

The Effect of Jackfruit Seed Flour Substitution in Making Flakes as an Alternative PMT for Malnourished Toddlers

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ABSTRACT

Introduction: A state of undernourished is indicated by a body weight to height ratio (BW/BH) of -3 SD to <-2 SD on the graph. Little ones enjoy cereal called flakes because of its delightfully sweet flavor. This research objective was to determine the effect of differences in jackfruit seed flour substitution on energy and protein levels of flakes as an alternative to SF (Supplementary Feeding) for undernourished toddlers aged 24-59 months. **Method:** This research used a completely randomized design method with three treatment levels (comparison of rice flour and jackfruit seed flour), namely F0 120:0, F1 90:30, and F2 60:60. Energy analysis uses the Bomb Calorimeter method and protein analysis uses the Kjeldahl method at the Polinela Food Technology Laboratory. Data normality test using the Shapiro Wilk Test, bivariate analysis using the One-Way-Anova test. **Results:** This research shows that the more substitutes for jackfruit seed flour, the higher the energy and protein content of the flakes. The One-Way-Anova test results showed there was no real difference. **Conclusion:** The best formulation is flakes with F2 formulation and this product according to the Ministry of Health meets SF standards in terms of energy and protein.

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INTRODUCTION

Nutritional problems in Indonesia include malnutrition and overnutrition (Djauhari, 2017). Malnutrition is a condition where body weight according to length or height (BB/PB, BB/TB) is on the graph -3SD to <-2 SD (Ministry of Health, 2023). Malnutrition is caused by inadequate nutritional needs for growth and development from the food consumed (Nelista & Fembi, 2021). The prevalence of malnutrition in toddlers worldwide in 2022 is 6.8% (45 million toddlers) (UNICEF et al., 2023). Meanwhile, the prevalence of malnutrition in Indonesia based on data from the Indonesian Health Survey (SKI) in 2023 is 6.4%, and the prevalence of malnutrition in Lampung province is 5.8% (SKI, 2023). This figure has met the government's target of 7% in the 2024 National Medium-Term Development Plan (RPJMN), but toddlers who experience malnutrition, if left untreated for

too long, will result in malnutrition (Rumaseb et al., 2023). According to the Ministry of Health (2023), it is necessary to provide additional food (PMT) to deal with malnutrition in toddlers.

Providing Additional Food (PMT) is one of the supplementation strategies to overcome nutritional problems (Putri & Mahmudiono, 2020). The purpose of providing PMT to toddlers is to provide sufficient protein, vitamin, and mineral intake that is carried out in stages to achieve nutritional status optimally and with sufficient nutrient composition (Hartini et al., 2023). According to the Ministry of Health in 2016 in Widya et al. (2019), the recovery PMT provided by the government is in the form of manufactured biscuits. However, based on data from the Ministry of Health in 2017, toddlers' acceptance of biscuits was only 32.2%, mainly because toddlers felt bored, so it was necessary to provide PMT in other forms to overcome boredom in toddlers, such as flakes.

Flakes are foods originally made from whole corn kernels (corn flakes) but can be developed into innovations; they can be made from nuts, tubers, and grains, which are helpful in increasing nutritional content and consumer preferences (Hadi et al., 2017). Young children widely like flakes because they taste sweet and delicious when mixed with milk or yogurt (Putri et al., 2020). Generally, flakes on the market are only high in carbohydrates, while the protein, fiber, and antioxidant content are relatively low (Iriyani & Ayustaningwarno, 2011). One way to increase flakes' nutritional content is to add ingredients that contain high protein, such as jackfruit seed flour, so these flakes can be used as PMT for toddlers because they have high energy and protein content. The amount of jackfruit production in Indonesia, based on data in 2023 from the Central Statistics Agency (BPS), is 789,200 tons, jackfruit production in Lampung in 2023 is 4.6% (36,684.6 tons), while jackfruit production in Pringsewu in 2023 is 0.04%. Not all parts of the jackfruit are optimally utilized (Andyarini & Hidayati, 2017). Jackfruit seeds can also be processed into flour, which aims to increase storage life and the economic value of jackfruit seed waste (Andyarini & Hidayati, 2017). The nutritional content of jackfruit seeds that have been processed into flour, namely carbohydrates 82.59 gr, protein 7.28 gr, fat 0.93 gr (Liana et al., 2023).

