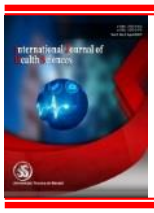

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Development of Products Based on Ke-Kame-Tu Formula for PMT at Posyandu as an Effort to Prevent Stunting

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Keywords

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Abstract

The "ke-kame-tu" formula is a mixture of Moringa leaf flour, red bean flour and tuna fish meal, with high protein, zinc, calcium, phosphorus and magnesium content. The specific aim of the research is to analyze the proximate content, amino acids, zinc, calcium, phosphorus and magnesium of supplementary feeding nugget products, and determine the most preferred supplementary feeding products. The “ke-kame-tu” formula (15-60-25) and supplementary feeding products were made using a randomized block design. Taste data was obtained using organoleptic tests. Analysis of calcium, phosphorus and magnesium using spectrophotometric methods. To determine the best supplementary feeding product, a diversity analysis (Anova) of organoleptic test results was carried out. The ke-kame-tu formula (15-60-35) contains 4.39 mg/100g of calcium, 530 mg/100 g of phosphorus, 80 mg/100 g of magnesium, 1.65 mg/100 g of zinc, and protein as much as 16.81%. In general, nuggets made using a modified recipe by adding to-kame-tu formulas with different concentrations have different nutritional content, namely increasing calcium, phosphorus, magnesium and protein content. Based on organoleptic tests, it was found that nugget products with N3 treatment were the preferred product compared to other treatments. This supplementary feeding product uses the addition of 100 grams of the second formula. This nugget product is very likely to be used as a substitute for supplementary feeding in integrated service post (In Indonesia it is known as posyandu) activities.

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Contents

1 Introduction

The still high problem of stunting in Indonesia, including in Bali Province, is a nutritional problem that can result in low quality of human resources. The latest data for 2022 nationally shows stunting data at 21.6% and for Bali Province at 8.0% (SSGI, 2022). Presidential Regulation of the Republic of Indonesia Number 72 of 2021 concerning the acceleration of stunting reduction mandates that in order to achieve the national target for stunting prevalence, an intermediate target must be achieved at l4% (fourteen percent) by 2024. The direct cause of stunting in toddlers is inadequate nutritional needs, especially nutrients that function for growth and development. These nutrients include protein, zinc, calcium, phosphorus and magnesium (Mataram, 2017; Almatsier, 2009; Unicef, 1997). Toddler Supplementary Food is nutritional supplementation in the form of additional food in the form of biscuits with a special formulation and fortified with vitamins and minerals given to babies and toddlers aged 6-59 months in the underweight category to meet nutritional needs (Indonesian Health Ministry, 2017).

An activity that is routinely carried out at integrated service post (in Indonesia known as posyandu) activities is providing supplementary feeding to toddlers. The distribution of supplementary feeding goes through the center to the puskesmas and continues to the posyandu. The costs required to procure supplementary feeding are quite large, but there has been no specific study regarding the effectiveness of supplementary feeding. The provision of additional food which is carried out independently at each posyandu still varies according to the availability of funds. The supplementary feeding given can be fresh fruit, green bean porridge, boiled eggs, pudding, UHT milk, and so on (Nicotera & Orrenius, 1998; Clapham, 1995).

To increase the variety of supplementary feeding, in this research a product will be developed that contains nutrients high in protein, zinc, calcium, phosphorus and magnesium. One of the basic ingredients of this product uses a ke-kame-tu formula which contains nutrients, namely a) Zinc content ranging from 17.28% (F6) to 23.87% (F1), b) Protein content ranging from 16.49 % (F6) up to 26.97% (F2), c) Fat content ranges from 4.20% (F1) to 5.93% (F5). The ke-kame-tu formula contains complete essential amino acids and the limiting amino acid is methionine, so it can guarantee the growth and maintenance of the toddler's body (Mataram & Kayanaya, 2021).

