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Alternative Food Supplements in the Form of Catfish Meal-Cowpea Based Biscuits and Their Implications for Acceptability

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ABSTRACT: Energy-protein deficiency is one of the nutritional disorders, the highest prevalence is in toddlers, pregnant, and breastfeeding mothers. has long-term impacts that result in slow growth and development, decreased intelligence, decreased immunity, productivity, and health and mental problems. However, energy-protein deficiency can be overcome through a high-energy and protein diet therapy program by providing additional food (PMT) in the form of biscuits, but PMT biscuits often experience stock limitations so that the KEP resolution program also always fluctuates following its availability, to solve the KEP problem, there needs to be innovation in nutrition through the use of local foods such as catfish and cowpeas which are processed and presented in the form of biscuit products as additional food substitutes. This study used an experimental method with a Completely Randomized Design (CRD) consisting of 5 treatments and 4 replications, the treatments are as follows; P0; commercial food supplement biscuits (control), P1; biscuits containing 10% catfish-cowpea flour, P2; biscuits containing 20% catfish-cowpea flour, P3; biscuits containing 30% fish meal-cowpea flour, P4; biscuits containing 40% catfish meal-cowpea flour. The data were analyzed using one way-Anova statistical test and continued with the least significant difference (LSD) test using SPSS 24 software. Based on the results of statistical tests using a one-way ANOVA test at a 95% confidence level ($p < 0.05$), it shows that there is a significant difference ($p = 0.027$) in the color of the biscuits, there is a significant difference ($p = 0.020$) in the taste of the biscuits, while the texture of the biscuits shows an insignificant difference ($p = 0.094$), and the aroma of the biscuits also shows an insignificant difference ($p = 0.091$). The conclusion of this study is based on the results of the organoleptic test, this study shows the potential for using catfish flour and cowpeas as alternative raw materials to increase protein content in food products, but requires optimization in terms of consumer acceptance.

KEYWORDS: Alternative, Biscuits, Catfish Flour, Cowpeas, Supplement Food.

INTRODUCTION

Nutritional problems are public health problems, but their management cannot be done with a medical approach and health services alone. The most basic cause of dietary problems is an imbalance in the nutritional composition of the food consumed, so certain dietary deficiencies often occur, which can impact development. Protein Energy Deficiency (PEM) is one of the nutritional disorders, the highest prevalence is in toddlers, pregnant, and breastfeeding mothers. PEM sufferers have various pathological conditions due to a lack of energy and protein in varying proportions. As a result of this deficiency, PEM occurs in mild to severe degrees (Suriani, et al., 2021). Fitriani, et al. (2024), Papotot and Salendu, (2021) explain that poor nutritional status has long-term impacts that result in slowed growth and development, decreased intelligence, decreased immunity, productivity, and health and mental problems.

In children, the nutritional adequacy required per day based on age group is 6-11 months old requires 800 kcal of energy and 15 grams of protein, 1-3 years old needs 1350 kcal of energy and 20 grams of protein, 4-6 years old requires 1400 kcal of energy and 25 grams of protein (Ministry of Health Regulation, 2019). However, energy protein deficiency can be overcome through a high-energy and protein diet therapy program by providing additional food (PMT) in the form of biscuits, with the following nutritional composition; 160 calories, 3.2-4.8 grams of protein, and 4-7.2 grams of fat per 40 grams of biscuits (Ministry of Health, 2017). PMT biscuits often experience limited stock so the completion of the KEP program also always fluctuates following its availability,

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to solve the KEP problem, there needs to be innovation in nutrition through the use of local food that is processed and served in the form of biscuits products as a substitute for additional food.

