

THE BENEFITS OF FISHBEAN BISCUITS AS A LOCAL SUPPLEMENT RICH IN ANIMAL PROTEIN FOR MALNOURISHED AND STUNTED TODDLERS IN CENTRAL BENGKULU REGENCY

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ABSTRACT

Background: Stunting and malnutrition among toddlers are major public health challenges, particularly in Indonesia. One effort is the development of supplementary feeding (PMT) based on local foods, such as fish and peanut biscuits. This study aims to determine the effect of fish and peanut biscuits on toddlers' nutritional status, hemoglobin (HB) levels, and the safety of kidney function as measured by urinary protein.

Method: This study used a pre-experimental one-group pre-test post-test design involving 30 children aged 6–60 months. The intervention consisted of providing Fishbean biscuits at 50 grams/day for 40 days along with booklet-based nutrition education. Data collected included anthropometric measurements, hemoglobin levels, and dietary intake, which were analyzed using univariate and bivariate methods with the Independent Sample t-test.

Result: Providing Fishbean biscuits increased energy, protein, and fat intake, but had no effect on carbohydrate intake. This intervention effectively increased weight-for-age (BW/A), but did not show a significant effect on height (H/A), BW/H ratio, or hemoglobin levels. Furthermore, the absence of changes in urinary protein indicates that consuming Fishbean biscuits is safe for toddlers' kidney function.

Conclusion: Fish nut biscuits can be integrated into the PMT program. Exploring the long-term impact of fish nut biscuits on the nutritional status of toddlers is recommended.

Keywords: Local Supplement Rich, Animal Protein, Fishbean, Stunting

INTRODUCTION

Stunting is a nutritional status based on the height/age (PB/A) or height/age (H/A) index as measured by the child's anthropometric standards. A Z-score of <-2 SD to -3 SD is categorized as stunted, and <-3 SD is categorized as very stunted¹. Stunting is caused by insufficient nutritional intake over a prolonged period due to inadequate feeding². Reducing the prevalence of wasting and stunting in toddlers is a key target of the 2020-2024 National Medium-Term Development Plan (RPJMN)³.

The results of the 2022 Indonesian Nutritional Status Study (SSGI) explain that the prevalence of stunting in Indonesia has decreased annually. In 2021, the prevalence

reached 24.4%, but stunting remains relatively high, having not yet reached the WHO target of 20%. Bengkulu Province ranks 25th out of 34 provinces in Indonesia with a stunting prevalence of 19.8%, while Central Bengkulu Regency ranks 21.2%⁴.

Factors that cause stunting include direct and indirect causes. Direct causes include dietary intake (consumption of macro and micronutrients) and health conditions (infectious diseases)⁶. One factor influencing growth retardation in toddlers is inadequate dietary intake, including protein, energy, and zinc⁷. Protein plays a major role in the growth and development of toddlers. Increase protein intake by approximately 15% to meet the needs of rapidly growing children⁸. The contribution of protein from

animal sources as an energy source in Indonesia is still low, only around 4%⁹.

One of the causes of growth and development disorders in infants and children aged 6-24 months in Indonesia is the poor quality of breast milk substitutes (MPASI). This results in inadequate energy and micronutrient needs, such as iron (Fe) and zinc (Zn). Inadequate provision of MPASI can lead to malnutrition, which will affect infant growth and development. Conversely, providing too much or the wrong composition can lead to overweight or obesity¹⁰.

Foods derived from animal protein can accelerate growth and prevent stunting¹¹. Numerous studies have shown that supplementation can improve children's cognitive development. One effort to accelerate the growth and development of toddlers includes improving the quality of complementary foods by utilizing local ingredients, such as Fishbean Biscuits, which are made from animal protein, specifically catfish, as a PMT. A portion of fishbean biscuits is 80 grams and the frequency of PMT is 2 times/day (The nutritional composition of fishbean biscuits in 100 grams has better nutritional value, namely 485.82 kcal of energy, 15.8 grams of protein, 24.78 grams of fat, 46 grams of vitamin A, and 594 IU of vitamin A¹².

The policy of developing food security and nutrition in Central Bengkulu Regency has been implemented in accordance with the authority of the regional government. Public understanding of diverse foods in Central Bengkulu Regency is improving and requires support from universities, the business world, and the mass media. It is important to instill PMT awareness of local food consumption from an early age through life skills education on food literacy and good food consumption. This can be achieved through the promotion and improvement of local food. Housewives are the decision-makers in processing and

consuming household food, and its variety can be expected to improve. PMT provided to toddlers aims to be able to meet the nutritional needs of children and toddlers, especially those with low height (stunting). Based on the problem description in the background, Based on the above, the research problem can be formulated as follows: Is there an effect of PMT with local animal protein food, Fishbean biscuits, on stunting reduction in Central Bengkulu Regency?