LITERATURE REVIEW

Toddlers aged 2-5 years are susceptible to malnutrition because they have started implementing a family food diet and high physical activity (Melsi et al., 2022). Malnutrition is caused by inadequate nutritional needs for growth and development from the food consumed (Nelista & Fembi, 2021). Malnutrition risk factors include inadequate parenting and feeding patterns (exclusive breastfeeding or low quantity and quality of complementary foods), lack of environmental sanitation, and poor food security (WHO et al., 2014). Direct factors causing malnutrition include energy and protein intake (Rahman et al., 2016). Low protein intake in daily food can be a risk factor for malnutrition in toddlers because low protein intake will disrupt productivity, growth, and development (Bili et al., 2020). Low energy consumption in toddlers will also result in a risk of malnutrition 8.413 times greater than in toddlers who consume sufficient energy (Rahman et al., 2016).

One way to deal with toddler malnutrition is to provide supplementary feeding (Ministry of Health, 2023). Toddlers with malnutrition are given local supplementary feeding for 4-8 weeks (Ministry of Health, 2023). The composition of nutritional content that must be contained in additional food for toddlers is seen based on the recommendations of the Ministry of Health in 2023 in Table 1.

Supplementary feeding is given to provide a high intake of sufficient protein, vitamins, and minerals carried out in stages to achieve nutritional status optimally and with sufficient nutrient composition (Hartini et al., 2023).

Table 1. The Composition of Nutritional Content That Must be Contained in Additional Food for Toddlers

Nutrients	6 - 8 Month	9 - 11 Month	12 - 23 Month	24 - 59 Month
Energy (kkal)	175 - 200	175 - 200	225 - 275	300 - 450
Protein (gr)	3.5 - 8	3.5 - 8	4.5 - 11	6 - 18
Fat (gr)	4.4 - 13	4.4 - 13	5.6 - 17.9	7.5 - 29.4

Source: Kemenkes, 2023

Based on the Ministry of Health in 2016 in Widya et al. (2019), the provision of additional recovery food provided by the government is usually in the form of manufactured biscuits. However, based on data from the Ministry of Health in 2017, the acceptance of toddlers for biscuits was only 32.2%, most of which was because toddlers felt bored, so it was necessary to provide supplementary feeding in other forms to overcome boredom in toddlers, for example, flakes. One way to increase flakes' nutritional content is to add ingredients that contain high protein, such as jackfruit seed flour, which can be seen in Table 2, so these flakes can be used as supplementary feeding for toddlers because they have a high energy and protein content.

Table 2. Comparison of Nutritional Content of Jackfruit Seed Flour and Rice Flour

Nutrients	Jackfruit Seed Flour	Rice Flour
Protein (gr)	7.28	7
Fat (gr)	0.93	1
Carbohydrate (gr)	82.59	80

Source: Liana dkk., 2023; Rose Brand

METHOD

This type of research is experimental in the Laboratory and uses the Completely Randomized Design (CRD) method. This research was conducted in May - June 2024 and 2024. The experimental unit in this study compared rice flour and jackfruit seed flour F0 120: 0, F1 90: 30, and F2 60: 60. The experiment was carried out with two statistical replications to obtain six experimental units.

The manufacture of jackfruit seed flour refers to the research of Liana et al. (2023). namely first, the jackfruit seeds are washed, weighed 450 grams, and peeled from the outer skin and epidermis, then thinly sliced (± 3 mm) to make it easier when dried. After sorting, it is then soaked with 15% lime juice for 4 hours to inhibit the browning process (caramelization), then dried at a temperature of 700C using an oven for 2.5 hours to reduce water content, then smoothed using a blender and sieved using an 80mesh sieve.

The making of flakes refers to the research of Sabilla and Martini (2020), which was then modified with a formula that by this research, namely first rice flour is mixed with jackfruit seed flour and mixed with 20% eggs, 18% powdered sugar, 6% skim milk, 1% salt, 80% water. Then, all the ingredients are mixed and stirred using a mixer at 1 for 3 minutes. One hundred grams of dough is put into a 7x18 cm pan and steamed at a temperature of 700C for 5 minutes. Then, the dough is flattened using a pasta maker with a thickness of 2 mm. After that, the flakes are baked at a temperature of 1200C using an oven for 25 minutes.

Flake energy analysis uses the Bomb Calorimeter method, and protein analysis uses the Kjeldahl method. Then, the data from the analysis are tested for normality using the Shapiro-Wilk Test, continued using the One-Way-Anova test, and continued with the Post Hoc Duncan test if there is a significant effect ($p < 0.05$).

RESULT AND DISCUSSION

Table 3 shows that there is no effect of jackfruit seed flour substitution on flakes' energy and protein content ($p > 0.05$), so it cannot be continued with the Duncan Post Hoc test to find out more about the significant formula. The highest energy content is in the F0 formula, which is 776.51 kcal, and the lowest is in the F1 formula, which is 469.81 kcal. Moreover, the highest protein content is in the F2 treatment, which is 9.26 gr, and the lowest protein content is in the F0 treatment, which is 7.28 gr.