Food ingredients that can be used as ingredients in making substitute biscuits are animal food in the form of catfish and vegetable food in the form of cowpeas. Catfish has a fairly good nutritional value in 100 grams, there is 113 kcal of energy, 17 grams of protein, quite complete amino acid content, especially the amino acid lysine, which is 10.15% (Mervina, 2012), calcium minerals 0.82%, phosphorus 0.29% (Primawestri, et al., (2023). The source of vegetable protein is cowpeas, of which 100 grams contain 331 kcal of energy, 24.4 grams of protein, 56.6 grams of carbohydrates, and 1.9 grams of fat (Rauf, S., et al. 2022). essential amino acids leucine 7.7 g and lysine 6.8 g (Affrifah., et al. 2022) and calcium minerals 110 mg, iron 8.3 mg, magnesium 184 mg, phosphorus 424 mg, potassium 1112 mg, 16.2 mg sodium, and manganese 1.53 mg (Wulandari, et al., 2020) so that the use of these two ingredients not only meets energy and protein needs but also meets amino acid and mineral needs.

Indicators of nutritional adequacy are eating patterns related to the level of preference and acceptability, which is a response from the nerve center to consume preferred foods continuously. Although we hypothesize that the use of both ingredients can affect the characteristics of acceptability, it needs to be proven through this experiment. The purpose of this study was to determine the acceptability (color, texture, aroma, taste) of biscuits made from wheat flour, catfish flour (Claris gariepinus), and cowpea flour (vigna unguiculata) as an alternative supplementary food for toddlers.

RESEARCH METHOD

Time and Place of Research

The research was conducted in May 2024. The research was conducted in several places, namely 1) The manufacture of flour and biscuits based on wheat flour, catfish flour and cowpea flour was carried out at the Bioscience Laboratory of Nusa Cendana University, Kupang, 2) Proximate analysis was carried out at the Laboratory of the Food and Drug Supervisory Agency (BPOM) in Kupang, 3) Organoleptic tests were carried out at the Faculty of Public Health, Nusa Cendana University, Kupang.

Type of Research

The type of research used was an experiment, using a Completely Randomized Design (CRD) with five treatments, where the control treatment (P0) was commercial food supplement biscuits, the first treatment (P1) was a 10% substitution biscuit of catfish flour and cowpea flour, the second treatment (P2) was a 20% substitution biscuit of catfish flour and cowpea flour, the third treatment (P3) was a 30% substitution biscuit of catfish flour and cowpea flour, and the fourth treatment (P4) was a 40% substitution biscuit of catfish flour and cowpea flour. Furthermore, the biscuits resulting from the substitution were subjected to proximate analysis to determine their nutritional feasibility and then continued with organoleptic testing.

Research Sample

The sample of this research is biscuits made from wheat flour, catfish flour and cowpea flour. The percentage of flour substitution is determined based on previous research with 5 treatment levels. The amount is calculated using the Fereder formula.

$(t - 1)(n - 1) \geq 15$

Description:

t: Number of treatments in the study

n: Number of repeated treatments (samples)

$(t - 1)(n - 1) \geq 15$

$(5 - 1)(n - 1) \geq 15$

$4(n - 1) \geq 15$

$4n - 4 \geq 15 = 4n \geq 19\ n = 19/4 = 4.7 - 5$

Each treatment level is repeated 5 times so that there are 25 experimental units in total. Furthermore, the completely randomized design research design can be seen in Table 1.

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Table 1. Completely Randomized Design

Type of Treatment			Replication		
Percentage Substitution	Replication 1	Replication 2	Replication 3	Replication 4	Replication 5
P0 (MT Biscuits)	P01	P02	P03	P04	P05
P1 (10%)	P11	P12	P33	P14	P15
P2 (20%)	P21	P22	P23	P24	P25
P3 (30%)	P31	P32	P33	P34	P35
P4 (40%)	P41	P42	P43	P44	P45

Description:
P0: Commercial food supplement biscuits.
P1: Substitution of catfish flour and cowpea flour 10%. P2: Substitution of catfish flour and cowpea flour 20%. P3: Substitution of catfish flour and cowpea flour 30%. P4: Substitution of catfish flour and cowpea flour 40%.

Panelist Criteria

In this study, the panelists used were those who met the following criteria:

1. 8th-semester students of the Public Health Study Program, majoring in Public Nutrition, Faculty of Public Health, Nusa Cendana University, who have sufficient basic knowledge about organoleptic testing.
2. Physically and mentally healthy and do not have sensory disorders, vision, taste and smell.