METHODS

This study employed a pre-experimental one-group pre-test post-test design with an intervention consisting of providing Fishbean biscuits as supplementary feeding (BSF) at 50 grams/day for 40 days, along with nutrition education through a booklet for mothers. Intervention monitoring was conducted through daily compliance tracking, periodic visits or follow-ups, and recording by mothers using a logbook in the booklet. The study subjects were mothers and children aged 6–60 months who met the inclusion criteria: physically and clinically healthy children, no congenital abnormalities, and parents willing to participate throughout the study, with a minimum sample size of 30 participants. Measurements were taken before and after the intervention, including anthropometry (body weight using a digital scale with 0.1 kg precision, body length/height using a length board/microtoise with 0.1 cm precision), hemoglobin levels, and dietary intake (food recall). Data were analyzed using descriptive (univariate) and bivariate methods with the Independent Sample t-test to assess the effect of the intervention. The study output is an academic manuscript (policy brief).

The research flowchart is presented as follows:

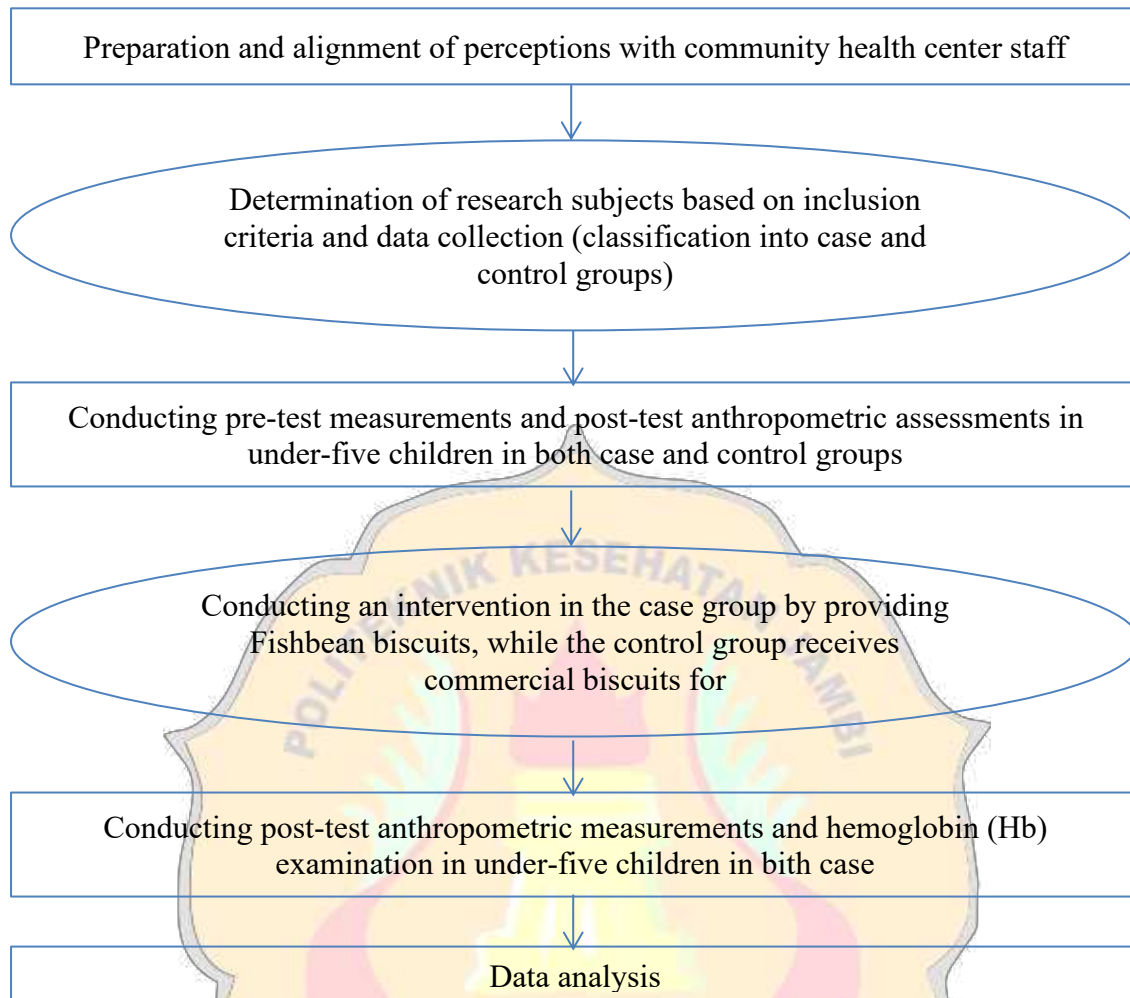


Figure 1. Research Flowcharts

Ethical approval information
 Research ethics permit at the Bengkulu
 Ministry of Health Polytechnic number
 00642/21/2024 and research permit from the
 Central Bengkulu Regency Government,
 Investment and One-Stop Integrated
 Services Office number
 070/062/IP/DPMPTSP/VII/2024.

RESULTS AND DISCUSSION

Stunting in children under two years of age can be caused by multiple factors, including socioeconomic conditions, maternal nutritional status during pregnancy, infant morbidity, and inadequate dietary intake. These contributing factors generally

occur over a prolonged period and are chronic in nature¹³. Stunting is a condition in which a child's height is shorter than that of peers of the same age. It reflects chronic malnutrition and indicates a long-term history of inadequate nutritional intake during early childhood^{14,15}. The main problems include lack of education, knowledge, and skills, unemployment, inflation, food insecurity, and poverty. Meanwhile, the root causes are economic, political, and social crises¹⁶.

The characteristics of respondents in this study include age, sex, initial nutritional status, and access to nutritious food, all of which may influence the effectiveness of the intervention. Most respondents were

children aged under 24 months, representing a critical period within the first 1,000 days of life, when adequate nutrition is essential for optimal growth and development. The distribution of sex was balanced between males and females, minimizing gender bias in the study outcomes^{18,19}. All respondents were categorized as undernourished or stunted at baseline, indicating that they were appropriate targets for nutritional intervention. Additionally, socioeconomic factors and limited access to nutritious food play an important role in shaping children's nutritional status. Therefore, interventions such as supplementary feeding using locally available, protein-rich foods like Fishbean biscuits, combined with nutrition education for mothers, are essential to support improvements in child nutrition and growth^{17,20,21}.

