

Effect of Tempeh Dates Biscuits on Nutritional Status of Preschool Children with Tuberculosis

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ABSTRACT

Introduction: Preschool children with tuberculosis (TB) often experience weight loss. Previously, underweight children have been given a supplement of soy protein biscuits made from *tempeh*. However, the efficacy of tempeh dates biscuits on nutritional status on underweight TB children has not been previously done. This study aimed to assess the effects of tempeh dates biscuit supplementation on the nutritional status of underweight TB children. **Methods:** A quasi experimental study was conducted on 41 subjects from the intervention group (tempeh dates biscuit) and control groups (tempeh and placebo biscuits). Parameters such as anthropometric data, hemoglobin, albumin, and macro-micronutrients intake were analysed before and after the intervention. **Results:** The three groups showed significant difference in weight, height, and albumin, except for hemoglobin, after six weeks. Tremendous weight and height gain was shown by the tempeh biscuit group (1 kg) and the placebo biscuit group (3.5 cm). The biggest positive change in nutritional status (weight for age) was recorded by the tempeh group (0.5 points). Hemoglobin level was increased by 0.4 point in the intervention group. The mean for blood albumin levels increased by 0.1 point among the intervention and the control groups. **Conclusion:** Although no evidence was found of a large gain in weight and height in the intervention group, the inclusion of the tempeh dates biscuits in the diet was able to increase hemoglobin level compared with the control group. A similar study in anemic children is necessary to assess the effect of tempeh dates biscuits on hemoglobin changes.

Keywords: Albumin, height, hemoglobin, tempeh dates biscuits, under-five children, weight

INTRODUCTION

Tuberculosis (TB) is a severe and contagious disease which remains a public health problem in the world. Around 45% of TB patients have been classified as underweight with 26% experiencing anorexia after being diagnosed with TB. The prevalence of malnutrition in TB patients is

caused by the disease process itself and a delay in diagnosis. Poor nutritional status will delay the healing process and increase the frequency of recurrence. Often, patients with TB who underwent treatment for 6 months still did not experience any weight gain (Yew, 2006).

Weight loss is associated with risk and severity of disease and response to therapy.

Good nutrition in the early treatment of TB will increase weight, fat-free mass, and physical function. Good nutritional status during treatment will reduce prevalence of the recurrence and accelerate the conversion of acid-resistant bacteria in sputum because anti tuberculosis drugs (ATD) shorten the duration of treatment (Yew, 2006). Poor nutritional status is one of the contributing factors for the high prevalence of TB. Weight gain, as one of the indicators for nutritional status during ATD administration, obviously has significant correlation with rapid conversion of sputum smear, low incidence of relapse, and duration of ATD administration in TB patients (Yew, 2006).

Malnutrition improvement through the provision of adequate food and high protein will end the process of depletion and encourage cell repair, mucosal tissue, cell integrity, and the immune system such as improving body defense and healing with tuberculosis treatment. An adequate intake of nutrients in the diet increases the nutritional status of the patients and has an effect on improving the immune system that helps to accelerate the healing of tuberculosis (Krishna *et al.*, 2009). In addition, in the case of children, in administering the TB drugs to combat the bacteria and break the chain of transmission, it is important to conduct nutritional counseling for children's mothers to raise awareness of the increasing need for food of their under-five children during sickness and the ways to increase their food intake.

Various sources of good quality protein can be chosen to meet increased protein intake needs during healing of TB such as meat, fish, eggs, milk, and soy (protein). A food with high nutrition content is tempeh (a soybean preparation) and dates in the form of a biscuit. Biscuits are preferred by under-five children. Some supplementary feeding programmes for undernourished children use biscuits. It is necessary to produce biscuits made from soy flour with extra dates jam to improve nutritional status of under-five children.

Dates (*Phoenix dactylifera*) and tempeh (*Glycine max*) were selected as raw materials because tempeh is made from soy flour, which is enriched by isoflavone, an antioxidant, and which serves as a functional food. Vegetable protein from soybean has the potential to replace animal protein from eggs, fish, and beef (Koswara, 1995). Meanwhile, dates contain high carbohydrates (glucose), vitamin A, minerals, and fibre, which can enhance weight as they serve as high energy resources to stimulate growth of under-five children. Dates also serve to increase the appetite of children and adults (Badwilan, 2008). Thus, it is necessary to conduct a study to determine the effect of tempeh date biscuit consumption on nutritional status changes in underweight preschool children with TB.