Organoleptic Assessment Work Procedure

1. Twenty-five panelists were given an explanation about the organoleptic test and a questionnaire was announced to be filled out.
2. One hundred and twenty-five (125) pieces of samples consisting of P0 (MT biscuits) 25 pieces, P1 (10% substitution) 25 pieces, P2 (20% substitution) 25 pieces, P3 (30% substitution) 25 and P4 (40% substitution) 25 pieces were prepared.
3. Samples were distributed on each panel alternately, each panel received 5 samples (P0, P1, P2, P3, P4) with 5 repetitions of each sample that had been given different codes and 1 bottle of mineral water.
4. Panelists were asked to try the samples one by one and assess the color, texture, aroma and taste of the samples.
5. Panelists were asked to write an assessment for each sample in the column listed on the organoleptic assessment form (Appendix 3) according to the code of each sample.
6. After completing the filling, the assessment form was returned to the researcher.

Data Analysis

The results of the biscuit acceptability assessment are presented in table form, then the data was analyzed using the one ANOVA statistical test with a 95% confidence level and continued with the Least Significant Difference (LSD) test to determine the real differences between treatments. Technically, data processing was analyzed using SPSS 24 software.

RESULTS

Acceptability Characteristics

Based on the results of the study in analyzing the acceptability characteristics (color, texture, aroma, taste) of biscuits based on catfish flour (clarias gariepinus) and cowpea flour (vigna unguiculata) as an alternative supplementary food for toddlers, the following table presents:

Table 4.3 Average results of organoleptic tests of biscuits based on wheat flour, catfish flour and cowpea flour

Treatment	Organoleptic Assessment			
	Color	Texture	Aroma	Flavor
P0	4.4±0,46^{b}	4.0±0,62	3.9±0,55	4.1±0,64^{ba}
P1	3.3±0,38^{a}	3.5±0,30	4.2±0,46	4.2±0,32^{ba}
P2	3.5±0,55^{a}	3.9±0,33	3.9±0,59	3.7±0,23^{a}

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P3	3.6±0,81[a]	3.6±0,87	3.0±1,07	3.0±0,23[a]
P4	4.1±0,36[ba]	4.4±0,17	3.8±0,59	4.0±0,82[ba]
LSD	< 0.05	-	-	< 0.05
P-Value	.027*	.094	.091	.020*

*Note: * has a significant effect p<0.05, Different superscripts in the same column indicate differences between treatments, MSE; mean square error*

Based on the results of statistical tests using the one-way ANOVA test at a 95% confidence level ($p < 0.05$), it shows that there is a significant difference ($p = 0.027$) in the color of the biscuits, there is a significant difference ($p = 0.020$) in the taste of the biscuits, while the texture of the biscuits shows an insignificant difference ($p = 0.094$), and the aroma of the biscuits also shows an insignificant difference ($p = 0.091$).

DISCUSSION

Color

The average level of panelists' preference for the color of the biscuits ranges from 3.3 - 4.4 (rather like-like). The highest level of color preference obtained from P0 is commercial food supplement biscuits, while the lowest level of color preference obtained from P1 is a biscuit substitute for catfish flour and 10% cowpea flour. Based on the results of the one-way ANOVA analysis, it show that there is a significant effect ($p < 0.05$) from the use of catfish and cowpea flour on the color of the biscuits. This is due to the composition of the ingredients for making biscuits which use catfish meat flour which has a brownish base color and cowpea flour which has a yellowish white base color, causing differences in the color of the biscuits produced between treatments.

The decrease in panelists' acceptance of biscuit color can be seen in Table 4.3. The results of the LSD test showed that there were significant differences in P0 - P1, P0 - P2, P0 - P3, and P1 - P4. This was due to the difference in the level of use of catfish and cowpea flour in replacing wheat flour, which caused a change in the color of the biscuits to become increasingly brownish yellow along with the increasing level of use of the two ingredients, especially during the baking process which took place at high temperatures for the ripening of the biscuits. According to Arvianto, et al., (2016), the substitution of dumbo catfish flour will cause a change in the color of the biscuits, and through the baking process at high temperatures, a reaction will occur between carbohydrates (especially reducing sugars) from wheat flour with the primary amine group, namely lysine from dumbo catfish flour which will produce increasingly brown biscuits. This reaction is called the Maillard reaction. The increasingly brown color of the biscuits will result in a decrease in the panelists' assessment of the color of the biscuits. According to Winarno (2004), the Maillard reaction is a reaction that occurs between carbohydrates, especially reducing sugars, with primary amino acid groups found in the material, which will produce a brown material called melanoidin.