Tabel 1. Characteristics of Respondents in Central Bengkulu Regency

Characteristics of Respondents	n	%
Age		
< 24 months	19	63
24 months	11	37
Total	30	100
Sex		
Female	15	50
Male	15	50
Total	30	100

The first 1,000 days of life, from pregnancy to two years of age, are a critical period for growth and development. Inadequate nutrition during this time can impair optimal physical and cognitive development. For children aged 6–24 months, appropriate complementary feeding alongside exclusive breastfeeding is essential to meet nutritional needs and support brain and motor development²².

In this study, most respondents were children aged 6–60 months, a group highly vulnerable to undernutrition and stunting. This age range is crucial because it falls within the first 1,000 days of life, often

referred to as the “golden period,” during which up to 80% of brain development occurs. Therefore, proper nutritional interventions during this stage are vital to prevent stunting and improve overall nutritional status²³.

In this study, the distribution of male and female respondents was relatively balanced. Although no significant differences were found in the effect of Fishbean biscuit intervention by sex, previous research indicates that male children are generally more vulnerable to undernutrition and stunting, suggesting the need for more targeted interventions in boys²⁴.

Stunting, defined as impaired growth due to chronic malnutrition, remains a major public health problem in developing countries, including Indonesia. National data show that a significant proportion of children experience stunting, which has long-term impacts on both physical growth and cognitive development²⁵. Therefore, effective interventions during early childhood, such as appropriate supplementary feeding, are essential to prevent stunting and improve nutritional outcomes²⁶.

Although supplementary feeding (PMT) can significantly improve child nutrition, its implementation is often constrained by socioeconomic factors such as limited access to nutritious food and low household income, particularly in disadvantaged areas²⁷. Therefore, alongside PMT, community-based approaches and parental nutrition education are essential, supported by government policies that improve access for low-income families²⁵. In Central Bengkulu Regency, challenges in distributing nutritious food persist despite abundant local resources; thus, locally sourced products like Fishbean biscuits offer a practical solution. Government programs, including nutrition education, PMT distribution, and health services through

community health posts, aim to reduce stunting and improve child nutrition. Overall, appropriate PMT for children aged

6–60 months during the first 1,000 days of life is crucial to prevent malnutrition and support optimal growth and development.