Toddlers who come to the posyandu from an early age can be given supplementary feeding based on this "ke-kame-tu" formula so that their nutritional needs, especially protein, zinc, calcium, phosphorus and magnesium for growth, can be met. The toddler's growth and development process will be more optimal if the nutritional needs, especially protein, zinc, calcium, phosphorus and magnesium, are met during the toddler period. The results of this research are a product in the form of snacks for toddlers as an effort to meet their body's nutritional needs. The nutritional content of the product, especially protein, zinc, calcium, phosphorus and magnesium, will help fulfill the nutritional needs of toddlers. The expected final impact is optimal nutritional needs, optimal growth so that nutritional problems, especially stunting, can be avoided (Pfitzenmeyer et al., 2007; Barone et al., 2021).

The general aim of the research is to develop a nugget product based on the Ke-Kame-Tu formula for supplementary feeding in Posyandu as an effort to prevent stunting. Specifically, the aim of the research is to create a "ke-kame-tu" formula (15-60-25), make a supplementary feeding product based on the ke-kame-tu formula, analyze the proximate, amino acid, zinc, calcium, phosphorus and magnesium content of the product. PMT, determines the preferred supplementary feeding product based on organoleptic tests by trained panelists (Suriani et al., 2021; Chang, 2007).

2 Research Methods

Research design on making the ke-kame-tu formula with a ratio of Moringa leaf flour, red bean flour and tuna flour: 15:60:25; with 3 repetitions (Mataram & Kayanaya, 2021). The manufacture of supplementary feeding products uses a randomized block design with 5 treatments and 3 replications so that the research units total 15 units, as follows:

Table 1
Manufacture of supplementary feeding products

PMT FORMULA	MATERIAL											
	Formula ke-kame-tu (g)	Flour (g)	Minced chicken (g)	chicken eggs (g)	Milk (ml)	White bread (g)	Carrot (g)	Lei leaves (g)	Garlic (g)	Pepper (g)	Salt (g)	Sugar (g)
A	50	100	600	50	100	30	100	50	10	1	1	10
B	75	100	600	50	100	30	100	50	10	1	1	10
C	100	100	600	50	100	30	100	50	10	1	1	10
D	125	100	600	50	100	30	100	50	10	1	1	10
E	150	100	600	50	100	30	100	50	10	1	1	10

The taste, which includes flavor, aroma, color, texture and overall taste, is obtained using organoleptic testing, using 30 trained panelists. Analysis of amino acids, zinc, calcium, phosphorus and magnesium using the spectrophotometric method and HPLC/AAS, proximate analysis using the titration method (Sudarmadji, 2000; Ganjar & Rohman, 2012). To determine the best supplementary feeding product, a diversity analysis (Anova) of organoleptic test results was carried out (Arikunto, 2010; Daniel, 1978). Ethical approval was issued by the Denpasar Ministry of Health Health Research Ethics Commission with Number LB.02.03/EA/KEPK/ 0644 /2023 dated June 21 2023 (Onuchic & Wolynes, 2004; Tanford, 1968).

3 Results and Discussions

Formula ke-kame-tu (15-60-25)

The ke-kame-tu formula in this research is based on the results of research in 2022, namely a mixture of moringa flour (15%), red bean flour (60%) and tuna flour (25%) so this formula is named the "Ke-Kame-Tu" formula. " (15-60-35) (Mataram & Kayanaya, 2021).

Supplementary Feeding Products Made from Ke-Kame-Tu Formula

The product made is a nugget with the addition of the second formula according to the treatment. The process of making nuggets is that all ingredients including ground chicken, milk, white bread, formula and spices are mixed using a blender (Table 1). Making supplementary feeding products in the form of nuggets using the ke-kame-tu addition treatment with different concentrations, namely in the N1 treatment 50 grams were added to the ke-kame-tu, in the N2 treatment 75 grams were added to the ke-kame-tu, in the N3 treatment they were added to the ke-kame-tu. tu as much as 100 grams, N4 treatment added to ke-kame-tu as much as 125 grams and treatment N5 added to ke-kame-tu as much as 150 grams. The difference in the addition of ke-kame-tu between treatments from N1 to N5 was 25 grams, while the use of other ingredients was the same weight (Table 2).

