

MOCAF TEMPEH DATES BISCUIT FOR THE IMPROVEMENT NUTRITIONAL STATUS OF UNDERWEIGHT CHILDREN

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ABSTRACT: The prevalence of protein-energy malnutrition) in Indonesian toddlers have increased due to lower macro-nutrient intake and exposure to infectious diseases. It is necessary to intervene with supplementary feeding in the form of highly nutritious food products, such as biscuits made from flour enriched from mocaf from soybean and date jam. The study was conducted to assess the effects of consumption of mocaf tempeh dates biscuits with the nutritional status of KEP toddlers. Randomized Controlled Trial (RCT) with pre-post tests were used with 70 subjects, divided into 3 groups: 27 subjects in the treated group (mocaf tempeh dates biscuits), 26 subjects of control group 1 (tempeh dates biscuits), and 17 subjects in control group 2 (placebo biscuits). The intake of energy, protein, and fat, along with hemoglobin examination and blood albumin were collected pre-post intervention. A change in weight of 0.4 kg was found in the intervention group. The highest increase in height was found in control group 1 (1.7 cm). An increase in blood hemoglobin levels of 0.1 points was found in the intervention group and the control group 1. The albumin was decreased by 0.3 points in the intervention group. Weight gain in the intervention group was influenced by macro-nutrient intake. Intake of vitamin A, Fe, and Zn affected blood hemoglobin levels in post-intervention with the intervention group. It can be concluded that mocaf tempeh dates biscuits can be consumed by underweight children as an alternative food of Nutritional Supplementation Program.

Keywords: Mocaf tempeh dates biscuits, Weight, Height, Hemoglobin, Albumin

1. INTRODUCTION

The lack of energy/calories and protein in the nutrition of toddlers increases morbidity and mortality and is a significant public health concern in Indonesia. In developing countries, approximately 60% of deaths occur in children under five years' old due to malnutrition [1]. In general, KEP in toddlers presents higher levels of hemoglobin (Hb) and lower albumin due to a decrease in protein content in the blood and body tissues [2]. One of the preventive efforts is through supplementary feeding recovery (PMT). The PMT food form preferred by children is a biscuit and PMT for toddlers in this from proved to be quite effective and significantly improve nutritional status [3-7].

Other studies have also shown an increase in the nutritional status of children under five with an increase in weight and height of 1.3 kg and 0.7 cm, respectively over four weeks through the supplementation of tempeh dates biscuits [8]. Similar studies on malnutrition in children under five who suffered from Tuberculosis in Depok and in East Jakarta show an increase of weight and height of 0.7 kg and 1.7 cm, and 0.4 kg and 2.4 cm, respectively [9-10]. Further, there are significant differences between the consumption of biscuits in the study that spanned six weeks in Ease Jakarta on the change of weight and height of toddlers.

Referring to the findings of the above study, it is clear that a study of the development of local food products in Indonesia that are easily available at affordable prices is warranted. One possibility is the use of the base material of modified cassava flour (mocaf) biscuits since it is widely used as an additional food product in PMT for malnourished toddlers in Indonesia.

This study has developed a biscuit made from a flour mixture of mocaf with tempeh and date jam. Mocaf is derived from extracts/cassava extract, which is chosen as the base material of biscuits because it has become a favorite food of Indonesian people, especially in Java. Tapioca processed foods from cassava (one of the staple food in Indonesia) should be consumed with complimentary foods due to its lower protein content and the presence of phytic acid that inhibits iron (Fe) and zinc (Zn) absorption. Excessive consumption of tapioca without consuming other nutrients will cause the body to become deficient in several nutrients [11].

Therefore, tapioca must be balanced with other foods that are high in protein, such as soybean flour, and iron and zinc, such as dates, in order to prevent severe anemia in KEP toddlers. Malnourished toddlers generally have low hemoglobin levels so that there is an interaction between the low nutrient status with infectious diseases [12]. This study was conducted in the Cinere and Pancoran Mas Subdistricts, Depok

City, which have the largest PEM toddler prevalence in Depok (10.6%).

