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Research Article
Effect of Mocaf Tempeh Date Biscuit on the Nutritional Status of Wasted and Stunted Toddlers

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Abstract

Background and Objective: The poor nutritional status of wasted and stunted toddlers can decrease their cognitive development and growth. This study aimed to assess the effects of the consumption of modified cassava flour tempeh date biscuits on the nutritional status of wasted, stunted and wasted-stunted toddlers. **Materials and Methods:** This study used a quasi-experimental design with purposive sampling included 50 toddlers who consumed 50 g of biscuits within 90 days. **Results:** The toddlers' means weight increased by 0.2 kg and their height increased by 1.9 cm. The intake of energy, protein and fat resulted in a change in the nutritional status of short toddlers, who reached normal height ($p<0.05$). **Conclusion:** Modified cassava flour tempeh date biscuit supplementation can decrease the prevalence of stunting in toddlers.

Key words: Wasted toddlers, stunted toddler, short toddlers, modified cassava flour tempeh date biscuits, nutritional status

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Thinness and stunting at an early age increase the body's vulnerability to degenerative diseases throughout the lifespan and can have long-term effects on toddlers' cognitive development and productivity. The direct cause of these problems in toddlers is inadequate intake of nutrients and exposure to infectious diseases. This situation is closely related to low familial education and income levels, poverty and a lack of nutritional knowledge or an inability to apply such knowledge in daily life[1].

Although the prevalence of stunting in toddlers in Indonesia has decreased from 36.8% in 2007 to 35.6% in 2010[2], it remains a public health problem because it has exceeded the limit for stunting in toddlers (20%) established by the WHO[3]. The main problem is caused by low nutrient intake[1,4]. Several studies have reported that low protein intake is associated with stunting in children. Inadequate energy intake is also significantly associated with stunting in toddlers[5,4]. The basic determination of stunting as a health problem among toddlers is its prevalence, which is more than 5%. Stunting among toddlers is considered a serious public health problem when its prevalence is between 10.1-15% and it is considered a critical problem, its prevalence is above 15.0%[3]. On a national scale, the prevalence of stunting among toddlers is 13.6%, indicating that it is still a serious public health problem in Indonesia.

One action that has been taken to improve nutrition is providing supplementary food, such as modified cassava flour (mocaf) tempeh date biscuits. This biscuit was chosen because it contains high levels of protein in the form of soybeans (tempeh), glucose (date), vitamins A and C and Fe to increase appetite. The theoretical basis for supplementation with this biscuit was demonstrated in the first study of stunting in Depok in 2010 and by two studies of tuberculosis (TBC) toddler malnutrition in Depok and East Jakarta in 2012 after 4-6 weeks of intervention. Three studies reported increases in weight and height of 1.3 kg and 0.7 cm, 0.7 kg and 1.7 cm, 0.4 kg and 2.4 cm, respectively[6-8].

However, the actions taken to improve family nutrition in posyandu (integrated service posts) were only aimed at reducing stunting and malnutrition. Government and private organizations/NGOs rarely focus on shortness and stunting. Therefore, it is necessary to conduct a study of nutritional intervention for short and stunted toddlers from poor families to prevent children from being short. Although, change in toddlers' height might not be related to changes in weight because the intervention only lasted 3 months, such efforts can atleast offer empirical evidence that such actions improved nutrition for short and stunted toddlers and encourage the government to more fully implement these actions at a later time. The research objective was to assess the effect of mocaf tempeh date biscuit consumption on the nutritional status of short and stunted toddlers. This study discovered that biscuits made from mocaf mixed with tempeh dates can be beneficial for wasted and stunted toddlers. This study will help researchers to investigate critical aspects of wasted and stunted toddlers that many researchers have not been able to explore thus leading to the development of new theories regarding the ingredients in this biscuit and other possible combinations.