Tabel 2
Formula Supplementary Feeding Nugget

MATERIAL	FORMULA SUPPLEMENTARY FEEDING NUGGET				
	N1	N2	N3	N4	N5
Ke-kame-tu (g)	50	75	100	125	150
Minced chicken (g)	600	600	600	600	600
White bread (g)	60	60	60	60	60
Milk UHT (ml)	200	200	200	200	200
White bread (g)	20	20	20	20	20
Flour (g)	20	20	20	20	20
Tapioca flour (g)	20	20	20	20	20
Chicken eggs (btr)	1	1	1	1	1
Carrot (g)	100	100	100	100	100
Lei leaves (g)	50	50	50	50	50
Seasonings (garlic, salt, sugar, chicken stock powder, pepper)	necessary	necessary	necessary	necessary	necessary

Proximate Content, Zinc, Calcium, Phosphorus, Magnesium and Amino Acids Ke-Kame-Tu Formula Ingredients and Nugget Products

The content of the formula ingredients is that the highest calcium is found in red bean flour, namely 12.1343 mg%, the highest phosphorus content is found in tuna fish meal, namely 723 mg%, the highest zinc content is found in red bean flour, namely 2 .51 mg%, the highest protein is found in red bean flour, namely 33.42 mg%. The ke-kame-tu formula (15-60-35) contains 4.39 mg/100g of calcium, 530 mg/100 g of phosphorus, 80 mg/100 g of magnesium, 1.65 mg/100 g of zinc, and protein as much as 16.81% (Table 3).

Table 3
Nutrient Content of Ingredients and Formula

Nutrients	Moringa Flour	Red Bean Flour	Tuna Flour	Formula Ke-kame-Tu
Calcium (mg/100 g)	1890	18.79	9.71	4.39
Phosphor (mg/100 g)	420	440	730	530
Magnesium (mg/100 g)	450	90	50	80
Zinc (mg/100 g)	2.56	3.19	1.12	1.65
Protein (%)	17.59	16.71	16.65	16.81
Fat (%)	7.59	1.79	2.48	4.37
Ash (%)	7.86	5.49	6.26	5.26
Water (%)	9.79	9.58	11.98	9.52

Nutrient Content of Supplementary Feeding Nugget

Nuggets made using a modified recipe by adding the ke-kame-tu formula have the following nutritional content: the lowest calcium content is N1 (68.98%) and the highest is N5 (132.58%); the lowest phosphorus content was in N1/N2 (146.0%) and the highest was in N5 (173.0%); the lowest magnesium content was in N1 33.35%) and the highest was in N5 (43.46%); the lowest zinc content was in N4 (2.89%) and the highest was in N2 (3.39%); The lowest protein content was in N3 (8.377%) and the highest was in N5 (10.29%). In general, it appears that with the increase in the number of second formulas, the nutritional content is also different, namely the calcium, phosphorus, magnesium and protein content increases (Table 4).

Table 4
Nutrient Content of Supplementary Feeding Nugget

Nutriens	N1	N2	N3	N4	N5
Calcium (mg/100 g)	68.98	87.89	119.3	125.79	132.58
Phosphor (mg/100 g)	146.66	146.66	156.66	153.33	173.33
Magnesium (mg/100 g)	33.35	34.94	39.97	40.94	43.46
Zinc (mg/100 g)	3.13	3.39	2.89	2.76	2.90
Protein (%)	8.57	8.61	8.37	8.54	10.29
Fat (%)	2.53	2.09	2.38	1.94	2.68
Ash (%)	1.39	1.40	1.40	1.55	1.85
Water (%)	62.93	59.92	59.08	60.587	58.87

When consuming 100 grams of N3 nuggets, you will be able to meet the nutritional needs of toddlers aged 1-3 years as follows: 18.37% calcium, 34.05% phosphorus, 61.49% magnesium, 96.33% zinc and protein as much as 41.85%. Calcium is one of the minerals needed by the body to help the process of forming bones and teeth (Mandal, 2019; Shita et al., 2015; Newman, 2020). Phosphorus is the main component of bones and one of its functions is to keep bones and teeth strong (Greenwood & Earnshaw, 1997). Magnesium plays a role in supporting the formation of energy and protein in the body. Proteins are composed of a number of amino acids using information encoded in genes. Each protein has its own unique amino acid sequence determined by the nucleotide sequence of the gene coding for this protein (Maret, 2005; Mocchegiani et al., 2006).