A prevalence of greater than 10% is considered a significant public health issue [13] Moreover, the proportion of children under five (KEP toddlers) in this district in Depok has exceeded 5.31% [14]. It was hypothesized that there would be the effect of supplementation with protein-enriched mocaf biscuits from soybean flour and iron and vitamin C levels from date jam to changes in anthropometry weight/age (W/A) and the biochemistry of blood (hemoglobin and albumin) in KEP toddlers three months post-intervention.

2. MATERIALS AND METHODS

2.1 Study Design

A Randomized Clinical Trial (RCT) was used in this study with 70 samples in Depok that have a prevalence of PEM (W/A) in toddlers, of which the largest was in Depok with 10.6% [14]. Nutritional interventions were conducted for three months from May-July 2014. Ethical Clearance was obtained from the Research Ethics Committee of Research and Development Agency for Health Care Ministry of Health of the Republic of Indonesia.

2.2 Data Collection

Initial screening of nutritional status was done through anthropometric measurements of body weight (BW) in 100 KEP toddlers based on the integrated health post (*posyandu*) data of toddlers in April 2014. The sample size was determined by the formula to mean difference test two independent groups with weight gain samples from a previous study of 0.4 kg [8]; significance level ($Z\alpha$) by 1.96; and strength test ($Z\beta$) of 0.84. The minimum sample in each group was, therefore, determined to be 15 toddlers.

Participants were selected through appropriate data from calendar notes of *posyandu* cadres of the weighing results from the previous month. Inclusion criteria for the study were male and female children aged between 12–56 months, a status of malnutrition (W/A) with a Z-score between -3 to -2 SD, not suffering from a chronic or acute infectious disease and not currently participating in the (PMT) Recovery and Counseling Program either from the government (*posyandu*, community health center, hospitals, and others), private organizations, or local or international NGOs.

A total of 70 samples were divided into three groups (mocaf tempeh date biscuits, tempeh dates biscuits, placebo biscuits). 75 samples were originally enrolled at the beginning of the study;

however, five did not continue in the second week of the study for a variety of reasons, including the toddler not wanting to eat the biscuits, out of town travel or moving without providing a forwarding address.

The use of indicators of weight/age (W/A) in this study was based on the indicators of malnutrition status. Each subject received 50 grams of biscuits per day for 12 weeks. The children were differentiated into three groups: the treatment group (mocaf tempeh dates biscuits) and two control groups (tempeh dates biscuits and placebo biscuits, respectively). Height and weight, as well as any presence of illness, were monitored every two weeks. Anthropometric measurements were collected twice and daily recordings of food consumption were collected by enumerators through home visits as many as 24 times during the study.

Nutritional counseling was conducted twice by investigators with the mothers of the sample in the village office simultaneously with *posyandu* with the monitoring of the nutritional status in the form of anthropometric measurements of samples. The distribution of mocaf tempeh dates biscuits, tempeh dates biscuits, and placebo biscuits were achieved through home visits by a team of researchers and toddlers cadres every three days at which time daily food record forms (24 hours food recall) were also collected.

At the end of the intervention, weight, height, and blood samples were taken again. Weight anthropometric data were measured using a digital scale (SECA) by trained field workers. An indicator Z-score of weight/age of less than -2 SD was used to determine the status of children under five who had malnutrition [13]. Basic data (baseline survey) were collected at the beginning and at the end of the study through direct interviews with a structured questionnaire administered with the mothers.

The independent variables were toddlers' weight before research and the dependent variable was their weight after the intervention. Confounding variables in this study included demographic characteristics of mothers and toddlers, mothers' knowledge about nutrition and intake of macro and micro nutrients.

The measurements for independent and confounding variables were obtained once before the study. The mothers' knowledge of nutrition and height were assessed before and after the study based on mean scores. The educational background of mothers was divided into categories of low and moderately long, an indicator of being educated for at least nine years. A flow chart diagram of this research scheme is shown in Fig.1.