MATERIALS AND METHODS

The study design was a quasi-experimental investigation of one group with a pre-test and a post-test using purposive sampling. Basic data collected included the socio-demographic characteristics of mothers (age, employment status, educational background) and toddlers (age, gender), the mothers' knowledge regarding nutrition for short and stunted toddlers, mocaf and food consumption over the last 24 h, which was collected at the beginning and end of the study. Ethical clearance was obtained from the Research Ethics Committee of the Research and Development Center of Health, The Indonesian Ministry of Health. The study was conducted at two villages in Depok city that were selected because they have a high prevalence of short toddlers (17.9%) and a high prevalence of stunted toddlers (8.5%)[9]. The inclusion criteria for toddlers participating in the study were being between 12 and 57 months of age, being male or female, having a Z-score for weight/height less than -2 standard deviations (SD) below the criteria for stunted toddlers and a height/age less than -2 SD[10] for short toddlers and not being part of a supplementary food program or recovery program for stunted toddlers.

The materials and tools used in this study were bathroom scales with a precision of 0.1 kg for measuring weight, a microtoise with a precision of 0.1 cm for measuring height and a questionnaire survey. The toddlers' food consumption was assessed with a 24 h food recall during the 90 days study. The screening of 50 short and stunted toddlers was conducted by a research team from The Faculty of Public Health, Universitas Indonesia, based on data from sub-district health centers and local neighborhood health centers. The mothers' compliance was monitored through a home visit by the research team in collaboration with local cadres from posyandu every 2 days and the research team also distributed the mocaf tempeh date biscuits as a 2 days supply at home. The toddlers' daily food

consumption was recorded for 2 days before the home visit. The toddlers' nutritional status after consuming the tempeh date biscuits was recorded by enumerators. Balanced nutrition education was provided at that time by posyandu cadres using printed media. At week 12 (the end of the intervention), the nutritional status of the toddlers was measured and validated to assess changes in weight and height and to determine the change in the mothers' nutrition knowledge before and after the study.

The primary data analysis included calculating the mean, standard deviation, minimum value, maximum value and proportions. The anthropometric data regarding the toddlers' weight were analyzed using the WHO 2007 standard, WHO AnthroPlus software version 02 (2009), based on height/age and weight/height indicators. Univariate analysis was conducted using SPSS version 13. The food consumption data used to assess the adequacy of macronutrient intake (energy, carbohydrates, protein, fat and fiber) and micronutrients intake (vitamin A, Fe and Zn) were analyzed using Nutri-survey. Independent t-test was used to assess changes in the macro- and micro-nutrient intake. One-way ANOVA test was performed to assess the mean intake of micro- and macro-nutrients, the socio-demographic characteristics of the mothers and the toddlers' nutritional status between measurement points.

RESULTS

Table 1 describes the proportions of male (50%) and female toddlers (50%). The mean number of toddlers was one/family, meaning that only one toddler/family received the mocaf tempeh date biscuits. The mean toddler age was 33 months, with a maximum of 57 months and a minimum of 12 months. The mean maternal age was 32 years, with a minimum of 21 years and a maximum of 46 years. Half of the mothers had a high school education (50%) and the rest had graduated from junior high school (24%) or elementary school (10%). However, there were also mothers who had graduated from a college/diploma program (6%) or a university/bachelor program (4%). More than three-quarters of the mothers did not work (86%) and the rest worked as private employees, factory workers or merchants.

The mothers' knowledge regarding short and stunted toddlers was assessed through questions about the definition, the results, the causes and the ways to prevent toddlers from being short or stunted. Only 18% of the mothers could correctly identify the definition of a stunted toddler, which is a toddler with a weight and height that are not normal. Most of the mothers said that stunted toddlers were those who had the weight that they should (42%). However, when asked about the definition of short toddlers, more mothers answered correctly (50%). Most of the mothers (over 75%) did not know the consequences or effects of being short or stunted. The majority of the mothers (approximately 90%) did not know the cause of shortness or stunting in toddlers and only approximately 10% of the mothers said that shortness and stunting were caused by a lack of baby food or a low intake of nutrition by pregnant women. Still, some mothers said that short toddlers came from short parents. Although most of the mothers did not know the cause of shortness or stunting in toddlers, they did indicate that eating a balanced diet could prevent a toddler from being short or stunted (Table 2).