Structural proteins provide hardness and rigidity to fluid biological components. Most structural proteins are fibrous proteins; for example, collagen and elastin are important components of connective tissue such as cartilage, while keratin is found in hard or filamentous structures such as hair, hooves, feathers, hooves, and some animal shells (Mathews, & Holde, 1996). Protein plays a very large role in the body's metabolic processes, especially in the formation of new cells to replace damaged cells. Other functions of proteins are: 1) As enzymes, 2) Transport tools (transport proteins), 3) Movement regulators (contractile proteins), 4) Tissue builders (structural proteins), 5) Reserve proteins. 6) Antibodies (antibody proteins), 7) Reaction regulators (regulatory proteins), 8) Growth controllers (Abdillah, 2018).

The function of amino acids is influenced by the type of amino acid itself, including: 1) Composing proteins or polypeptides in the body, 2) Supporting the metabolic reactions of body cells. Helps carbohydrate metabolism and protein metabolism. Composes several important compounds such as adrenaline, melanin, histamine, pophyrin, hemoglobin, purine, choline, vitamins, and others, 3) Forms and increases muscle mass (Glutamine) As a protein building substance (Lysine), 4) Repairing liver damage and maintaining healthy nerves (Leucine, Valine, and Isoleucine), 5) Improving mental health such as depression, and helping neurotransmitter synthesis (Phenylalanine), 6) Helping cysteine synthesis and burning fat (Methionine), 7) Maintaining healthy joints and treating arthritis (Histidine), 8) Producing lymphocytes, increasing body immunity, accelerating health recovery, and increasing growth hormones (Lysine and Arginine).

By paying attention to the nutritional content of these nuggets (Table 3), it is very possible to use them as PMT in posyandu activities. Providing supplementary feeding if applied to children under five in their respective homes will be able to help meet the nutritional needs of toddlers. Consuming staple foods by paying attention to the principles of a balanced nutritional menu for toddlers will better ensure that toddlers' consumption levels are met. The expected impact is that toddlers will experience a period of optimal growth and development so that indirectly the problem of stunting can be prevented or overcome. The application of providing these nuggets as a substitute for supplementary feeding in posyandu activities will greatly help achieve the prevalence of stunting nationally to 14% in 2024 and in Bali to 6%.

Sinta et al. (2019) made nuggets with the addition of skimmed milk powder and obtained results that had a significant effect on the quality of the organoleptic test and the level of preference for broiler chicken nuggets with the best treatment was P1 with the addition of 5% (Sinta et al., 2019). The ke-kame-tu formula ingredients consisting of moringa flour, red bean flour and tuna fish meal contain complete essential amino acids. This will really help the growth and development of toddlers to achieve optimal nutritional status. The limiting amino acid in moringa flour, red bean flour and tuna flour is methionine (Table 5).

Table 5
Amino Acid Content of Formula Ingredients

AMINO ACID	MORINGA FLOUR (%w/w)	RED BEAN FLOUR (%w/w)	TUNA FLOUR (%w/w)	FORMULA (%w/w)
Essensial Amino Acid				
Histidine	0.98	1.00	4.59	1.87
Iso Leusine	1.78	1.05	3.94	1.92
Leusine	3.22	1.88	6.91	3.38
Lysine	2.11	1.75	9.26	3.50
Methionine	0.36	0.21	2.46	0.70
Phenylalanine	2.18	1.46	5.50	2.62
Threonine	1.55	0.90	3.83	1.76
Valine	1.95	1.21	4.09	2.08
Arginine	1.10	0.93	2.82	1.37
Non-Essensial Amino Acid				
Aspartic Acid	3.25	2.79	12.01	4.95
Serine	1.49	1.27	3.35	1.84
Glutamate	4.42	4.64	14.82	7.14
Glysine	1.86	0.96	4.48	1.96
Alanine	2.11	1.01	5.54	2.29
Tyrosine	1.25	0.70	2.89	1.26