Several studies on nutrition intervention have been conducted in Indonesia. One study showed that high-protein foods (soy protein) as a supplementary food improved the nutritional status of patients with TB (Taslim, 2006). Another study revealed an average weight gain of 1.3 kg in the intervention group and an increase in height of 2.8 cm in the control group. There were significant differences in terms of weight and height gains between the three types of biscuit consumption (Fatmah *et al.*, 2012). Intervention studies on tempeh date biscuit consumption for underweight children aged 5 years with TB is not available in Indonesia. Hence this study was undertaken to assess the effect of consuming tempeh date biscuit on changes in nutritional status of children using anthropometric (weight and height) and biochemical (hemoglobin and albumin) measurements.

METHODS

Study design

The study used quasi-experimental pre-test and post-test design (single-blind study) on 41 subjects selected from over 8 districts in

East Jakarta. Ethical clearance was obtained from the Research Ethics Committee of the National Institute of Health Research & Development Ministry of Health. Initial anthropometric screening of nutritional status for the selection of subjects was conducted by measuring weight and height of 113 under-five children with TB in the selected subdistrict health centres. Under-five children with TB and index Z-score W/A (weight for age) below < -2 standard deviation (WHO, 2006) were included in the research study along with blood sampling for examination of hemoglobin and albumin levels. Each subject received 50 grams of biscuits during 6 weeks and was randomly assigned into the treatment group (tempeh dates biscuit) and control group (placebo biscuit and tempeh biscuit). However, boredom and children wanting to get back to their home at Central and West Java, led to 72 children dropping out from the study, leaving 41 subjects.

Baseline survey

Before intervention, baseline data were collected using a structured interview questionnaire that included the following: demographic characteristics of under-five children (age, sex) and mothers (age, education level); knowledge on nutrition and incidence of TB and history of TB transmission; smoking behaviour of family members at children's home; and food consumption by 24-hour recall. At the end of the intervention, final baseline data collection covering knowledge of mothers on TB and nutrition, weight and height measurement, and hemoglobin and albumin examination was undertaken again.

Subjects

Subjects were selected based on the secondary data of the under-five TB patients from the District Health Office in East Jakarta and 8 subdistrict health centres. Inclusive criteria for this study were as follows: (1) children aged 12 to 59 months with TB (with

or without ATD) or those who had a TB history; (2) those who had undergone ATD treatment within the last 4 months so that at the end of the intervention period, subjects would have completed their long-term ATD treatment during the 6 months; (3) those with malnutrition or undernourishment status (W/A score); and (4) those who obtained informed consent from parents, especially mothers, to participate throughout the study.

Follow-up procedures

All study subjects were followed up every two weeks to monitor their weight and height. The research study team visited all children in their homes once in a 5-day week period. During each visit, the study team distributed the 5 packs of biscuits for the next five days, collected the food record forms from mothers, recorded health status of the subject, and checked for compliance with anti-TB therapy. During each visit, the team distributed the biscuits, collected the plastic pack of the biscuit, and recorded the number of biscuits left uneaten at that point in time. The objective of the home visit was to check on preschooler compliance with their instructions and to make sure that they ate the biscuits regularly.

All mothers in the study were subjected to a health promotion programme to enhance their knowledge of the importance of good nutrition. It was hoped that this programme would indirectly help raise awareness of mothers on the need to ensure that their children consumed the biscuits as instructed

Statistical analysis

Anthropometric data (weight and height) were analysed using WHO Anthroplus software version 02 of 2009 (WHO, 2009) based on W/A as an indicator. Food consumption data to assess the adequacy of macronutrients (energy, protein, and fat) and micronutrient intakes were analysed using Nutrisurvey and then compared with the recommended dietary allowance of

children aged 12 to 59 months (WNPG, 2004). Univariate and bivariate data analysis was conducted using SPSS version 13. Paired *t*-test was used to assess changes in the mean intake of energy, protein, fat, vitamin A, vitamin C, Ca, Zn, Fe, weight, height, albumin, and hemoglobin before and after intervention in each group. ANOVA test was used to assess the mean of all the above-mentioned variables by group (between groups).

Anthropometric and biochemical data collection

Anthropometric data including weight and height were measured using SECA digital scales and microtoa by trained field workers. Indicators of Z-score $W/A < -2$ SD were used to determine the nutritional status of under-five children (WHO, 2005). Hemoglobin and albumin were measured by trained laboratory personnel from a private laboratory in Jakarta. Anemia was determined depending on the following: hemoglobin level, < 11.0 g/dL, and normal albumin level, > 3.5 g/dL.

