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Effect of ikametebiwawo bars as an alternative high protein supplement on the nutritional status of stunting toddlers

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Abstract

Ikametebiwawo bars are complementary foods made from local food typical of West Nusa Tenggara which contains essential amino acids as an alternative food for stunting toddlers. This study aimed to analyze the effect of giving ikametebiwawo bars as an alternative high-protein supplement to the nutritional status of stunted toddler. It is a healthy soft bar with the local food as primary raw materials such as mackerel fish, red beans, soybean tempeh, sweet potatoes, pumpkin (yellow pumpkin), and carrots. This study used a pre-post quasi-experimental design with a non-equivalent control group design. The subjects of this study were 20 toddlers who were divided into 2 groups consisting of 10 stunted toddlers in the intervention group and 10 toddlers with normal nutritional status in the control group. The food bar for this intervention was 40 g/day with an intervention duration of 90 days. Paired t-test was used to test the mean difference before and after the intervention. There was a significant effect of giving Ikametebiwawo Bars to stunting toddlers with an increase in serum albumin ($p = 0.007$), body weight ($p = 0.025$), and height ($p = 0.048$), while there was no effect on lymphocyte levels ($p = 0.075$) and hemoglobin levels ($p = 0.068$). Ikametebiwawo bars administration had a significant effect on increasing serum albumin, height and weight. The author recommends ikametebiwawo bars as an additional food high in amino acids to overcome stunting problems in toddlers.

1. Introduction

Stunting is one of the most significant barriers to development. Children under 5 years of age who are stunted have twice the cognitive scores, much lower than children who have never been stunted (Alam *et al*., 2020). In addition, stunting also has an impact on linear growth failure. It is a marker of various pathological disorders associated with loss of physical growth potential and an increased risk of chronic disease in adulthood (de Onis and Branca, 2016).

Globally stunting affects about 149.2 million children under the age of 5, mainly in low and middle-income countries (World Health Organization [WHO], 2020). Indonesia is one of the middle-income countries that have a severe stunting problem. Based on the Indonesian Nutrition Status Study results in 2021, the national stunting rate decreased by 1.6% per year from 27.7% in 2019 to 24.4% in 2021 (Kemenkes RI, 2021). West Nusa Tenggara is one of the provinces with a very high prevalence. In 2018 this province had a prevalence of 33.48%, much higher than the national average (Kemenkes RI, 2018).

Stunting is one of the nutritional problems caused by a lack of long-term nutrient intake (Domili, Ruhmayanti, Tumenggung *et al*., 2020). One of the factors is quality protein intake. The quality of protein is determined by the quality of the food provided. Previous studies have shown that good-quality protein can increase stunting children's growth (Tessema *et al*., 2018). Mackerel is an animal food source that has good quality protein. Previous research found that floured mackerel has good protein quality standards based on fish meal standards in Indonesia which are registered with the Indonesian National Standard number (SNI) 2715:2013 (Domili, Labatjo, Ntau *et al*., 2020).

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Mackerel is a protein source with high essential amino acids (Aspevik *et al*., 2021). In addition, the use of various types of local food (diversification) from cereals, tubers, legumes (nuts), and fish will be able to complement each other (complementation) the composition of essential amino acids. The concept of diversification and complementation of various types of local food ingredients such as cereals, tubers, legumes (nuts), and fish will be able to produce food products containing essential amino acids with a protein score of at least 75 (eggs reference from the Food and Agriculture Organization of the United Nations (FAO) (2017). In Indonesia, food products commonly developed are in the form of 'Supplementary Food Provision' known as 'Pemberian Makanan Tambahan' (PMT) in Bahasa Indonesia.

Giving additional food to toddlers can increase nutrient intake, significantly improving the nutritional status of children (Masuke *et al*., 2021). Previous studies have shown that the provision of various complementary foods in the form of animal protein, especially fish combined with cereals and nuts, has a significant effect on improving stunted children's nutritional status (Soesanti *et al*., 2020). Toddler supplementary food products that are currently being developed to improve the nutritional status of stunted toddlers are still limited to biscuits and cookies (Irwan *et al*., 2020). Therefore, the authors developed additional food products in local food-based food bars for stunting toddlers intervention. Ikametebiwawo bars are a food bar product in the form of soft bars due to our research formulated using local food ingredients high in essential amino acids, namely mackerel fish meal, red bean, tempeh flour, sweet potato flour, pumpkin flour, and carrot flour. The purpose of this study was to analyze the effect of giving ikametebiwawo bars as an alternative high protein supplement to albumin levels, increasing body weight and height of stunted toddlers.