Considering that the limiting amino acid is methionine, to further perfect this formula, you can consider adding food ingredients in the form of nuts or animal foods that are high in the amino acid methionine. Table 6 shows the amino acid content of supplementary feeding nugget products, namely the lowest histidine amino acid content in treatment N4 (0.72% w/w) and the highest in N5 (0.84% w/w); Iso Leucine was lowest at N1 (0.60 %w/w) and highest at N5 (0.87 %w/w); Leucine was lowest in N1 (1.03 %w/w) and highest in N5 (1.49 %w/w); Lysine was lowest in N1 (0.1 %w/w) and highest in N5 (1.11 %w/w); Methionine was lowest in N1 (0.25 %w/w) and highest in N5 (0.34 %w/w); Phenylalanine was lowest in N1 (0.48 %w/w) and lowest in N5 (0.73 %w/w); Threonine was lowest in N1 (0.53 %w/w) and highest in N5 (0.77 %w/w); Valine was lowest at N1 (0.65 %w/w) and highest at N5 (0.93 %w/w); and Arginine was lowest in N2 (0.74 %w/w) and highest in N5 (1.01 %w/w).

Table 6
Amino Acid Content of Supplementary Feeding Nugget

AMINO ACID	N1 (%w/w)	N2 (%w/w)	N3 (%w/w)	N4 (%w/w)	N5 (%w/w)
Essensial Amino Acid					
Histidine	0.77	0.74	0.76	0.72	0.84
Iso Leusine	0.60	0.63	0.73	0.69	0.87
Leusine	1.03	1.08	1.24	1.17	1.49
Lysine	0.71	0.75	0.84	0.78	1.11
Methionine	0.25	0.26	0.28	0.26	0.34
Phenylalanine	0.48	0.54	0.61	0.58	0.73
Threonine	0.53	0.56	0.64	0.60	0.77
Valine	0.65	0.68	0.77	0.74	0.93
Arginine	0.77	0.74	0.82	0.76	1.01

Non-Essensial Amino Acid					
Aspartic Acid	1.10	1.17	1.36	1.37	1.26
Serine	0.56	0.60	0.65	0.62	0.76
Glutamate	2.70	2.86	3.07	3.08	3.52
Glysine	0.53	0.58	0.62	0.62	0.75
Alanine	0.67	0.71	0.81	0.77	0.99
Tyrosine	0.34	0.35	0.39	0.36	0.47

Organoleptic Test of Supplementary Feeding Nugget

The results of organoleptic tests on aroma on average showed the lowest value in treatment N1 (3.36) and the highest in treatment N3 (3.75), the lowest color value in P5 (3.21) and the highest in N3 (3.60) , taste lowest value at N5 (2.98) and highest at N3 (3.43), texture lowest value at N5 (3.16) and highest at N3 (3.55), and overall the lowest value at N5 (3.18) and the highest at N3 (3.65). Based on the ANOVA test at a significance level of 5%, different results were obtained between treatments, then continued with the Duncan test. The preferred aroma is N3 treatment with a score of 3.75; the preferred color is treatment N3 or N1 with a score of 3.60; the preferred taste is N3 treatment with a score of 3.43; the preferred texture is N3 treatment with a score of 3.55; The overall preferred treatment was N3 with a score of 3.65. Based on the results of the anova test, it can be considered to use nuggets with N3 treatment as a substitute for supplementary feeding in posyandu activities. This N3 treatment is a nugget with the addition of 100 grams of the second formula.

4 Conclusion and Recommendations

Conclusion of this research as follows 1) The “ke-kame-tu” formula (15-60-25) is made with a mixture of moringa flour, red bean flour and tuna fish flour; 2) Make one supplementary feeding nugget product by adding different formulas, namely adding 50 grams (N1), 75 grams (N2), 100 grams (N3), 125 grams (N4) and 150 grams (N5); 3) Analyze the proximate, amino acid, zinc, calcium, phosphorus and magnesium content of supplementary feeding products; 4) The most preferred supplementary feeding nugget product based on organoleptic tests analyzed using "anova" is nuget with the addition of 100 grams of ke-kame-tu formula (N3). Suggestions based on research results are the nugget product recommended for use as supplementary feeding for toddlers in posyandu activities is a product with the addition of 100 grams of ke-kame-tu (15-60-25) formula.

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