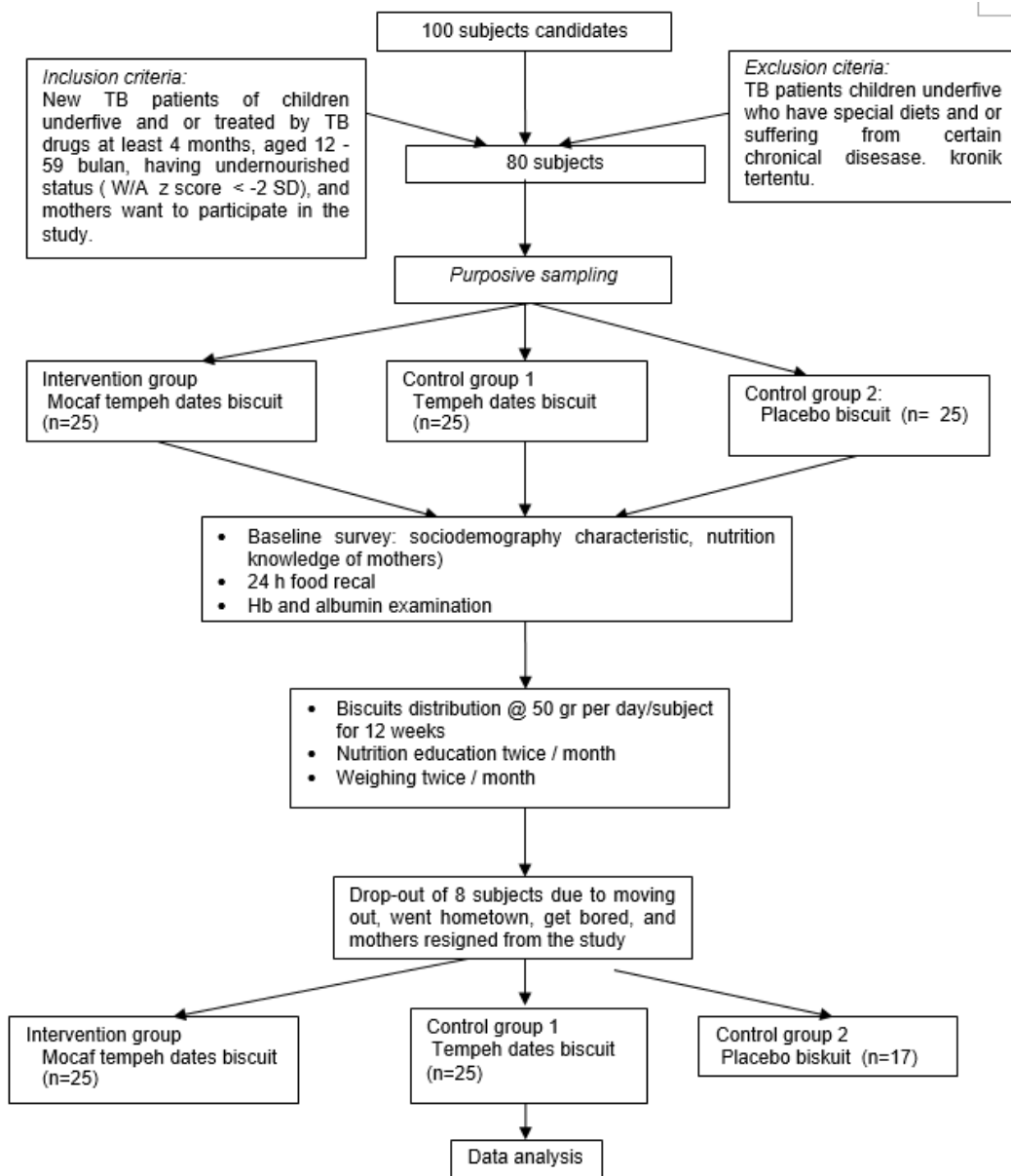


Fig 1. Flowchart of the research scheme

2.3 Data Analysis

Weight anthropometric data samples were analyzed by WHO Anthroplus software Version 02 of 2009 based on indicators of W/A [13]. Food consumption data to assess the adequacy of intake of energy and protein with Nutri Survey were analyzed and then compared to Nutritional Adequacy Rate in toddlers aged 12–59 months (14). Univariate and bivariate data analyses were performed using SPSS version 13. Test paired t-tests were used to assess changes in the mean intake of energy, protein, fat, vitamin A, vitamin C, calcium (Ca), zinc (Zn), ferrous (Fe), weight, height, albumin and Hb pre- and post-intervention in each group. ANOVA test was used to assess the