2. Materials and methods

2.1 Study design and setting

This study was conducted in the working area of the Twin Bridge Health Center, West Lombok Regency, West Nusa Tenggara Province. This study used a pre-post quasi-experimental design with a non-equivalent control group design. The study was conducted in June-November, 2017. The study began with a physical examination and measurement of nutritional status with the help of medical personnel (doctors) and nutrition staff at the Jembatan Kembar Health Center. The research subjects were children aged 3-5 years who experienced stunting (Z score: < -2SD) as the treatment group and children aged 3-5 years with normal nutritional status as the control group. The inclusion criteria of research subjects were not having a chronic disease, not having heart or liver disorders, not currently undergoing similar nutritional intervention, and being willing to be involved in this study by consuming ikametebiwawo bars for 90 days. The minimum number of subjects was determined by the following formula (Lemeshow *et al*. 1990):

$$n \geq 2\,(\sigma/\delta)^2\,(Z_{1-\alpha}+Z_{1-\beta})^2$$

Where n = number of subjects, $Z_{1-\alpha}$ = Z value in the two-tailed test with a significance level of (α) 5% = 1.96, $Z_{1-\beta}$ = Z value on test power 1 – β = 0.842, σ = standard deviation (plasma albumin): 0.15, δ = mean value of increase (plasma albumin) between before and after intervention: 21.4% (Hearst *et al*., 2014).

Based on the calculation results, the minimum number of subjects was 7.69 = 8 people, plus 20% reserves; it took 10 stunted toddlers as a treatment group and 10 toddlers with normal nutritional status as a control group. Subjects were selected using a purposive sampling method according to the inclusion criteria.

2.2 Ethical approval

In carrying out this research, we received ethical approval from the Health Research Ethics Commission, Faculty of Medicine, University of Mataram, West Nusa Tenggara. The ethical approval is based on Review Decision No: 176/UN18.8/ETIK/2017.

2.3 Biscuit supplementation

Ikametebiwawo bars are a food additive specially formulated to provide additional energy and nutrients that are lacking or only available in limited quantities in the daily diet (Figure 1). Supplementation can be given in various forms, such as food bars. All age groups, especially toddlers, usually like food bars; then, to achieve good nutritional quality, food bars must meet standards and increase functional value (Widodo *et al*., 2016). The composition of food bars must contain various ingredients with good nutritional value. The local food ingredients used to develop ikametebiwawo bars consist of sweet potato flour, mackerel fish meal, tempeh flour, red bean flour, pumpkin flour, carrot flour,

Figure 1. Ikametebiwawo bars.

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margarine, eggs, sugar, and salt. The food bar formula refers to the findings of Darawati *et al*. (2021). Proximate and amino acid analysis was carried out at the PAU UGM Laboratory, LPPT UGM. The total microbial analysis was carried out at the Chemical Laboratory, Department of Health Analyst, Poltekkes, Ministry of Health, Mataram.

The laboratory analysis results showed that ikametebiwawo bars (in 100 g) contain nutrients as seen in Table 1. As an additional food, the subjects were given 40 g of ikametebiwawo bars every day (containing 188.31 kcal energy and 6.27 g of protein). This contribution can meet 15.06% of children's energy needs and 17.941% of children's protein needs (Kemenkes RI, 2019). The essential amino acid content of ikametebiwawo bars is presented in Table 2.

Table 1. Ikametebiwawo bars contain nutrients in 100 g.

Nutrients	Content
Energy	470.77 kcal
Protein	15.65%
Fat	24.13%
Carbohydrates	47.74%
Ash	2.14%
Water	10.33%

Table 2. The essential amino acid content of the intervention product food bar.

No.	Essential amino acid	Value (mg/kg)
1	L-Histidine	6.52
2	L-Lysine	11.46
3	L-Phenylalanine	3.34
4	L-Isoleucine	3.94
5	L-Leucine	5.24
6	L-Methionine	223.70
7	L-Valine	4.67
8	L-Cysteine	62.10
9	L-Threonine	3.12
10	L-Tyrosine	5.20

2.4 Data collection and measurements

All participants were research subjects, and anthropometric nutritional assessments were carried out: measurements of weight and height before and after the intervention, which trained and experienced field nutritionists carried out. Anthropometric data on body weight used a Camry digital stamping scale with an accuracy of 0.5 g by weighing the child without wearing any clothes. Height was measured using a rigid height board (Seca 417) with an accuracy of 0.1 cm. Data on food bar consumption was obtained from a monitoring form that contained the number of ikametebiwawo bars received, consumed, and not consumed. A total of six packs of ikametebiwawo bars were distributed to children every week, and each package contained 2 ikametebiwawo bars (40 g). Data on albumin levels, lymphocyte levels, and Hb levels of toddlers were obtained before and after the intervention. The equipment used is a 1 mL syringe and a 0.5-micron syringe. Blood serum was taken from venous blood as 2-4 mL. Blood collection was carried out by laboratory staff of the Health Analyst Poltekkes, Ministry of Health, Mataram.