Food consumption data

To assess daily food intake, a food record was used to assess the adequacy of the average intake of macronutrients that included energy, carbohydrate, protein, and fat, as well as micronutrients that play a role in improved health of TB patients (vitamin A, vitamin C, vitamin B6, Ca, Zn, and Fe). Data were analysed using Nutrisurvey food consumption (WHO, 2005).

Biscuit formulation

Biscuits used in this study were made from egg yolks, white sugar, butter, wheat flour, maize flour, and essence/pasta of strawberry, pandanus, or chocolate. As much as 1.4 kg of soybean flour was used to make the tempeh biscuit and for the tempeh dates biscuits, 20 gram of dates jam was added for each biscuit. The placebo biscuits

were made by beating egg yolk until white in colour with a mixer before adding the white sugar, butter, and maize flour. To this mix, wheat flour was gradually added without the aid of a mixer until the dough was smooth and could be made into shapes. The process of making the tempeh and tempeh dates biscuits was similar to the placebo biscuits, except for the addition of soybean flour and dates jam. All the biscuits were in the shape of animals, figures, and plants to attract the attention of preschool children, and baked for 15-20 min at a temperature of 160°C.

RESULTS

Nutritive value of biscuits

The content of macronutrients and micronutrients in 100 grams of three types of biscuits are presented in Table 1. Compared to tempeh dates biscuits and placebo biscuits, 100 g of tempeh biscuits contained higher amounts of energy (516 kcal), fat (27.5 g) and Zn(1.46 mg) (Table1). Nutrients, such as carbohydrate (66.1 grams), protein (8.44 g), Ca (49 mg), Fe (1.32 mg), and vitamin C, in tempeh dates biscuits were higher than those in tempeh and placebo biscuits. Meanwhile, the placebo biscuits merely contained high amounts of carbohydrates (70.4 grams) and Zn, similar to tempeh dates biscuits.

Baseline survey

The pre-intervention baseline survey included information on the socio-demographic profile of mothers and under-five children and other aspects of TB (Table 2). The highest mean age of children younger than five years was recorded in the tempeh dates biscuit group, and the lowest in the placebo biscuit group. The majority of the subjects in the tempeh biscuit group were aged 12 to 23 months; those in the tempeh dates biscuit group were aged 36 months, whereas those in the placebo group

Table 1. Nutritive value of three types of biscuit per 100 gram

Type	Type of nutrient									
	Energy (calori)	Carbohydrate (gram)	Protein (gram)	Fat (gram)	Ca (mg)	Fe (mg)	Zinc (mg)	Vit. A (IU)	Vit. B6 (mg)	Vit. C (mg)
Tempeh dates	485	66.1	8.44	22.6	49.0	1.32	1.28	< 0.5	< 0.02	0.82
Tempeh	516	58.7	8.40	27.5	41.4	0.96	1.46	< 0.5	< 0.02	0.77
Placebo	462	70.4	5.03	17.8	31.1	0.63	1.28	< 0.5	< 0.02	< 0.2

From BBIA Laboratory, Bogor 2012

Note 1 RE = 3,33 IU

Content of vitamin A in each biscuit is < 0,5 IU = < 1,67 RE

were between 12 and 23 months. The ratio of male to female in the tempeh biscuit group was 1:1. Female subjects were more dominant in the treatment group than in the control group. The mean number of female children younger than five years was similar in both tempeh and tempeh dates biscuit groups. There was a significant difference in mean age among mothers for all groups ($p < 0.05$). Most of the mothers of under-five children in either the treatment group or the control group had only 9 years of education.

At the beginning of the intervention, the mothers from both treatment and control group already knew about '*flek paru*' or the term used for tuberculosis in Indonesia, and no mother said that it was a cursed disease. They stated that TB attacks the pulmonary organ and may be transmitted from adult persons with TB to the children through the air, either by coughing or sneezing. Most of the children's mothers said that the symptoms were cough or cold, stable weight, loss of appetite, and frequent fever. When asked about their children's health status with TB over the last two-week period, almost 75% of children younger than five years in the placebo biscuit group were reported to be having cough and fever. This proportion was higher than in the sick under-five children in the placebo and tempeh biscuit groups.

