

Emergency food is a highly nutritious food product to meet daily needs during emergencies (3). The characteristics of emergency food include being safe for consumption, sensorially acceptable, nutrient-dense, and easy to distribute (4). Emergency food supplies that utilize local food sources can be more readily accessible and sustainable. These local food sources are developed in accordance with the potential of the region's resources, local wisdom, and culture (5). In addition, the development of emergency food products based on local foods in known to be superior in terms of quality, quantity, and function for the preservation of biodiversity and ecosystems (6). Common form of emergency food based on local food in Indonesia include food bars, biscuits, and IMF (Intermediate Moisture Food). In addition, other emergency food products that have been developed include meals ready to eat (MRE), camping pouch products, and long-shelf-life food supplies (4).

Local foods high in protein and carbohydrates that have potential for development in Indonesia are milkfish and mocaf flour (modified cassava flour). In addition, milkfish is a good source of omega-3 and omega-6, which are beneficial for improving brain intelligence (3). Mocaf flour is not only high in carbohydrates and gluten-free, but also has good digestibility and has been proven to control sugar levels and reduce weight (8,9).

Emergency food can be processed into solid food bars (6), because it is easy to package and distribute (7). The production of food bars from local foods as emergency food has been done using jackfruit and mocaf flour (8), as well as sago, skipjack tuna flour, and banana puree (9). The use of milkfish and mocaf flour has the potential to be

an alternative in the manufacture of food bars because it has not been done on a large scale and requires periodic research. In this study, an alternative emergency food product based on local foods in the form of food bars made from milkfish and mocaf flour was developed and reviewed in terms of palatability and nutritional value.

MATERIALS AND METHODS

This type of research is quasy experimental research with a quantitative approach. The research design used is a completely randomized design (CRD) with 1 control group and 3 treatment groups. namely F1 (50% wheat flour, 25% milkfish flour, and 25% mocaf flour), F2 (50% wheat flour, 30% milkfish flour, and 20% mocaf flour), and F3 (50% wheat flour, 20% milkfish flour, and 30% mocaf flour). This study was conducted from May to July 2025 at the Alma Ata University Culinary Laboratory and macronutrient content was anayzed using proximate analysis. Ash content was analyzed using the dry ashing method, moisture content using thermogravimetry, protein content using the Kjeldahl method, and fat content using the Soxhlet method. Carbohydrates were determined by difference, and calories were calculated using the Atwater formula (10)(11).

The independent variables in this study were the types of milkfish and mocaf flour food bar formulations, while the dependent variables were the level of preference and nutritional value of milkfish and mocaf flour food bars.

The main ingredients used for control were wheat flour (50 g) and mung bean flour (50 g). The treatments were performed by substituting mung bean flour with milkfish flour and mocaf flour. The complementary ingredients used included skim milk (30 g), oats (30 g), sugar (40 g), margarine (40 g). The tools used in this study included an oven, mixer, digital scales, knife, bowl, spoon, glass, plastic gloves, 20 x 10 x 3 cm baking tray, mixing spoon, saucapen, blender, and sieve.

The food bar was made by mixing margarine, sugar, baking powder, and vanilla powder in a mixer for 3 minutes, then wheat flour, milkfish flour, mocaf flour, skim milk, oats, and salt were added. Next, the dough were mixed manually with a spoon for 5 minutes and added 20 ml of water to form the food bar dough. The food bar dough was then pressed into a baking pan with a thickness of 1.5 cm and baked at 100°C for 60 minutes in the oven. After that, the food bars were cut and baked again at 140°C for 45 minutes in the oven to produce the food bar product.

The food bars were then evaluated sensorially for aroma, taste, colour, and texture preferences using 30 semi-trained panelists who met the criteria of being nutrition students at Alma Ata University, healthy, and non-smoker (12). The preference test used a put 5-hedonic scale with numbers 1 (dislike very much), 2 (dislike), 3 (neutral), 4 (like), and 5 (like very much). The best formula based on sensory evaluation was selected for nutritional analysis.

Data are presented as mean ± standard deviation. To determine the effect of treatment on the level of food bar preference (sensory evaluation), data were analyzed statistically using the Kruskal-Wallis test at a 5% confidence level, followed by the Mann-Whitney test for significant differences. This analysis was chosen because the data were not normally distributed based on Shapiro-Wilk test. Data of macronutrient were analyzed using the independent sample t-test to determine the difference between the treated food bars and the control.