2.5 Statistical analysis

Univariate analysis was used to analyze the characteristics of the subjects carried out using an unpaired t-test. Data processing and analysis were carried out using SPSS 25 for Windows. Data analysis was carried out descriptively and inferentially using a significance level of 0.05. The mean difference between before and after the intervention was analyzed using a paired t-test.

3. Results

Based on the characteristics of the subject, it can be seen that based on the characteristics, gender, mother's education, and parents' occupations, there was no significant difference between the stunting group and the normal group. However, the subjects' blood type and mean age showed a significant difference in contrast. The subject characteristics are listed in Table 3.

Table 3. Distribution of respondents based on characteristics.

Characteristics	Subject groups				P-value
	Stunting		Normal		
	n	%	n	%	
Gender:					
Male	3	30	4	40	0.083
Female	7	70	6	60	
Mother's education:					
Primary school	3	30	2	20	0.061
Junior high school	1	10	2	20	
Senior high school	5	50	6	60	
College	1	10	-	-	
Parent's occupation:					
Laborer	4	40	1	10	0.056
Private	6	60	8	80	
Civil servant	-	-	1	10	
Blood type:					
A	4	40	2	20	
B	2	20	5	50	0.049
AB	-	-	1	10	
O	4	40	2	20	
Average age (months)	44.3±9.6		45.8±7.4		0.035

Based on the data in Table 4, the mean albumin level

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of the stunting group before the intervention was 14.90% lower than the normal group. After the intervention, subjects with stunting experienced an increase in plasma albumin levels by 13.61%. The statistical test results showed that the plasma albumin levels before and after the intervention were significantly different (P<0.05). Meanwhile, in subjects with normal nutritional status, the difference in plasma albumin levels before and after the intervention was not significantly different (P>0.05). It showed that the intervention with food bar additives had increased plasma albumin levels in stunted toddlers.

Table 4. The average value of plasma albumin levels of subjects before and after intervention.

Subject groups	Food Bar Intervention		P-value
	Before	After	
The average value of plasma albumin level (g%)			
Stunting	4.00±0.40	4.63±0.19	0.007*
Normal	4.71±0.17	4.69±0.15	
The mean value of blood lymphocyte levels (10^3/µL)			
Stunting	4.52±1.26	4.12±1.10	0.075
Normal	4.02±0.90	3.77±0.82	
The average value of Hb levels (g/dL)			
Stunting	11.26±0.95	11.64±0.09	0.068
Normal	11.34±0.68	11.70±0.08	

The subjects' blood lymphocyte levels decreased after the intervention, both in the stunting and normal groups. Before the intervention, the mean blood lymphocyte level of stunting subjects was 10.99% higher than normal subjects. Meanwhile, after the intervention, the mean blood lymphocyte level of stunting subjects was 8.47% higher than normal subjects. Blood hemoglobin levels after the intervention tended to increase in both the stunting and normal groups. The statistical tests showed no significant difference in blood Hb levels before and after the intervention, both in stunting and normal subjects (P>0.05).

Table 5 shows a higher body weight and height increase in stunting subjects than in normal subjects. This indicated a positive tendency to catch up with growth. The statistical test results showed a significant difference in the weight and height, before and after the intervention, both in the stunting and normal subjects (p<0.05).

4. Discussion

Stunting is one of the nutritional problems that are still high in Indonesia. There are twenty predictors of stunting problems, including inadequate nutrient intake; macronutrient intake is a significant determinant in feeding stunting toddlers (Mulyaningsih *et al*., 2021). Previous studies have shown that stunted children have low protein intake (Domili, Ruhmayanti, Tumenggung *et al*., 2020; Rahayu *et al*., 2020). Stunting toddlers need to consume quality protein to improve their nutritional status. Quality protein generally comes from animal food sources such as fish. In addition, foods derived from various types of local food ingredients such as cereals, tubers, legumes (nuts), and fish will be able to produce food products that contain high essential amino acids (FAO, 2017). Food products that are commonly developed to improve the nutritional status of stunted toddlers are usually in the form of biscuits and cookies (Irwan *et al*., 2020). There is a need for renewal and modification in developing additional food products rich in amino acids to improve the nutritional status of stunted toddlers, such as food bars. Ikametebiwawo bars is a food bar based on local food that can be used as additional food for toddlers because it has a texture similar to biscuits (Diana *et al*., 2021).

