Nugget Based on Ke-Kame-Tu Formula for Supplementary Feeding (PMT) at Posyandu as an Efforts to Prevent Stunting

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Abstract

The specific objectives of the study were 1) To create a "ke-kame-tu" formula (15-60-25), 2) To create nuggets as a PMT product based on the ke-kame-tu formula, 3) To analyze the proximate content, amino acids, zinc, calcium, phosphorus and magnesium of PMT products, 4) To determine the preferred PMT product based on the acceptance test by toddlers. The making of the "ke-kame-tu" formula (15-60-25) used a randomized block design (RAK) with one treatment and three replications. The PMT product was made using the ke-kame-tu formula (15-60-25) and the acceptability test used 30 toddler panelists. Analysis of protein, calcium, phosphorus and magnesium (HPLC/AAS and spectrophotometry). To determine the acceptability of the PMT product, a limit of ≥50% of toddlers stated that they liked it was used. Nuggets made using a modified recipe with the addition of 100 grams of ke-kame-tu formula. The results of the protein analysis were 16.60%, calcium 0.07 mg%, phosphorus 0.15 mg%, magnesium 0.02 mg%, zinc 1.95 mg%. If toddlers consume 100 grams of this nugget, it will be able to meet the nutritional needs, especially protein for toddlers aged 6-11 months by 110.6%, 1-3 years by 83% and 4-6 years by 66.4%. The results of the trial on toddler panelists showed that all toddlers liked the nuggets served. If we looked at carefully at the protein content of this nugget with complete essential amino acid content, it is very possible to substitute the fulfillment of toddler protein requirements. Consumption of toddler protein according to needs will achieve optimal nutritional status, in other words, the problem of stunting can be prevented and dealt with.

Keywords: Kame-tu formula; PMT; Nuggets; Stunting; Proteins.

The high problem of stunting in Indonesia, including in Bali Province, is one of the nutritional problems that can result in low quality of human resources. In 2023, the incidence of stunting nationally will be 21.5% and in Bali Province it will be 7.2% (SKI, 2023). The target prevalence of stunting in 2024 is 14% (fourteen percent) in 2024. (1)

The direct cause of stunting in toddlers is the inadequacy of nutritional needs, especially

nutrients that function for growth and development. These nutrients include protein, zinc, calcium, phosphorus and magnesium. 2) 3)

Supplemental feeding (PMT) can be divided into PMT-Counseling and PMT-Recovery. Additional counseling food is additional food given during posyandu activities. Additional Recovery Food is additional food given to improve the nutritional status of targets who have poor or poor nutritional status.

Activities that are routinely carried out in integrated health post activities are the provision of PMT counseling for toddlers. The distribution of PMT is through the center to the health center and continued to the integrated health post. The costs required for the procurement of PMT are quite large, but there has been no specific study on the effectiveness of the PMT.

Additional food for toddlers packaged in aluminum foil with a net weight of 40 grams, containing 4 biscuits (@ 10 grams per piece in a round shape, is given to toddlers with poor nutritional status.

In 2023, the program was changed to a program for providing additional food based on local food for toddlers and pregnant women, with the aim of improving the nutritional status of toddlers through the provision of additional food based on local food according to established standards. The target recipients of additional food based on local food are toddlers whose weight is not increasing, toddlers who are underweight and toddlers who are malnourished. The implementation of this program is handed over to the village in coordination with the local health center. 4)

The provision of additional food that is done independently at each posyandu still varies according to the availability of funds. The PMT provided can be in the form of fresh fruit, green bean porridge, sumsum porridge, boiled eggs, pudding, UHT milk, and so on.

Based on the description of the background of the research problem, on this occasion a toddler PMT product will be developed to add to the variety of PMT at the integrated health post. With the hope that PMT products can provide a significant contribution to meeting the nutritional needs of toddlers as an effort to prevent and overcome stunting.

The general objective of the study was to develop nugget products based on the Ke-Kame-Tu formula for PMT at Posyandu as an effort to prevent stunting. Specifically, the objectives of the study were 1) to create a "ke-kame-tu" formula (15-60-25), 2) to create one PMT nugget product based on the ke-kame-tu formula, 3) to analyze PMT products including proximate content, amino acids, zinc, calcium, phosphorus and magnesium and 4) to determine the level of preference for PMT products based on the acceptability test by toddlers.