RESULTS AND DISCUSSIONS

Level of acceptance for aroma, taste, colour, and texture of the food bar

The preference test was conducted on three treatment groups and one control group, and the statistical test results are presented in **Table 1**. The preference score for aroma of food bar ranged from 3.47 to 3.97. The normality test showed p values of F0, F1, F2, and F3 were 0.003, 0.002, 0.003, <0.001, respectively. From these results, the significance value was <0.05, which means that the data was not normally distributed. Therefore, the Kruskal-Wallis test was performed and a p-value of 0.097 (>0.05) was obtained, indicating that there was no significant difference in aroma for all formulations. This was due to the addition of lime and vanilla powder in the production of milkfish flour to eliminate the fishy smell (15,16). The preference score for taste ranged from 2.83 to 3.60. According to the data normality test, the p-values obtained were F0 (<0.001), F1 (0.013), F2 (<0.001), and F3

(<0.001). From these results, a significance value of <0.05 indicates that the data is not normal, so the Kruskal-Wallis test was continued, which produced a p-value of 0.012 (<0.05), indicating that there are significant differences between the formulations. The Mann-Whitney test was then performed, with the results demonstrating that F0 and F1 were significantly different (p=0.009) (<0.05), F0 and F2 were significantly different 0.043 (<0.05), F0 and F3 were not significantly different 0.508 (>0.05), F1 and F2 were not significantly different 0.496 (>0.05), F1 and F3 were significantly different 0.008 (<0.05), and F2 and F3 were not significantly different 0.066 (>0.05). In F3, the amount of milkfish flour was small and the amount of mocaf flour was large compared to F1 and F2, resulting in a less fishy and more pleasant taste (8).

Table 1. Acceptance level of food bar made from milkfish and mocaf flour

Formulation	Aroma	Taste	Colour	Texture
F0	3.53 ± 0.90^{a}	3.60 ± 1.10^{a}	3.97 ± 0.96^{a}	3.83 ± 0.69^{a}
F1	3.47 ± 0.86^{a}	2.83 ± 1.02^{c}	3.07 ± 0.82^{b}	2.90 ± 0.88^{b}
F2	3.50 ± 0.93^{a}	3.03 ± 0.99^{bc}	2.83 ± 0.74^{b}	3.13 ± 0.81^{b}
F3	3.97 ± 0.71^{a}	3.47 ± 0.81^{ab}	3.67 ± 0.84^{a}	3.17 ± 0.87^{b}

Notes:
^{abc}Different letters in the same column indicate significant differences between treatments (p-value <0.05) using the Mann-Whitney test. Score 1 = strongly dislike, 2 = dislike, 3 = neutral, 4 = like, 5 = strongly like. F0 (50% wheat flour and 50% mung bean flour), F1 (50% wheat flour, 25% milkfish flour, and 25% mocaf flour), F2 (50% wheat flour, 30% milkfish flour, and 20% mocaf flour), and F3 (50% wheat flour, 20% milkfish flour, and 30% mocaf flour).

The preference score for colour ranged from 2.83 to 3.97. According to the data normality test, the p-values obtained were F0 (<0.001), F1 (<0.001), F2 (<0.001), and F3 (0.001). From these results, the significance value was <0.05, which means that the data was not normal, so a Kruskal-Wallis test was performed, which produced a p-value of <0.001 (<0.05), indicating that there were significant differences between the formulations. The Mann-Whitney test was then performed, with the results demonstrating that F0 and F1 were significantly different <0.001 (<0.05), F0 and F2 were significantly different <0.001 (<0.05), F0 and F3 were not significantly different 0.150 (>0.05), F1 and F2 were not significantly different 0.240 (>0.05), F1 and F3 were significantly different 0.008 (<0.05), and F2 and F3 were significantly different <0.001 (<0.05). F3 has a brighter colour than F1 and F2 because it contains less milkfish flour and more mocaf flour (15). Furthermore, the colour of the food bar is influenced by the baking process, which causes a Maillard reaction, resulting in a brown colour (16)(17).

The preference score for texture ranged from 2.90 to 3.83. According to the normality test of the data, the p-values obtained were F0 (<0.001), F1 (<0.001), F2 (<0.001), and F3 (0.002). From these results, the significance value was <0.05, which means that the data was not normal. Therefore, a Kruskal-Wallis test was performed with a p-value of <0.001 (<0.05), indicating that there were significant differences between the formulations. A Mann-Whitney test was conducted, with the results demonstrating that F0 and F1 were significantly different <0.001 (<0.05), F0 and F2 were significantly different 0.001 (<0.05), F0 and F3 were significantly different 0.002 (<0.05), F1 and F2 were not significantly different 0.260 (>0.05), F1 and F3 were not significantly different 0.235 (>0.05), and F2 and F3 were not significantly different 0.937 (>0.05). F0 (wheat flour and mung bean flour) has low WHC (Water Holding Capacity) due to its low protein content, resulting in a dense texture (18). The WHC level is influenced by protein content, the higher the protein content, the higher the WHC level (19). In F1, F2, and F3, there was a decrease in average value due to high WHC levels, which made the texture softer and the drying time longer (20).