Table 3. The Result of One-Way-Anova Test

Parameter	The Result of Flakes's Energy and Protein Levels			p value
	Average $\pm$ SD	Average $\pm$ SD	Average $\pm$ SD	
	F0	F1	F2	
Energi	776.51 $\pm$ 10.80	469.81 $\pm$ 161.26	589.08 $\pm$ 10.50	.100
Protein	7.28 $\pm$ 0.041	8.07 $\pm$ 0.81	9.26 $\pm$ 1.29	.224

Based on the analysis results, it was found that the flakes with the highest energy content were in the F0 treatment. There was a decrease in energy content of 39.5% in the flakes treatment with 30% jackfruit seed flour substitution (F1) and a decrease of 24.14% in flakes with 60% jackfruit seed flour substitution (F2). The energy content of F1 flakes was lower than F0 because the fat content in jackfruit seed flour is lower than in rice flour. The fat content in rice flour is 1 gr/100 gr, while the fat content in jackfruit seed flour, based on Liana et al. (2023), is 0.93 gr/100 gr. This study aligns with research conducted by Aprivia (2019), which found that the highest energy content is found in pancakes without the addition of jackfruit seed flour. However, based on Table 3, the energy content of F2 is higher than F1, so it can be concluded that the energy content of flakes will increase along with the amount of jackfruit seed flour added.

Energy is a source of energy that helps the metabolic process and regulates body temperature, growth, and physical activity (Herawati et al., 2023). Low energy intake will cause the body to use lipids and proteins to produce energy so that lipids and proteins cannot perform their primary functions and cause metabolic disorders in the body so that the nutritional status of toddlers becomes abnormal (Fadlillah & Herdiani, 2020).

Based on the analysis results, it was found that the highest protein content was in the F2 treatment, which was 9.26 gr, and the lowest energy content was in the F0 treatment, which was 7.28 gr. There was an increase in protein content of 10.85% in the flakes treatment with 30% jackfruit seed flour substitution (F1) and an increase of 27.2% in flakes with 60% jackfruit seed flour substitution (F2). Based on these data, it can be concluded that the more jackfruit seed flour substitutions, the higher the protein content in the flakes. This is because jackfruit seed flour contains high protein, which is 7.28 gr/100 gr.

This study aligns with Hadi, Yusmarini, and Efendi's (2017) study that the more jackfruit seed flour added, the higher the protein content. This study is also in line with the results of Herviandri's study (2018), which found that the protein content will increase along with the amount of jackfruit seed flour added.

Protein functions to form new tissue and increase muscle mass, which can improve nutritional status (Kumala et al., 2023). Insufficient protein intake is one of the factors in malnutrition because low protein intake can cause disorders in the intestinal mucosa, which

can then cause a decrease in the immune system so that it is susceptible to disease (Bili et al., 2020).

The best result of this study was the F2 formulation (60% jackfruit seed flour); the determination of the best results was reviewed in terms of the highest protein content because protein has a function as growth, maintenance of body tissue, regulating body processes, and functioning as a source of energy (Mardalena, 2021).

F2 formulation flakes with a daily portion of 65 - 75 grams per day are recommended to overcome malnutrition in toddlers. The nutritional content of 65 - 75 grams of flakes is 6 - 7 grams of protein and 382.9 - 441.81 kcal. Flakes can be consumed 3 times daily with a weight of 20-25 grams per meal. Based on the nutritional content of F2 formula flakes with a portion of 65-75 grams per day, it is by the nutritional content requirements for PMT recovery from the Ministry of Health (2023). The limitations of this study are that the formulation is less varied and does not examine the complete proximate, so it is not known whether the decreasing nutritional content affects the decreasing energy levels of flakes. It is hoped that laboratory tests can be carried out on flakes' fat and carbohydrate levels in subsequent studies. However, when viewed from the PMT standard based on the Ministry of Health (2023), this product is sufficient by the standards.

CONCLUSION

There is no significant effect of jackfruit seed flour substitution on flakes' energy and protein content. However, there is an increase in flakes' energy and protein content, along with the amount of jackfruit seed flour added. Flakes recommended as PMT for malnourished toddlers aged 24-59 months are F2 formulation flakes with a portion of 65-75 grams per day and can be consumed 3 times per day with a weight of 20-25 grams per meal. The nutritional content of F2 flakes with a portion of 65-75 grams is to the nutritional content requirements for recovery PMT from the Ministry of Health (2023).

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