Table 1: Frequency distribution of toddler and mother socio-demographic characteristics on all nutrition status groups

Variables	Number of people	Proportion (%)
Sex		
Female	25	50
Male	25	50
Number of toddlers of a mother		
1	37	74
2	13	26
Mean+SD	1.26+0.4	
Toddler's age (months)		
<24	14	28
24-36	15	30
37-60	21	42
Mean±SD	33.0+13.2	
Mother's age (years)		
Mean±SD	31.6+6.1	
Mother's educational background		
Low (<9 years)	19	38
Medium-high (>9 years)	31	62
Mother's Occupation		
Unemployed	43	86
Employed	7	14

Table 2 shows the mothers' knowledge regarding what mocaf is. They were asked whether they had heard of mocaf and whether they were aware of what it is, its benefits and the need to consume it at daily family meals. Almost all the mothers (92%) had never heard the term "mocaf" and only 6% knew that mocaf was made from cassava flour. A small proportion of the mothers who were familiar with mocaf stated that its benefits included being high in fiber and free of gluten. Most of the mothers did not indicate that they were willing to cook with mocaf because they did not know what it was.

The early screening of nutritional status indicated that the number of short toddlers was higher (52%) than the number of stunted toddlers (22%), short and stunted toddlers (26%). At the end of the study, there were decrease in the prevalence of short toddlers to 24%, short and stunted toddlers to 6% and stunted toddlers to 12%. The remaining toddlers (58%) had a normal nutritional status after participating in the study for 3 months (Table 3).

Table 2: Frequency distribution of mother's knowledge on short and stunted toddler and mother's knowledge on modified cassava flour

Variables	Number of people	Proportion (%)
Knowledge on short and stunted toddler		
Definition of stunted toddler		
Having body weight less than normal	21	42
Having body height and body weight	9	18
Less than normal		
Having body height less than normal	5	10
Others: Less nutrition	7	14
Less active	1	2
Don't know	7	14
Definition of short toddler		
Having body height less than normal	27	54
Having body height and body weight	3	6
Less than normal		
Having body weight less than normal	4	8
Others: Less nutrition	5	10
Inherited	1	2
Don't know	10	20
Effects on short and stunted toddler		
Fat when adult	11	22
Vulnerable from infectious disease	7	14
Being short when adult	10	20
No effect at all	6	12
Others: Will have short children	2	2
Don't know	15	30
Cause of short and stunted toddler		
Baby only gets breast milk till 2 years old	3	6
Baby gets supplementary food besides breast milk	4	8
Baby sick quiet often	8	16
Baby gets less food intake	20	40
Inherited	8	16
Don't know	7	14
Preventive action of short and stunted toddler		
Consuming nutritious food	31	62
Giving exclusive breast milk	4	8
Swimming	1	2
Don't know	14	28
Knowledge on modified cassava flour		
Has or has not heard about modified cassava flour		
Yes	4	8
No	46	92
Mocaf ingredient: Cassava	4	100
Benefits of mocaf: High in fiber	2	50
Free from gluten	2	50

Table 3: Changes of toddler's nutrition status at the end of study

	Pre-study		Post-study	
Variables (toddler)	n	%	n	%
Short	26	52	12	24
Stunted	11	22	6	12
Short and stunted	13	26	3	6
Normal	0	0	29	58

Table 4 illustrates the relationship between the demographic characteristics of the toddlers and mothers, with the nutritional status of the toddlers based on height/age indicators. The short toddler group had a different nutritional status (height/age) at the end of the study ($p<0.05$), as indicated by a decrease in the height/age Z-score at the end of the study. The toddlers between 36 and 59 months of age had a change in their height/age Z-score from the beginning of the study, when they fell into the short range on average, to the end of the study, when they fell into the normal range on average. The toddlers' gender and health status at the time of the interview and the mothers' age and education level contributed to the change in nutritional status ($p<0.05$).