Based on the sensory evaluation results, the food bar with the highest level of acceptability was formula F3, particularly for the parameters of aroma, taste, color, and texture, with respective scores of 3.97, 3.47, 3.67, and 3.17. Therefore, formula F3 was selected for further macronutrient analysis.

Table 2. Proximate Analysis Results of Milkfish and Mocaf Flour Food Bars

Nutritional Value	Mean ± SD		Emergency Food References (21)	USDA Food Bar Standards (22)	Significance (P)
	F0	F3			
Ash (%)	3.67 ± 0.00[a]	4.08 ± 0.06[b]	-	-	0.01
Water (%)	17.30 ± 0.05[a]	18.51 ± 0.08[b]	-	11.40	<0.001
Fat (%)	14.78 ± 0.11[a]	16.17 ± 0.06[b]	35-45	20.00	<0.001
Protein (%)	4.89 ± 0.07[a]	6.04 ± 0.02[b]	10-15	16.70	<0.001
Carbohydrate (%)	59.33 ± 0.13[a]	55.18 ± 0.10[b]	40-50	46.67	<0.001
Calories (kkal/100g)	390.03 ± 0.79[a]	390.49 ± 0.27[a]	466-500	280	0.52

Description:
[ab] Different letters indicate significant differences based on the independent sample t-test with a significance level of p-value <0.05. F0 (50% wheat flour and 50% mung bean flour) and F3 (50% wheat flour, 20% milkfish flour, and 30% mocaf flour).

Nutritional value of food bars

Proximate analysis was conducted to determine nutritional values, including ash, water, fat, protein, carbohydrates, and calories. The statistical test results are presented in **Table 2**.

Ash content

F3 (4.08%) had significantly higher ash content than F0 (3.67%) ($p = 0.01$), likely due to longer roasting time and higher temperature (23). Higher ash content indicates greater mineral content (24)(11).

Moisture content

F3 (18.51%) showed significantly higher moisture content than F0 (17.30%) ($p < 0.001$). The high moisture content may be attributed to high-protein raw materials (milkfish flour 24.175% wb; mung bean flour 23.84% wb), which increase WHC and water absorption. Additionally, higher added water in F3 (20 mL) compared to F0 (10 mL) contributed to this result (25).

Fat content

F3 (16.17%) had higher fat content than F0 (14.78%) ($p < 0.001$), due to the higher fat content of milkfish flour (10.44% wb) compared to mung bean flour (1.53% wb) (20). However, both formulations did not meet emergency food references (35–45%). Increasing fat-rich ingredients such as nut flour, margarine, oil, eggs, or cheese may improve compliance (26).

Protein content

F3 (6.04%) had higher protein content than F0 (4.89%) ($p < 0.001$), attributed to milkfish flour's protein content (24.175% wb). Nevertheless, both formulations did not meet emergency food references (10–15%). Protein levels could be improved by incorporating higher-protein ingredients such as milkfish flour, nut flour, eggs, or skim milk (27).

Carbohydrate content

F0 showed higher carbohydrate content (59.33%) than F3 (55.18%) ($p < 0.001$). Carbohydrate content was calculated by difference; therefore, lower levels of other nutrients result in higher calculated carbohydrate values (24)(28). Both formulations met emergency food carbohydrate references (40–50%).

Calorie content

The calorie content of F0 (390.03 kcal/100 g) and F3 (390.49 kcal/100 g) did not differ significantly ($p = 0.52$). The similar energy values are due to comparable caloric contributions from the raw materials: milkfish (123 kcal/100 g), mocaf flour (350 kcal/100 g), and mung bean flour (323 kcal/100 g). However, both formulations did not meet emergency food reference (466–500 kcal/100 g). Energy density could be increased by incorporating high-calorie ingredients such as nut flour, margarine, oil, eggs, or cheese (29).

CONCLUSION AND RECOMMENDATION

Formula F3 (50% wheat flour, 20% milkfish flour, and 30% mocaf flour) showed the highest overall sensory acceptability, particularly for aroma, taste, colour, and texture. Significant differences were observed among formulations for taste, colour, and texture ($p < 0.05$), while aroma did not differ significantly. Proximate analysis indicated that F3 had significantly higher ash, moisture, fat, and protein content than F0 ($p < 0.05$), with similar calorie values. Although the

carbohydrate content met emergency food reference, the fat, protein, and energy levels did not yet comply with recommended emergency food requirements. Overall, F3 is the most promising formulation but requires further nutritional optimization.

Future research should improve fat, protein, and energy content to meet emergency food references. Optimization of moisture content and shelf-life evaluation are also recommended to enhance product stability and suitability as an emergency food product.

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