Table 2. The Effect of Energy, Protein, Fat, and Carbohydrate Intake Before and After Supplementary Feeding (PMT) Intervention

Variable	n	Min-Maks	Mean±SD	p-value
Energy				
Pre	30	207,1-1333	567,6±265,3	0,001
Post	30	423,8-1524,4	683,4±290,9	
Protein				
Pre	30	6-46,9	25±9,8	0,000
Post	30	14,5-55,5	31,7±12,3	
Fat				
Pre	30	5,2-31,7	15,7±7,3	0,001
Post	30	9,1-63,8	27,8±16,7	
Carbohydrates				
Pre	30	26,6-189,6	75,5±40,9	0,124
Post	30	37,4-199,4	82,4±36	

Supplementary feeding (PMT) is essential for children aged 6–60 months to meet their nutritional needs during a critical period of rapid physical and cognitive growth. Adequate nutrition at this stage plays a key role in supporting optimal body and brain development. Conversely, undernutrition can negatively affect children's cognitive and motor abilities. Therefore, PMT helps address nutritional deficiencies by providing essential macronutrients and micronutrients needed for healthy growth and development²³.

The study showed significant improvements in energy, protein, and fat intake after the intervention, while carbohydrate intake did not change significantly. Energy intake increased to meet approximately 85–100% of daily requirements based on the 2019 Recommended Dietary Allowances for children aged 1–3 years. Protein intake also increased significantly ($p<0.05$), largely due to the contribution of animal protein from Fishbean biscuits, which provide essential amino acids important for growth and tissue repair. Fat intake improved as well, supported by healthy fat content from the biscuit ingredients. However, the increase in carbohydrate intake was not statistically

significant ($p>0.05$), indicating a lower contribution compared to protein and fat. Overall, the findings highlight the potential of Fishbean biscuits as a locally based supplementary feeding (PMT) intervention to improve the nutritional status of children in Central Bengkulu Regency.

The study demonstrates that Fishbean biscuits significantly improved energy, protein, and fat intake among undernourished children, with energy intake increasing by up to 300 kcal and helping close nutritional gaps²⁸. Animal protein from fish played a key role due to its high bioavailability and complete essential amino acids, supporting linear growth and tissue development, while increased fat intake contributed to energy density and absorption of fat-soluble vitamins. However, carbohydrate intake showed no significant improvement, likely due to the product's composition, indicating the need to combine the biscuits with staple foods to meet overall energy needs²³. The use of locally sourced ingredients highlights the potential of community-based food interventions to enhance food security and economic empowerment²⁹. As a supplementary feeding (PMT) strategy, Fishbean biscuits are effective in supporting

stunting prevention by improving nutritional status, particularly through protein and micronutrient intake³⁰. Nevertheless, challenges such as sustainability, policy support, and community involvement remain, and further research is needed to assess long-term impacts on growth, cognitive development, and micronutrient status³¹.

Biochemical assessment is used to detect nutrient deficiencies, especially in more severe cases, by measuring nutrient levels in body tissues through static biochemical tests. Functional tests can also be used to assess the physiological impact of specific nutrient deficiencies. Ideally, a combination of both methods provides a more accurate evaluation²⁰.

Table 3. Hemoglobin Levels of Under-Five Children Before and After Supplementary Feeding (PMT) Intervention with Animal Protein-Based Local Food (Fishbean Biscuits) in Stunting Prevention in Central Bengkulu Regency

Variable	n	Min-Maks	Mean±SD	p-value
Hemoglobin				
Pre	30	7,1-14,6	11,4±1,7	0,271
Post	30	8 -14,6	11,7±1,6	

Low biochemical parameters are often associated with inadequate nutrient intake. Hemoglobin, a red blood pigment composed of protein, plays a key role in transporting oxygen and carbon dioxide and is essential for children's physical growth and development²¹.

This study evaluated the effects of Fishbean biscuit supplementation on urinary protein levels and hemoglobin (Hb) in undernourished and stunted children. The results showed no significant changes in urinary protein levels ($p>0.05$), indicating that the intervention did not negatively affect kidney function and that protein intake remained within safe limits³². Similarly, hemoglobin levels showed a slight but non-significant increase (from 11.4 g/dL to 11.7

g/dL; $p=0.271$), suggesting a positive trend but insufficient evidence of a strong impact within the short intervention period. Although Fishbean biscuits provide high-quality animal protein and some iron, the duration and dosage may not have been adequate to significantly improve Hb levels, especially if baseline iron status was already sufficient or influenced by other dietary factors³³.