Table 4: Relations between demographic characteristics of toddlers and mothers and toddler's nutrition status based on body height/age indicators

	Body height/age			
Variables	Pre	Post	Difference	p-value
Toddler's nutrition status				
Short and stunted	-2.220	-2.030	0.190	0.418
Short	-2.484	-2.176	0.308	*0.001
Stunted	-1.144	-0.893	0.251	0.055
Toddler's age (months)				
<24	-2.098	-1.650	0.448	0.006
24-35	-1.893	-1.780	0.113	0.330
36-59	-2.235	-1.963	0.273	*0.005
Sex of toddler				
Male	-2.082	-1.792	0.291	*0.006
Female	-2.105	-1.848	0.258	*0.003
Toddler's health status				
Sick	-2.237	-1.985	0.253	*0.040
Healthy	-2.007	-1.715	0.292	*0.001
Mother's age (years)				
20-30	-2.211	-1.883	0.328	*0.011
>30	-1.987	-1.754	0.233	*0.002
Mother educational background				
Junior high	-2.328	-1.973	0.355	*0.001
Senior high+	-1.821	-1.632	0.189	*0.036

*p<0.05

The nutritional status of short toddlers based on weight/height at the end of the study remained different from that of the other toddler groups. Although nutritional status was analyzed according to the demographic characteristics of the toddlers and mothers, none of these characteristics differed significantly with changes in nutritional status, as indicated by weight/height Z-scores. Furthermore, the other five independent variables (toddler gender, toddler age, toddler health status at the time of the interview, mother's education and mother's age) did not affect the nutritional status of short and stunted toddlers at the end of the study (Table 5).

Table 6 illustrates the effects of the macro- and micro-nutrient intakes for all nutritional status groups. The intake of energy, protein and fat led to changes in nutritional status ($p<0.05$). The short-stunted toddlers and the stunted toddlers groups tended to have lower macro-nutrient intakes. The intake of vitamin A, Fe and Zn did not affect the nutritional changes in any of the groups, but the short-stunted

toddler group tended to have a lower intake of these micronutrients. Unlike the other groups, short toddlers had an increased intake of vitamin A, Fe and Zn, but the changes in these nutrients intake were not significant at the end of the study (p>0.05).

DISCUSSION

Changes in toddlers' nutritional status shortly after eating mocaf tempeh date biscuits for 3 months were influenced by energy, fat and protein intake. Consuming 50 g of mocaf tempeh date biscuits per day allows a toddler aged 1-3 years old to meet 22% of their energy consumption requirements, 11.2% of their protein requirements and 27% of their fat requirements[11]. By consuming 50 g of biscuits each day, toddlers aged 4-5 years old met 15.5% of their energy consumption requirements, 8.3% of their protein requirements and 19.2% of their fat requirements. The increase in weight and height in this study was similar to a previous study which provided tempeh date biscuits as supplementary food[12]. That study reported increases of 1.9 kg in weight and 2.5 cm in height. The nutritional status improved for short toddlers in one study and for stunted toddlers in the second study. The differences in the study results may be due to differences in the taste of the biscuit. Tempeh date biscuits have a better taste than mocaf tempeh date biscuits. Therefore, taste also indirectly affects children's willingness to consume both types of biscuits.

Table 5: Relations between demographic characteristics of toddlers and mothers and toddler's nutrition status based on body weight/body height indicators

	Body weight/body height			
Indicators	Pre	Post	Difference	p-value
Toddler's nutrition status				
Short and stunted	-2.565	-1.000	1.565	0.169
Short	-0.589	-0.822	-0.233	0.013*
Stunted	-2.258	-1.516	0.741	0.103
Toddler's age (months)				
<24	-1.489	-0.970	0.519	0.368
24-35	-1.952	-1.601	0.351	0.259
36-59	-0.663	-0.649	0.013	0.942
Sex				
Male	-1.505	-1.196	0.309	0.300
Female	-0.986	-0.783	0.203	0.411
Toddler's health status				
Sick	-1.225	-1.286	-0.061	0.771
Healthy	-1.339	-0.883	-0.456	0.119
Mother's age (years)				
20-30	-1.006	-0.840	0.166	0.638
>30	-1.552	-1.198	0.354	0.120
Mother's educational background				
Junior high	-1.253	-0.927	0.326	0.299
Senior high+	-1.348	-1.150	0.198	0.432