mean differences between variables based on the group (among groups).

3. RESULTS

3.1 Nutrition Value of Biscuits

Table 1 describes the contents of macronutrients (energy, carbohydrates, protein, and fat) and micronutrients (Na, Zn, Fe, and vitamin A) in three kinds of biscuits. Mocaf tempeh dates biscuits contain the most energy, fat, and vitamin A compared with the other types of biscuits. The placebo biscuits contained the highest amount of

Table 1 Nutrient value per 100 gr biscuit

Type	Energy (cal)	Carbohydrate (gr)	Protein (gram)	Fat (gram)	Na (mg)	Fe (mg)	Zn (mg)	Vitamin A (IU)
Tempeh dates	490	61.8	9.62	22.7	267	1.9	1.9	139
Mocaf tempeh dates	495	61.8	5.80	23.8	460	1.3	0.9	155
Placebo	462	70.4	5.03	17.8	-	0.6	1.3	< 0,5 IU

Source: BBIA Laboratory, 2014

carbohydrates. Tempeh dates biscuits contained protein, Fe, and Zn in larger amounts than the mocaf tempeh dates biscuits and placebo biscuits. By consuming 50 grams of mocaf tempeh dates biscuits per day, the energy sufficiency of a toddler aged 1–3 years would be met with a fat content of between 22 % and 27%.

3.2 Nutritional Status Change

Gender distribution of toddlers involved in this study was almost equal between males and females, 54.3% and 45.7%, respectively. The largest number of children were between the ages of 12–23 months (38.6%) followed by 24–25 months of age (28.6%). Changes in nutritional status of toddlers in anthropometric and biochemical are illustrated in Table 2. The increase in weight of toddlers was slightly larger in the intervention group (0.4 kg) than the other two control groups (0.2 kg for control group 1 and 0.3 kg for control group 2). Weight before and after the intervention showed significant differences in all three groups ($p = 0.05$). Changes in body height of 1.7 cm in toddlers who consumed the tempeh dates biscuits and the placebo biscuits group are slightly higher than the toddlers who consumed mocaf tempeh dates biscuits (1.3 cm). Toddlers in the intervention and control group 1 initially had lower nutrition status at the end of the normal nutritional intervention based upon Z-score of W/A. Significant differences were found on these indicators in both groups, except the control group 2 ($p = 0.142$). Further, the mean measurement of Hb increased by 0.1 at the end of the intervention in the intervention group and the control group 1. The albumin in the intervention group decreased by 0.3 after three months of ingesting mocaf tempeh dates biscuits. The toddlers in control group 1 did not show increased levels of albumin and the toddlers in control group 2 showed an increase of 0.1 at the end of the study. Mean albumin levels are significantly different in all groups, unlike the case with the mean change in Hb level. A significant difference in nutrient intake at the end of the study was found in the