Method

A. Research Design

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.5)6) Making PMT Nugget products with modifications by adding 100 grams of the ka-me-tu formula and other ingredients, namely minced chicken, white bread without crust, UHT milk, white bread flour, wheat flour, tapioca, chicken eggs, carrots, par leaves and spices (garlic, salt, sugar, Chicken broth powder, pepper).

B. Population and Sample

The ke-kame-tu formula ingredients consisting of moringa leaves, red beans and tuna fish were obtained from traditional markets and supermarkets in Denpasar. The amount purchased was adjusted to the needs of each treatment. In Year I, the organoleptic test used 30 semi-trained panelists and in Year II, the organoleptic test used 30 toddler panelists at the integrated health post.

C. Data Collection Method

1) Acceptability test using 30 toddler panelists. Proximate analysis, amino acids, zinc, calcium, phosphorus and magnesium using HPLC/AAS and spectrophotometry methods.7)

2) Analysis of nutrients including protein, amino acids, calcium, phosphorus and magnesium, Ke-Kame-Tu formula and PMT products were analyzed in the Food Technology Laboratory and Analytical Laboratory of Udayana University, Denpasar, Basic Sciences Laboratory of the Faculty of Agriculture, Warmadewa University, Denpasar and the Testing, Calibration and Certification Services Laboratory of the Bogor Agricultural Institute.

3) Making PMT products

PMT is made by adding 100 grams of the ke-kame-tu formula (15-60-25) to the nugget recipe used. Some additional ingredients used are wheat flour, chicken, white bread, chicken eggs, carrots, pre leaves, salt, pepper, broth powder and fine granulated sugar.

4) PMT Organoleptic Test

Two nugget PMT products were packed in plastic and then tested for organoleptic acceptability by 30 toddlers. This organoleptic test was conducted at the integrated health post in Kesiman Kertalangu Village, East Denpasar. The PMT accepted by toddlers was determined based on the results of the acceptability test, namely ≥50% of panelists stated that they liked it.

D. Data Processing and Analysis

1) The data from the acceptance test and laboratory analysis were each averaged and tabulated, then narrated according to the objectives.

2) To determine the acceptability of PMT products, the average score of toddler panelists' preferences was used and based on the results of the acceptance test, namely ≥50% of panelists stated that they liked it. 8)9)

E. Ethical Implications for Panelists

Approval was submitted to the Health Research Ethics Commission of the Denpasar Ministry of Health Polytechnic and has received the following approval: ETHICAL APPROVAL, dated June 7, 2024, Number: DP.04.02/F.XXXII.25/0702/2024.

Results and Discussion

Results

A. Formula "Ke-Kamu-TU (15-60-25)

The ke-kame-tu formula in this study is based on the results of a 2023 study, namely a mixture of moringa flour (15%), red bean flour (60%) and tuna flour (25%) so that this formula is named Formula "Ke-Kame-Tu" (15-60-35) 10)

B. PMT Nugget Products Based on Ke-Kame-Tu Formula

The product made is a nugget with the addition of 100 grams of ke-kame-tu formula for one recipe. The making of this nugget is based on the results of a 2023 study, namely the best results were obtained in the N3 treatment. In this N3 treatment, the addition of 100 grams of Ke-Kame-Tu formula was used in the nugget recipe, see table 1.

Table 1. PMT Nugget Formula

Material	Unit	Amount
Ke-kame-tu formula	grams	100
Minced Chicken	grams	600
White bread without crust	grams	60
UHT Milk	ml	200
White bread flour	grams	20
Flour	grams	20
Tapioca flour	grams	20
Chicken eggs	grain	1
Carrot	grams	100
Pre leaves/leek	grams	50

Seasonings (garlic, salt, sugar, Chicken broth powder, pepper)		enough

C. Proximate Content, Zinc, Calcium, Phosphorus, Magnesium and Amino Acids

1) Ke-Kame-Tu Formula Ingredients and Nugget Products

The ke-kame-tu formula is a mixture of moringa flour, red bean flour and tuna fish flour. The nutrients analyzed are still limited, especially those related to toddler growth, such as protein, calcium, phosphorus, magnesium and zinc. For more details, see table 2.

Table 2. Nutrient Content of Ke-Kame-Tu Formula

Nutrients	Unit	Ke-kame-Tu Formula
Calcium	mg%	0.26
Phosphorus	mg%	0.42
Magnesium	mg%	0.18
Zinc	mg%	2.49
Protein	%	10.58
Fat	%	3.2
Ash	%	4.03
Water	%	1.78

2) Nutritional Content of PMT Nugget

Nuggets made using a modified recipe by adding 100 grams of ke-kame-tu formula have the nutritional content shown in Table 3.