Most mothers of under-five children in the tempeh dates biscuit group realised that their children had TB after pulmonary X-ray tests showed positive results. The

majority of the mothers of under-five children in the placebo and tempeh biscuit groups stated that their children had tested positive for the Mantoux test which proved that their children had TB. However, some mothers of under-five children in the tempeh dates and tempeh groups admitted that they did not know or had forgotten how they found out that their children had TB. Most under-five children had been infected by their father or mother and none by a brother or sister in the same house or by other adults or friends. However, some of them still had less knowledge about TB or were unable to remember how the disease was transmitted to their under-five children.

When asked whether their children were still on anti-tuberculosis medication, they responded that their children were still undergoing treatment. In terms of duration of TB, the lowest duration was experienced by the tempeh biscuit group, and the highest by the placebo biscuit group. There was a significant differences between groups for duration of TB. The mean period of under-five children experiencing TB was similar to the period of taking anti-tuberculosis medication, 4 months for the placebo biscuit group and 6.2 months for the tempeh biscuit group.

The mean highest score of mothers' knowledge about nutrients after intervention was found in the placebo and tempeh biscuit groups (1.3 points). However, there was no significant difference in knowledge scores between groups, except in the tempeh biscuit

Table 2. Baseline survey at pre-intervention of 41 unde-five children

	Tempeh dates		Type of group				p-value			
	n	%	p-value	Tempeh n	%	Placebo p-value		n	%	p-value
Age (months)										
Mean \pm SD	37.5	\pm 28.1		34.1	\pm 17.3		28.2	\pm 14.4		0.34
12-23 months	4	26.6		3	18.8		4	40.0		
24 -35 months	7	46.8		5	31.3		3	30.0		
\geq 36 months	4	26.6		8	50.0		3	30.0		
Sex										0.39
Male	5	33.3		8	50.0		6	60.0		
Female	10	66.7		8	50.0		4	40.0		
Mother										
Age (year)										
Mean \pm SD	30.1	\pm 5.4		30.1	\pm 6.5		24.7	\pm 3.2		*0.04
Last education level										
Low (< 9 years)	7	46.6		5	31.1		2	20.0		0.37
Middle (\geq 9 years)	8	53.4		11	68.9		8	80.0		
Test of TB diagnosis										
Tuberculin/Mantoux	4	26.7		7	43.8		7	70.0		
X-ray rontgen	7	46.7		4	25.0		3	30.0		
Mantoux test & X-ray	2	13.3		3	18.8		0	0.0		
Did not know/forgot	2	13.3		2	12.4		0	0.0		
Source of TB infection										
Father	3	21.4		3	20.0		0	0.0		
Adult neighborhood	3	21.4		0	0.0		0	0.0		
Mother	2	14.3		3	20.0		2	20.0		
Others	4	28.6		5	33.3		1	10.0		
Friend	1	7.1		0	0.0		1	10.0		
Adult brother/sister	0	0.0		0	0.0		1	10.0		
Do not know	1	7.1		4	26.7		5	50.0		
Status of ADT										
Still taking	11	73.3		9	40.0		9	90.0		
Stopped taking	4	26.7		6	60.0		1	10.0		
Taking of ADT										
Regular	11	84.6		16	100.0		10	100.0		
Irregular	2	15.4		0	0.0		0	0.0		
Duration suffered from TB										
Mean \pm SD	5.6	\pm 3.0		7.4	\pm 3.8		4.1	\pm 2.1		*0,04
Duration taking ADT										
Mean \pm SD	4.6	\pm 1.9		6.2	\pm 4.1		4.0	\pm 2.2		0,09
Nutrition knowledge of mothers										
Pre-intervention										
Mean \pm SD	5.9	\pm 2.7	0.16	7.1	\pm 2.1	* 0.04	5.5	\pm 3.3		0.25
Post-intervention										
Mean \pm SD	6.9	\pm 1.9		8.4	\pm 1.7		6.8	\pm 2.0	0.04	0.42
TB knowledge of mothers										
Pre-intervention										
Mean \pm SD	6.1	\pm 3.8	0.05	5.9	\pm 4.6	* 0.005	7.8	\pm 1.2	0.12	
Post-intervention										
Mean \pm SD	7.8	\pm 2.9		9.4	\pm 2.4		8.2	\pm 2.0	0.60	0.19

*significant level at $p < 0.05$

group ($p < 0.05$). Also, the mean highest score (3.5 points) on TB knowledge was found in the tempeh dates and tempeh biscuit group, and was significantly different before and after intervention ($p < 0.05$), except for between groups. Most of the mothers of the tempeh biscuit group were found to have a good level of nutrient knowledge. The majority of mothers of all the groups had a good level of knowledge on TB.