Supplementary feeding is one way to improve the nutritional status of stunted toddlers. This is because parents do not have a good income to provide the best food for their children (Bustami and Ampera, 2020). With good food processing technology, many processed fish are used as additional food for toddlers with high nutritional content. Previous studies have shown that consuming biscuits with the formula of green beans and fish for 4 weeks can improve the nutritional status of children with Z-score (BB/U) stunting children. This is supported by the research of Herawati *et al*. (2020), which showed that giving eel biscuits for 3 months increased the high nutritional status of stunted children (Herawati *et al*., 2020).

Albumin is a major serum protein with several critical physiological functions, including maintenance of colloid osmotic pressure, binding of various compounds, and providing most of the antioxidant activity of plasma (Levitt Levitt, 2016). Research conducted by Hearst *et al*. (2014) found that blood albumin levels in stunted children were 21.4% lower

Table 5. Average weight and height of subjects before and after intervention.

Anthropometry	Subject groups						p
	Stunting			Normal			
	Before intervention	After intervention	Difference	Before intervention	After intervention	Difference	
Body weight (kg)	11.89±1.74	12.67±1.84	0.8±0.29	14.23±2.10	14.94±2.04	0.7±0.28	0.025
Height /body length (cm)	89.54±5.94	90.89±5.71	1.35±0.69	100.54±5.94	101.34±5.77	0.8±0.35	0.048

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than those with normal nutritional status. Lower albumin levels in stunting subjects indicate that protein availability in the body plays a vital role in the growth process (Hearst *et al*., 2014). This was supported by research by Abdullahi *et al*. (2018), who showed that stunting toddlers have lower serum albumin than normal toddlers (Abdullahi *et al*., 2018). This study showed that the administration of ikametebiwawo bars significantly increased serum albumin levels in the intervention group. These results are consistent with a previous study; giving additional food in blondo-based biscuits, snakehead fish, and brown rice for 90 days can significantly increase albumin levels in stunting toddlers (Widodo *et al*., 2016).

Lymphocytes are white blood cells that maintain immunity against foreign substances, such as bacteria, viruses, and even cancer cells (Larosa and Orange, 2008; Cooper and Miller, 2019). Lymphocytes are essential in fighting infection (Olsen Saraiva Camara *et al*., 2012). This study showed no significant effect of giving ikametebiwawo bars to increase lymphocyte levels in both groups. This was different from previous studies, which showed that supplementary feeding based on animal foods such as milk could increase lymphocyte levels and affect the linear growth of stunted toddlers (Millward, 2017). Stunting toddlers have low lymphocyte levels, affecting the immune system (Rytter *et al*., 2014). Low lymphocyte levels are associated with a decrease in the immune system, making it easier for infectious diseases to enter the body (Bourke *et al*., 2016).

Giving ikametebiwawo bars significantly affects the nutritional status of stunting toddlers, evidenced by an increase in body weight in both groups, especially the intervention group. Previous studies have shown that consuming biscuits with mung bean and fish formula for 4 weeks can increase the bodyweight of stunting toddlers (Widodo *et al*., 2016; Iskandar, 2017). In addition, giving ikametebiwawo bars for 2 months can also increase height. Previous studies showed that supplementary feeding in the form of fish-based products such as eel biscuits could significantly increase stunting toddlers' height (Widodo *et al*., 2016; Herawati *et al*., 2020). The provision of additional food is important for stunting toddlers to improve their nutritional status. This is supported by the initiation of additional food, frequency of additional feeding, consistency, or type of supplementary food (Marfianti *et al*., 2017).

5. Conclusion

Interventions with additional food in the form of food bars have been proven to increase plasma albumin levels in stunted toddlers. This intervention contributed to the weight and height of toddlers in both the stunting and normal groups. Ikametebiwawo bars, from local food ingredients as an intervention product, have the potential to be developed as an alternative food additive for stunting toddlers. This study implies that it is necessary to study the method of community empowerment for the development of this food bar product.

Conflict of interest

The authors declare no conflict of interest.

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