*p<0.05

The decline in the prevalence of short toddlers in this study is supported by another study of short toddlers conducted in Bangladesh[13]. That study showed a decrease in the prevalence of stunting from 44-39% over the 18 months of the study. The main difference in the decrease in the prevalence of stunting in these studies may be caused by differences in study design. The second study used a clustered, randomized trial design and this study used a quasi-experimental design. However, the study results were not consistent with those of many other studies that found no increase in height and no decrease in stunting[14,15].

Theoretical/methodological studies of mocaf tempeh biscuits (made from mocaf flour, tempeh flour and dates) can support the fact that providing mocaf tempeh date biscuits to toddlers is beneficial by gaining weight and height. This program was indirectly able to improve nutritional status based on macro indicators of height by increasing the energy, protein and fat intake of the toddlers who consumed the biscuits. The protein content of 100 g of tempeh flour is greater (46.5 g) than the protein content of soybeans (42.6 g). Tempeh flour also has higher fat and carbohydrate contents (19.7 g and 30.2 g/100 g of flour, respectively) than soy

Table 6: Effects of macro-nutrient and micro-nutrient intakes on all nutritional status groups

	Short and stunted			Short stunted			Total		
Indicators	Pre	Post	p-value	Pre	Post	p-value	Pre	Post	p-value
Intake of macro-nutrient									
Energy (cal)	1631.3	1431.6	0.22	1341.5	1600.2	*0.004	1510.2	1571.8	0.51
Protein (g)	46.3	39.4	0.39	40.9	49.8	*0.007	48.5	46.3	0.64
Fat (g)	59.3	53.5	0.50	48.1	62.1	*0.001	62.8	60.9	0.79
Carbohydrate (g)	230.5	197.4	0.48	183.5	210.3	0.09	186.1	209.1	0.25
Fiber (g)	5.8	5.9	0.92	4.2	6.2	0.09	3.6	4.7	0.04
Intake of micro-nutrients									
Vitamin A	1261.3	1065.5	0.67	614.4	1263.2	0.14	1157.3	2055.6	0.24
Fe	28.4	13.0	0.45	7.1	9.9	0.06	12.0	16.0	0.53
Zn	6.2	5.1	0.29	5.3	6.5	0.03	6.0	6.2	0.69

(19.1 and 28.5 g, respectively). One hundred grams of date jam contains 463 kcal of energy, 9.17 g of protein and 9.12 g of fat. Dates increase immune system activity and appetite. The combination of soybean flour and date jam as the base materials of the biscuits is good because these ingredients can enhance the effectiveness of supplementation by increasing appetite and improving the immune response compared with biscuits that are only made from tempeh or dates.

CONCLUSION AND RECOMMENDATIONS

A change in weight was found for the three groups of short toddlers. The change was 0.2 kg for weight and 1.9 cm for height over a 12 weeks intervention in which the toddlers were given 50 g of mocaf tempeh date biscuits each day. This increase was caused by the increased energy, fat and protein intake in the short toddlers. Tempeh biscuits are good for short and stunted toddlers, stunted toddlers and short toddlers because they can increase weight and height as part of supplementary food programs. Therefore, this kind of biscuit is recommended as an alternative food choice in supplementary food recovery programs in health centers, posyandu, supplementary food programs for school children and therapeutic feeding centers (TFCs) in the community health center in Depok. The wheat flour in tempeh date biscuits can be replaced with mocaf or cassava flour, canna flour, arrowroot flour, breadfruit flour and other flours. These biscuits support food security in Indonesia because Indonesia is a rich source of food tubers. In addition, soybean flour can be replaced with lentils that have been converted into lentil flour as a source of protein. Tempeh date biscuits made with flour are safe for children with autism if they are free from wheat and dairy. These biscuits are also safe for consumption by vegetarians if they are made without eggs, which is feasible because the eggs function only as a softener and adhesive in the biscuit dough.

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