intervention group and control group 1. Table 3 illustrates the differences in nutrient intake of macro and micronutrients among groups. There are significant differences in both macro-nutrient intakes of energy, carbohydrate, fat, and protein and micronutrients. This is in contrast with the current post-study in which the intake of energy and carbohydrates are different among groups ($p < 0.05$). The intervention group has energy intake, fat, protein, and carbohydrate levels that are large compared with the control groups. Whereas, the intake of Fe, vitamin A, and zinc were the most widely consumed by the control group 2. The intake of energy and carbohydrate were significantly different at all the groups after the intervention ($p < 0.05$). Changes in the nutritional status of children under five in the intervention group were based on the indicators of weight/age which were affected by the intake of energy, protein, and fat ($p < 0.05$). This indicator changed for toddlers in control group 1, which was affected by the intake of carbohydrates and Fe ($p < 0.05$) and in control group 2, which was affected by the intake of vitamin A, Fe, and Zn. Further, the intake of vitamin A, Fe, and Zn affected the hemoglobin levels post-intervention in the intervention group ($p < 0.005$). Meanwhile, an influence on the intake of macro and micro nutrients on changes in Hb levels at the end of the study in control groups 1 and 2 was not found ($p > 0.05$). The same is also found concerning the influence of intake of macro and micronutrients to changes in blood albumin levels post-intervention ($p > 0.05$).

4. DISCUSSION

The limitations of the study were the small sample size and a short period of supplementation and follow-up, which could have led us to miss a beneficial effect of high nutrient dense biscuit on growth indices in the overall cohort as the primary outcome. A major finding in the study is the increased weight in the underweight toddlers within 12 weeks of intervention. The highest gain weight has occurred in groups who were taking mocaf biscuits.

Table 2 Mean change of anthropometric and biochemical assessment

Indicator	Group								
	Intervention (n=26)		p	Control 1 (n=25)		p	Control 2 (n=17)		p
	Pre	Post		Pre	Post		Pre	Post	
Weight (kg)	11.0 ± 2.1	11.4 ± 2.2	*0.001	9.1 ± 1.0	9.3 ± 1.6	0.001	9.3 ± 1.6	9.6 ± 1.5	*0.013
Height (cm)	86.1 ± 8.3	87.4 ± 8.1	*0.001	76.7 ± 4.3	78.4 ± 4.3	0.001	81.0 ± 8.3	82.7 ± 7.9	*0.001
W/A (kg/m ²)	-2.0 ± 1.3	-1.5 ± 1.4	*0.007	-2.1 ± 1.4	-1.4 ± 0.8	0.001	-2.5 ± 0.9	-1.9 ± 0.9	0.142
Haemoglobin	11.8 ± 1.1	11.9 ± 1.0	*0.001	11.9 ± 0.9	12.0 ± 0.9	0.001	11.6 ± 0.7	11.5 ± 0.9	0.114
Albumin	4.4 ± 0.3	4.1 ± 0.3	*0.003	4.3 ± 0.4	4.3 ± 0.4	0.036	4.2 ± 0.2	4.3 ± 0.3	0.013

Table 3 Mean macro-micronutrients intakes of the subject

Type of nutrient	Group			p
	Intervention Mean ± SD	Control 1 Mean ± SD	Control 2 Mean ± SD	
<i>Pre-intervention:</i>				
Energi (cal)	1360.3 ± 335.2	932.2 ± 420.6	1184.1 ± 426.3	*0.000
Karbohidrat	187.7 ± 50.2	122.5 ± 58.7	144.1 ± 50.1	*0.000
Protein (gr)	43.5 ± 13.2	35.1 ± 14.7	40.9 ± 17.9	*0.003
Fat (gr)	47.8 ± 18.7	33.6 ± 15.8	48.9 ± 20.8	*0.000
Vitamin A (IU)	1027.9 ± 515.1	1172.8 ± 1270.5	939.5 ± 541.4	0.757
Fe (mg)	14.5 ± 7.7	13.1 ± 9.1	12.0 ± 9.6	0.468
Zinc (mg)	10.0 ± 6.5	8.4 ± 7.7	9.9 ± 6.8	0.179
<i>Post-intervention:</i>				
Energy (cal)	1755.7 ± 479.4	1081.9 ± 381.2	1258.2 ± 351.1	*0.032
Carbohydrate (gr)	231.1 ± 61.1	144.4 ± 47.8	160.4 ± 64.5	*0.025
Protein (gr)	58.2 ± 17.9	37.3 ± 15.5	43.0 ± 13.5	0.265
Fat (mg)	66.4 ± 26.2	38.5 ± 17.2	52.1 ± 18.2	0.053
Vitamin A (IU)	1076.6 ± 682.7	1301.5 ± 1242.2	1183.6 ± 59.9	0.557
Fe (mg)	18.2 ± 13.9	16.2 ± 15.7	14.3 ± 9.7	0.828
Zinc (mg)	13.7 ± 7.3	9.8 ± 7.4	11.0 ± 7.0	