The decrease in panelist acceptance of the color of biscuits obtained in this study is in line with the results obtained by Wahyu, et al., (2017) by making biscuits using 70% wheat flour, 20% catfish meat flour, and 10% pumpkin flour resulting in a panelist acceptance of the color of 3.35 and 50% wheat flour, 30% catfish meat flour and 20% pumpkin flour resulting in a panelist acceptance of the color of 2.35, but different when compared to the results obtained by Widyaniputri, et al., (2020) through making biscuits using 11% catfish flour: 6% soybean flour resulting in a panelist acceptance of the color of 5.14 and 17% catfish flour: 0% soybean flour resulting in a panelist acceptance of the color of 5.26.

Texture

The average level of panelists' preference for biscuit texture ranged from 3.5 - 4.4 (rather like-like). The highest level of texture preference obtained from P4 was biscuits substituted with catfish flour and cowpea flour 40%, while the lowest level of texture preference obtained from P1 was biscuits substituted with catfish flour and cowpea flour 10%. Based on the results of the one-way ANOVA analysis, it showed that the treatment had no significant effect ($p > 0.05$) on the aroma of the biscuits. This is because the texture of biscuits containing catfish flour and cowpea flour at different levels becomes slightly hard and crunchy due to baking using an oven. According to Aini and Wirawani (2013), crispiness is identical to fragility. According to Pratama, et al., (2014), the addition of fish flour to biscuits causes the texture of the biscuits to be more brittle compared to biscuits without modification.

The increase in panelists' acceptance of the biscuit texture at P4 can be seen in Table 4.3, but there was a decrease in P1, P2, and

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P3 compared to P0. This is because wheat flour as the main ingredient in making biscuits contains gluten. Gluten itself is a wheat protein that is insoluble in water and has elastic properties. The substitution of catfish flour causes the elastic properties of gluten to decrease, thus affecting the texture of the resulting biscuits. Although there was an increase in P4, biscuits without catfish flour substitution had the softest texture. According to Maulida (2005), the starch in wheat will coat the outside of the biscuits during the biscuit evaporation process. Steam heating causes the gluten to coagulate so that the starch melts to form a film layer that provides softness to the biscuits.

The decrease in panelist acceptance of the biscuit texture obtained in this study is in line with the results obtained by Wahyu, et al., (2017) by making biscuits using 70% wheat flour, 20% catfish meat flour, and 10% pumpkin flour resulting in a panelist acceptance of the texture of 3.55 and 50% wheat flour, 30% catfish meat flour and 20% pumpkin flour resulting in a panelist acceptance of the texture of 2.20, but different when compared to the results obtained by Widyaniputri, et al., (2020) through making biscuits using 11% catfish flour: 6% soybean flour resulting in a panelist acceptance of the texture of 5.40 and 17% catfish flour: 0% soybean flour resulting in a panelist acceptance of the texture of 6.06.

Aroma

The average level of panelists' preference for the aroma of biscuits ranged from 3.0 to 4.2 (somewhat like-like). The highest level of aroma preference obtained from P1 was biscuits substituted with catfish flour and cowpea flour 10%, while the lowest level of aroma preference obtained from P3 was biscuits substituted with catfish flour and cowpea flour 30%. Based on the results of the one-way ANOVA analysis, it showed that the treatment had no significant effect ($p>0.05$) on the aroma of biscuits. This is due to the difference in the levels of catfish flour and cowpea flour in each treatment, which causes a difference in the aroma of biscuits. According to Arvianto, et al., (2016), the aroma of fish can reduce the panelists' assessment of the aroma of biscuits, especially freshwater fish. Widyaniputri et al., (2020) added that the difference in aroma from processed food ingredients using catfish flour is caused by the fishy aroma of catfish flour not being able to completely cover the flavorings or spices.