Overall, the findings support the safety and potential nutritional benefits of Fishbean biscuits as a supplementary feeding (PMT) intervention, particularly for improving macronutrient intake without burdening kidney function. However, longer intervention periods, larger sample sizes, and more comprehensive nutritional assessments are needed to evaluate their full impact on hemoglobin levels, micronutrient status, and long-term growth outcomes, including stunting prevention³³.

Table 4. Nutritional Status of Under-Five Children Before and After Supplementary Feeding (PMT) Intervention with Animal Protein-Based Local Food (Fishbean biscuits) in Stunting Prevention in Central Bengkulu Regency

Variable	n	Min-Maks	Mean±SD	p-value
Weight-for-Height (W/H)				
Pre	30	-4,60 - 1,35	-1,20 ± 1,45	0,203
Post	30	-4,60 - 1,42	-1,34 ± 1,40	
Weight-for-Age (W/A)				
Pre	30	-3,18 - 2,04	-1,38 ± 1,40	0,050
Post	30	-3,26 - 2,04	-1,56 ± 1,44	
Height-for-Age (H/A)				
Pre	30	-2,85 - 7,42	-0,95 ± 2,56	0,616
Post	30	-5,14 - 6,76	-1,06 ± 2,60	

The study found that the Fishbean biscuit intervention had no significant effect on weight-for-height (W/H) and height-for-age (H/A) indicators ($p>0.05$), suggesting that short-term supplementation was insufficient to influence body proportionality or linear growth, which typically require longer and more comprehensive interventions. However, weight-for-age

(W/A) showed a statistically significant improvement ($p \approx 0.05$), indicating that the intervention contributed to increased body weight relative to age. This suggests that Fishbean biscuits, which are rich in energy, protein, and fat, are effective in supporting weight gain among undernourished children²⁷.

The lack of significant changes in W/H and H/A may be due to the short duration of the intervention, small sample size, and the multifactorial nature of stunting, which involves long-term nutritional, environmental, and health factors^{27,35}. Overall, while the intervention shows promise in improving short-term nutritional status (especially body weight), longer and more comprehensive strategies are needed to achieve significant improvements in linear growth and overall stunting reduction^{29,36}.

Table 5. Urinary Protein Levels of Under-Five Children Before and After Supplementary Feeding (PMT) Intervention with Animal Protein-Based Local Food (Fishbean Biscuits) in Stunting Prevention in Central Bengkulu Regency

Variable	n	Min-Maks	Mean±SD	p-value
Urinary Protein Level				
Pre	30	-/- (Negative)	-	-
Post	30	-/- (Negative)	-	-

All samples showed negative urinary protein results both before and after the intervention, indicating no changes in urinary protein levels following supplementary feeding (PMT) with Fishbean biscuits. Since there was no variation in results, no p-value was calculated. The absence of proteinuria suggests that the intervention did not adversely affect kidney function or overall health in under-five children. Proteinuria is typically an indicator of kidney dysfunction or medical conditions such as urinary tract infections, hypertension, or diabetes;

however, none of these were observed in this study³⁷.

These findings confirm that Fishbean biscuits, which contain animal protein from local food sources, are safe and do not impose additional stress on renal function when consumed within appropriate limits. Previous studies support that increased protein intake does not harm kidney function in healthy children without underlying medical conditions. Nutritional interventions like PMT have been shown to improve nutritional status without negative effects on organ function when properly administered^{20,27}.

Although no adverse effects were observed, continuous monitoring of kidney health and other physiological parameters is recommended in long-term nutritional interventions to ensure safety. Future studies should consider longer intervention durations and evaluate additional factors such as infections, genetic predisposition, and broader metabolic indicators to comprehensively assess health outcomes^{36,37}.

CONCLUSION

The study shows that Fishbean biscuits significantly improved energy, protein, and fat intake, as well as weight-for-age (W/A) among undernourished children. However, no significant effects were observed on carbohydrate intake, weight-for-height (W/H), height-for-age (H/A), or hemoglobin levels. The intervention was also found to be safe, as it did not affect urinary protein levels or kidney function. Overall, Fishbean biscuits have potential as a local, animal protein-based supplementary food to improve nutritional status, particularly body weight, in under-five children.

It is recommended to extend the duration of the intervention to better assess long-term effects on growth indicators.

Fortification with iron or combination with iron supplementation should be considered to improve hemoglobin levels. Nutrition education for families and improved access to nutritious foods are essential to support sustainable outcomes. Further research with larger samples and longer follow-up is needed to evaluate broader impacts on micronutrient status and child development.

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