By consuming 50 grams biscuits each day, the total energy needs of children aged 1-3 years can be fulfilled by 24.25%, 20% of carbohydrates nutritional adequacy rate and 16.9% of protein nutritional adequacy rate. The rapid increase in weight in the intervention group of mocaf tempeh dates biscuits was caused by the intake of carbohydrates, which was the greatest in this group compared to the two control groups. The high intake of carbohydrates can be obtained from the content of glucose and fructose in the dates that can be digested by the body and directly changed into energy. Fulfilling the needs of carbohydrates by 20% is derived from dates jam consumption in toddlers 1 years old and 15% carbohydrates in toddlers 4-5 years old. The toddlers who consumed mocaf tempeh dates biscuits showed an increase in height greater than the other two groups. The height increased in tempeh dates biscuits groups (control group 1) is affected by the

increase mothers' knowledge on nutrition and TB disease. Mothers' knowledge of nutrition and TB may be affected the level of tempeh dates biscuits consumption, which effects on the height of the most rapid increase in this group. In the present study, weight and height improvement before and after the intervention in line with the similar study conducted in East Jakarta [10] and studies in Sragen [15] and Ghana [16]. Weight gain generally comes from fat mass, whereas fat-free mass includes protein and may take longer [17-18]. Mothers' knowledge about nutrition was significantly associated with the nutritional status of her children. Specifically, the intervention of nutrition education with families with children under five has shown to change the behavior of the mother and the family in terms of feeding the child resulting in improvements in the nutritional status of children [19]. The highest weight gained in the group of mocaf tempeh dates biscuits in this study

is in line with the three previous studies [20-21, 10]. The first study proved that there are significant differences in weight and height through the provision of biscuits from potato flour for undernourished children in India over the course of months. The second study was conducted with children under five years old who had malnutrition in Depok, which found a weight gain of 1.3 kg in the group consuming tempeh dates biscuits over four weeks. The third study proved that a multi-micronutrient in toddlers who had malnutrition can improve the weight of toddler in four months. Gaining mean Hb among the three groups of study at post-intervention might be caused by the high contents of Fe and vitamin C in the dates jam of biscuit. Vitamin C has a role in the production of hemoglobin in blood by assisting Fe absorption from foods. Thus, it can be processed into red blood cell [22].

5. CONCLUSIONS

The greatest weight gain (0.4 kg) was found in toddlers who consumed mocaf tempeh dates biscuits, while the largest increase in height (1.7 cm) was found in toddlers who consumed tempeh dates biscuits. It is recommended that mocaf tempeh dates biscuits can be consumed by toddlers as an alternative food for PMT recovery for undernourished children in Depok.