Table 3. Nutritional Content of PMT Nuggets

Nutrients	Unit	Amount
Calcium	mg%	0.07
Phosphorus	mg%	0.15
Magnesium	mg%	0.02
Zinc	mg%	1.95
Protein	%	16.60
Fat	%	2.83
Ash	%	0.43
Water	%	59.30

The essential amino acid content of the ke-kame-tu formula ranges from 0.0120 (tryptophane) to 0.2953 (lysine). For details, see Table 4.

Table 4. Amino Acid Content of Formula

AMINO ACIDS	Amount (mg%)
Essential Amino Acids	
Histidine	0.177
Isoleusine	0.165
Leucine	0.293
Lysine	0.295
Methionine	0.075
Phenylalanine	0.219
Threonine	0.159
Valine	0.184
Arginine	0.192
Tryptophane	0.012
Non-Essential Amino Acids	
Aspartic Acid	0.383
Serine	0.160
Glutamate	0.628
Glycine	0.172
Alanine	0.201
Tyrosine	0.101
Proline	0.126
Cystine	0.020

Table 5. shows that PMT nugget products contain complete essential amino acids, namely the amino acids histidine, iso leucine, leucine, lysine (highest), methionine, phenylalanine, threonine, valine, arginine and tryptophane (lowest).

Table 5. Amino Acid Content of PMT Nuggets

AMINO ACIDS	Amount (mg%)
Essential Amino Acids	
Histidine	0.051
Isoleusine	0.056
Leucine	0.096
Lysine	0.066
Methionine	0.028
Phenylalanine	0.064
Threonine	0.051
Valine	0.059
Arginine	0.058
Tryptophane	0.007
Non-Essential Amino Acids	
Aspartic Acid	0.111
Serine	0.051
Glutamate	0.243

Glycine	0.053
Alanine	0.067
Tyrosine	0.031
Proline	0.240
Cystine	0.008

D. Organoleptic Test of PMT Nugget

The results of the organoleptic test by 30 toddlers on taste showed that all toddlers liked the nuggets they tasted. This can be seen when the toddlers were able to finish the nugget samples served.

Discussion

The PMT nuggets produced contain nutrients that are essential for the growth and development of toddlers (Table 3) and complete essential amino acids (Table 5). According to the Regulation of the Minister of Health, the adequacy of nutrients, especially protein, for toddlers aged 6-11 months is 15 grams, aged 1-3 years is 20 grams and aged 4-6 years is 25 grams. 11)

If 100 grams of these nuggets are consumed, it will be able to meet the nutritional needs, especially protein, for toddlers aged 6-11 months by 110.6%, toddlers aged 1-3 years by 83% and toddlers aged 4-6 years by 66.4%. If observed, the protein content of this nugget is very possible to substitute for fulfilling the adequacy of toddler protein. One effort that can be done is to improve the management of integrated health post activities, especially at the counseling table about balanced nutritional menus for toddlers to mothers of toddlers.

It is hoped that with the increase in knowledge and skills about balanced nutrition menus, it will then be applied to toddlers in each household. Mothers of toddlers can provide this PMT nugget as a snack or side dish for breakfast, lunch or dinner. Toddlers who receive a balanced nutritional menu with a variety of nugget side dishes will ensure that their protein needs are met. Protein that has benefits for toddler growth and development will have an impact on achieving optimal nutritional status. This condition greatly helps to make the program to accelerate the reduction of stunting a success. 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 implementation of providing these nuggets as a substitute for PMT in posyandu activities will greatly help achieve the prevalence of stunting according to the specified target.