The decrease in panelists' acceptance of the biscuit aroma can be seen in Table 4.3. The panelists' level of preference for the biscuit flavor ranged from slightly liking to liking. The panelists' level of acceptance of the biscuit aroma decreased in P3 and P4 in line with the increasing level of use of catfish and cowpea flour. This is due to the distinctive aroma of catfish meat flour in the biscuits so that the aroma is thought to be a causal factor and reduces the panelists' assessment of the aroma of the biscuits produced, in addition, the public in general is not accustomed to the aroma of freshwater fish in biscuits. According to Wahyu et al., (2017), the higher proportion of catfish flour used can cause a decrease in the panelists' level of preference for the aroma of biscuits. McClements (2019) added that the aroma of food greatly determines the deliciousness of food ingredients is related to the five senses of the nose and does not depend on sight. The decrease in panelists' acceptance of the aroma of biscuits obtained in this study is in line with the results obtained by Wahyu, et al., (2017) by making biscuits using 70% wheat flour, 20% catfish meat flour, and 10% pumpkin flour resulting in a panelist acceptance of the aroma of 2.70 and 50% wheat flour, 30% catfish meat flour and 20% pumpkin flour resulting in a panelist acceptance of the aroma of 2.65, but different when compared to the results obtained by Widyaniputri et al., (2020) through making biscuits using 11% catfish flour: 6% soybean flour resulting in a panelist acceptance of the color of 5.40 and 17% catfish flour: 0% soybean flour resulting in a panelist acceptance of the color of 5.46.

Taste

The average level of panelists' preference for the taste of biscuits ranged from 3.0 to 4.2 (somewhat like-like). The highest level of taste preference obtained from P1 was biscuits substituted with catfish flour and cowpea flour 10%, while the lowest level of aroma preference obtained from P3 was biscuits substituted with catfish flour and cowpea flour 30%. Based on the results of the one-way ANOVA analysis, showed that there was a significant effect ($p <0.05$) of the use of catfish flour and cowpea flour on the taste of biscuits. This is thought to be closely related to the aroma and texture of the biscuits produced, thus affecting the level of panelists' preference for the taste. According to Meilgaard et al. (2018), aroma is a volatile compound produced by food and can stimulate the sense of smell, which affects how food is received and enjoyed. McClements (2019) also stated that aroma plays a very important role in determining the appeal of food because it can arouse appetite and enrich the overall sensory experience. Rista, et al., (2018) added that the taste of biscuits can be influenced by the composition of the ingredients in making biscuits, as well as the aroma.

The decrease in panelists' acceptance of the taste of biscuits can be seen in Table 4.3. The results of the LSD test show that there

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are significant differences in P0 - P3, P1 - P3, and P3 - P4. This is due to differences in the level of panelists' preference for biscuits which then affect the taste of the biscuits, the level of preference aims to determine the nature or factors of taste and acceptability of food, in addition, to the nutritional components contained in biscuits also affect the taste of biscuits. According to Hamidah, et al., (2017), the taste of a food is a factor that also determines consumer acceptance. Taste is influenced by several factors, namely chemical composition, temperature, concentration, and interaction with other taste components and flavor-producing ingredients. The results obtained in this study are in line with the results obtained by Wahyu, et al., (2017) through making biscuits using 70% wheat flour, 20% catfish flour, and 10% pumpkin flour resulting in a panelist acceptance of the taste of 3.25 and 50% wheat flour, 30% catfish flour and 20% pumpkin flour resulting in a panelist acceptance of the taste of 2.10, but different when compared to the results obtained by Widyaniputri, et al., (2020) through making biscuits using 11% catfish flour: 6% soybean flour resulting in a panelist acceptance of the taste of 5.36 and 17% catfish flour: 0% soybean flour resulting in a panelist acceptance of the taste of 5.56.

CONCLUSION

Based on the results of organoleptic tests, this study shows the potential for using catfish and cowpea flour as alternative raw materials to increase protein content in food products but requires optimization in terms of consumer acceptance.

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