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7. REFERENCES

- [1] Faruque ASQ, Shamsir A., Ahmed T., Islam M.M., Hossain M.I., Roy S.K. Nutrition: Basis for Healthy Children and Mothers in Bangladesh. *J. Health Popul Nutr.*, Vol 26, No. 3, 2008, pp. 325-339.
- [2] Muller O., Krawinkel M. Malnutrition and Health in Developing Countries. *CMAJ*, Vol. 173, No. 3, 2005, pp. 279-286.
- [3] Fitriyanti. Effect of Recovery Supplementary Feeding for Undernourished Children Underfive. *Scriptio*. Semarang: Public Health Faculty, University of Diponegoro, 2012.
- [4] Kandarina J.I. Effectivity of Giving Cassava Flour Fortified with Ferrous Among Elementary School Children at Bantul District: Effort to Overcome Micronutrient Deficiency Local Food Based. Final report of National Strategic Fund Year 2010. LPPM UGM, 2010.
- [5] Kurnia P. et al. Ferrous and Zinc Fortification Effect on Biscuits Made from Tempeh and Bran Combination to Increase Albumin Level of Anemic and Undernourished Childen Underfive Explanation, Vol. 5, No. 2, 2010, pp. 10-23.
- [6] Rivera J.A. & J.P. Habitch. Recovery of Guatemalan Children with Mild to Moderate Wasting: Factors Enhancing the Impact of Supplementary Feeding. *Am J Public Health*, Vol. 86, No. 10, 1996, pp. 1430-1434.
- [7] Maleta et al. Feeding patterns of Underweight Children in Rural Malawi Given Supplementary fortified spread at home. *Matern Child Nutr*, Vol. 4, No. 1, 2008, pp. 65-73
- [8] Fatmah, M. Indrawani, Triyanti. Tempeh-Dates Biscuits Effect on the Gained Weight of Moderate Underweight children. *International Journal of Medicine and Medical Sciences*, Vol. 2, No. 8, 2012, pp. 165-172.
- [9] Fatmah. The Intervention of Tempeh Dates Biscuit on the Improved Nutritional Status of Tuberculosis Preschoolers Patients. *The Indonesian Journal of Clinical Nutrition*, Vol. 9, No. 4, 2013, pp. 147-154.
- [10] Fatmah. Effect of Tempeh Dates Biscuit on Nutritional Status of Preschool Children with Tuberculosis. *Malaysian Journal of Nutrition* Vol. 19, No. 2, 2013, pp.173-184.
- [11] Astawan M. Cassava Flour, Benefit, and Its procedure <http://www.aremaipb.wordpress.com>, 2010.
- [12] Sulaeman A., Deddy Muchtadi. The Nutrient Quality of Children Under-five Food Products Made from Cassava Flour and Banana Flour Enriched with Fish Flour and Tempeh Flour *Media Gizi dan Keluarga*, Vol. 27, No. 2, 2003, pp. 77-85.
- [13] World Health Organization. Physical Status: Uses and Interpretation of Anthropometry. WHO Technical Report Series, Report No. 854. Geneva, Switzerland World Health Organization, 1995, pp. 223-224.
- [14] The Indonesian Ministry of Health. (2013). *Widyakarya Nasional Pangan dan Gizi*. Jakarta: MOH..
- [15] Munthofiah S.. The Association Between Knowledge, Attitude, and Practice of Mothers with the Nutritional Status of Children Underfive. Thesis. Solo: Postgraduate Faculty of Sebelas Maret University, 2008.
- [16] Appoh LY, Krekling S. Maternal Nutritional Knowledge and Child Nutritional Status in

- the Volta Region of Ghana. *Maternal Child Nutrition*, Vol. 1, No. 2, 2005, pp.100-10.
- [17]Karnovsky ML, Sbarra AJ. Metabolic changes accompanying the ingestion of particulate matter by cells. *Am J Clin Nutr* No. 8, 1960, pp. 147-153.
- [18]Beisel WR, Fiser RH. Lipid metabolism during infectious illness. *Am J Clin Nutr* Vol. 23, No. 8: pp.1069-107.
- [19] Frost MB, Forste R, Haas DW. Maternal Education and Child Nutritional Status in Bolivia: finding the links. *Soc Sci Med*, Vol. 60, No. 2, 2005, pp. 395-407.
- [20] Vasantha M, Gopi PG & Subramani R. Weight Gain in Patients with Tuberculosis Treated Under Directly Observed Treatment Short-course (DOTS). *The Indian Journal of Tuberculosis*, Vol. 56, No. 1, 2009: pp. 5-9.
- [21]Mursalim, Juffrie M., Sri Mulyani N. Multimicronutrient Fortification Affecting the Growth of Poor Family Children Underfive. *The Indonesian Journal on Clinical Nutrition*, Vol. 8, No. 2, 2011, pp. 69-80.
- [22]Saurabh. M. A randomized trial of multivitamin supplementation in children with tuberculosis in Tanzania. *Nutrition Journal* 10, 2011: pp. 120.

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