Proteins are made up 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 that codes for this protein. 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 tissues such as cartilage, while keratin is found in hard or filamentous structures such as hair, nails, feathers, hooves, and some animal shells. 3)12)

Protein a very important role in the body's metabolic processes, especially in the formation of new cells to replace damaged cells. Other functions of protein are: 1) As an enzyme, 2) Transport tool (transport protein), 3) Movement regulator (contractile protein), 4) Tissue builder (structural protein), 5) Reserve protein. 6) Antibodies (antibody protein), 7) Reaction regulator (regulatory protein), 8) Growth controller.13)

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 metabolic reactions of body cells. Helping carbohydrate metabolism and protein metabolism Composing several important compounds such as adrenaline, melanin, histamine, porphyrin, hemoglobin, purine, choline, vitamins, and others, 3) Forming and increasing muscle mass (Glutamine) As a protein building substance (Lysine), 4) Repairing liver damage and maintaining nerve health (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 joint health and overcoming arthritis (Histidine), 8) Producing lymphocytes, increasing body immunity, accelerating health recovery, and increasing growth hormones (Lysine and Arginine).14)15)

Minerals that function in the growth and development of toddlers include calcium, phosphorus, and magnesium. Calcium is one of the minerals needed by the body to help the process of bone and tooth formation 16)17)18)19) Phosphorus is the main component of bones and one of its functions is to keep bones and teeth strong.20)21) Magnesium plays a role in supporting the formation of energy and protein in the body.21)23)

Research on nuggets with the addition of skim milk powder and obtained results that had a significant effect on the quality of organoleptic tests and the level of preference for broiler chicken nuggets, the best treatment was P1 with an addition of 5%.24)

The ke-kame-tu formula ingredients consisting of moringa flour, red bean flour and tuna fish flour contain complete essential amino acids. This will greatly assist the growth and development of toddlers to achieve optimal nutritional status. Given that the limiting amino acid in the ke-kame-tu formula and nugget products is tryptophane. To further refine this formula, you can consider modifying the amount of ingredients used or adding other food ingredients such as peas, green beans, peanuts, or cashew nuts, eggs, chicken.

Conclusion and Suggestions

The conclusions that can be drawn are: a) The "ke-kame-tu" formula (15-60-25) is made with a mixture of moringa flour, red bean flour and tuna fish flour, b) PMT nugget products are made by modifying the nugget recipe with the addition of 100 grams of ke-kame-tu formula in one recipe, c) The nutritional content of the nugget product is as follows: calcium 0.07 mg%, phosphorus 0.15 mg%, magnesium 0.02 mg%, zinc 1.95 mg%, protein 16.60%, fat 2.83%, ash 0.43% and water 9.30% and 4) Based on organoleptic tests by toddlers, the PMT nugget product served is very much liked.

The recommended nugget product to be applied as PMT for toddlers in posyandu activities is a product with the addition of the ke-kame-tu formula (15-60-25) as much as 100 grams. This PMT will greatly help meet the nutritional needs of toddlers, especially protein. This nugget can be consumed as PMT or snacks or used as a variation of side dishes when consuming a balanced nutritional menu for breakfast, lunch or dinner. The expected impact is that by consuming this nugget product, it will be able to meet the nutritional needs of toddlers, especially protein, so that optimal nutritional status is achieved. Thus, the acceleration of stunting reduction can be realized and the next impact will be able to overcome and prevent stunting.

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WORKS CITED

Peraturan Presiden RI No. 72 Tahun 2021 tentang Percepatan Penurunan Stunting. Kementerian Sekretariat Negara RI, Jakarta.

Mataram, I Komang Agusjaya. Stunting Cause Factors in the Village of Traditional Bali. International Research Journal of Engineering, IT & Scientific Research. Available online at

https://sloap.org/journals/index.php/irjeis/.Vol. 3 No. 2, March 2017, pages: 157~164. ISSN: 2454 2261. https://sloap.org/journals/index.php/irjeis/article/view/543

Almatsier, Sunita, 2005. Prinsip Dasar Ilmu Gizi. Gramedia Pustaka Utama, Jakarta.

Kemenkes RI, 2023. Petunjuk Teknis Pemberian Makanan Tambahan (PMT) Berbahan Pangan Lokal untuk Balita dan Ibu Hamil, Dirjen Kesmas, Jakarta.

Mataram, I Komang Agusjaya dan A. A. Gde Raka Kayanaya. Formula "Ke-Kame-Tu" High Protein and Zinc as Basic Ingredients for Under Five Years Old Supplementary Feeding. International Research Journal of Engineering, IT & Scientific Research Available online at https://sloap.org/journals/index.php/irjeis/ Vol. 7 No. 6, November 2021, pages: 225-232 ISSN: 2454-2261. https://doi.org/10.21744/irjeis.v7n6.1991

Mataram, I Komang Agusjaya dan Agustini, Ni Putu. Formula "KE-KAME-TU" High Calcium, Phosphore and Magnesium as Basic Ingredients for Under Five Years Supplementary Feeding. International Journal of Health Sciences Available online at www.sciencescholar.us

Vol. 6 No. 3, December 2022, pages: 1596-1606. e-ISSN: 2550-696X, p-ISSN: 2550-6978. https://doi.org/10.53730/ijhs.v6n3.13539

Sudarmadji, 2000. Pedoman Analisi Laboratorium, Jakarta.

Arikunto, Suharsini, 2002. Prosedur Penelitian Suatu Pendekatan Praktek. Rineka Cipta, Yogyakarta.

Daniel, Wayne W., 1999. Biostatistics A Foundation For Analysis In the Health Sciences. John Wiley & Sons, Inc, New York.

Mataram, I Komang Agusjaya, Ni Putu Agustini, Anak Agung Nanak Antarini dan Yuli Laraeni, 2023. Development of Products Based on Ke-Kame-Tu Formula for PMT at Posyandu as an Effort to Prevent Stunting. Available at International Journal of Health Sciences. Available online at www.sciencescholar.us; Vol. 7 No. 3, December 2023, pages: 119-127; e-ISSN: 2550-696X, p-ISSN: 2550-6978; https://doi.org/10.53730/ijhs.v7n3.14632

Kemenkes RI, 2019. Peraturan Menteri Kesehatan Nomor 28 Tahun 2019 Tentang Angka Kecukupan Gizi Yang Dianjurkan Untuk Masyarakat Indonesia. Jakarta.

Christopher K. Mathews and Kensal Edward Van Holde, 1996. Biochemistry. Benjamin/Cummings Publishing Company, Incorporated, 1996.

Abdillah, Fahri, 2018. Protein: Pengertian, Sifat, dan Fungsi. Available at https://www.ruangguru.com/blog/pengertian-sifat-dan-fungsi-protein. Jumat, 15-04-2022

Yandri Daniel Damaledo, 2022. Mengenal Asam Amino dan Apa Pentingnya untuk Tubuh?Available at https://tirto.id/mengenal-asam-amino-dan-apa-pentingnya-untuk-tubuh-gyVj#google_vignette, 16-09-2024

Bukyt Aprilliawan. 2017. Asam Amino Esensial dan Non Esensial. Kendari: Universitas Haluoleo. Available at ttps://www.academia.edu/32445616/Asam_amino_esensial_dan_non_esensial, 16-09-2024.

Mandal, Ananya (2019). "Uses of Calcium". News-Medical.net (dalam bahasa Inggris). 24-03-2024.

Shita, Amandia Dewi Permana dan Sulistyani, 2015.Pengaruh Kalsium Terhadap Tumbuh Kembang Gigi Geligi Anak. Stomatognatic, Jurnal Kedokteran Gigi: 7 (3): 41. ISSN 2442-4935.

Newman, et al, 2020. "Calcium: Health benefits, foods, and deficiency". www.medicalnewstoday.com (dalam bahasa Inggris). 24-03-2023.

Weaver CM. Calcium. In: Erdman JJ, Macdonald I, Zeisel S, eds. Present Knowledge in Nutrition. 10th ed: John Wiley & Sons, Inc.; 2012:434-446.

https://lpi.oregonstate.edu/mic/minerals/calcium

Claudia, L.V., 2021. Fosfor: Manfaat, Sumber, dan Kebutuhan Hariannya untuk Tubuh, available at https://www.orami.co.id/magazine/manfaat-fosfor, 05-11-2023.

Greenwood, N. N.; & Earnshaw, A. (1997). Chemistry of the Elements (Edisi ke-2), Oxford:Butterworth-Heinemann. ISBN 0-7506-3365-4.

Arnaud MJ (2008). "Update on the assessment of magnesium status". Br. J. Nutr. 99 Suppl 3: S24–36. doi:10.1017/S000711450800682X. PMID 18598586.

MedlinePlus, 2012. "Magnesium in diet"., U.S. National Library of Medicine, National Institutes of Health. Availanle at 24-08-2024, https://medlineplus.gov/ency/article/002423.htm

Dewi Sinta, Nurhaeda, Rasbawati dan Fitriani, 2019. Uji Organoleptik dan Tingkat Kesukakan Ngget Ayam Broiler Dengan Penambahan Susu Bubuk Skim Pada Level Yang Berbeda. Jurnal Sinergitas Multidisiplin Ilmu Pengetahuan dan Teknologi, Vol. 2, 2019, ISSN: 2622-0520.