At the first intervention, most mothers knew that taking anti-tuberculosis medication and having a normal weight could improve the recovery process. After the nutrient and TB campaign at the last intervention, all mothers stated that there was a relationship between weight and recovery from the disease. They said that normal weight advanced the TB recovery process and less weight slowed it down.

Nutritional status changes

There was a significant difference in mean weight, height, and Z scores and weight for age among all groups (Table 3). The highest

increment in weight (1.0 kg) was recorded by subjects in Group II with tempeh biscuits, followed by an increment of 0.7 kg recorded by subjects in Group III with placebo biscuits. For height, Group III registered a mean increment of 3.5 cm, and Group II (tempeh group) registered the least increment of 2.6 cm.

Group I showed the highest increase in hemoglobin gain (0.4 point), whereas the other two groups showed a decrease in hemoglobin as they had experienced anemia at the last intervention. The mean albumin concentration increased in all three groups, with the highest increment recorded by the tempeh dates biscuit group (0.2 point). There were significant differences in the albumin gain between the three groups during follow-up ($p = 0.00$).

Biscuit consumption and micro-nutrient and macronutrient intake

Table 4 shows the total mean of treatment and control group biscuit consumption and micro-nutrient and macronutrient intake

Table 3. Nutritional status changes pre-post intervention inter-group

	Group of biscuits						p-value inter group
	Tempeh dates		Tempeh		Placebo		
	Mean ± SD	p-value	Mean ± SD	p-value	Mean ± SD	p-value	
Weight							
Pre-intervention	10.4 ± 3.2	* 0,006	11.0 ± 2.5	*0.00	9.7 ± 2.0	*0.02	0.46
Post-intervention	10.8 ± 3.2		12.0 ± 2.7		10.4 ± 2.1		0.28
Height							
Pre-intervention	83.5 ± 10.6	*0.001	88.3 ± 11.0	*0.00	82.2 ± 8.4	*0,00	0.26
Post-intervention	86.9 ± 11.8		90.9 ± 1.,2		85.7 ± 8.7		0.43
Z-score BB/U							
Pre-intervention	- 2.3 ± 0	* 0,05	- 2.1 ± 0.6	*0.00	- 2.2 ± 0.8	*0.007	0.75
Post-intervention	-1.9 ± 0.9		-1.6 ± 0.8		-1.8 ± 1.3		0.38
Hb							
Pre-intervention	11.4 ± 1.3	0.31	11.5 ± 0.8	0.08	11.7 ± 1.0	0.47	0.78
Post-intervention	11.8 ± 1.8		11.1 ± 0.8		11.2 ± 1.7		0.42
Albumin							
Pre-intervention	4.5 ± 0.5	0.06	4.7 ± 0.2	0.13	4.6 ± 0.2	0.78	0.40
Post-intervention	4.7 ± 0.3		4.8 ± 0.2		4.7 ± 0.5		*0.00

*significant level at $p < 0.05$

Table 4. Mean biscuits total consumption (gram) and micronutrient and macronutrient intake (mg)

	<i>Biscuit Group</i>						<i>p-value inter-group</i>
	<i>Tempeh Dates</i>		<i>Tempeh</i>		<i>Placebo</i>		
	<i>Mean ± SD</i>	<i>p-value</i>	<i>Mean ± SD</i>	<i>p-value</i>	<i>Mean ± SD</i>	<i>p-value</i>	
Biscuits consumption	1500 ± 56	8.5	728 ± 443		1860 ± 339,8		0.17
Mean macronutrient intake							
Energy							
Pre-intervention	928.0 ± 247.90	0.76	809.1 ± 236.4	0.21	881.2 ± 192.0	0.51	0.36
Post-intervention	955.4 ± 24	6.6	854.3 ± 244.3		949.3 ± 218,6		0.44
Carbohydrate							
Pre-intervention	133.5 ± 36.4	0.19	105.6 ± 26.8	*0.00	131.7 ± 18.9	0.16	*0.02
Post-intervention	153.1 ± 55.0		127.4 ± 36.9		147.6 ± 9.6		0.24
Protein							
Pre-intervention	34.4 ± 19.2	0.75	31.2 ± 15.4	0.16	29.3 ± 11.8	*0.02	0.73
Post-intervention	35.9 ± 10.7		34.7 ± 10.4		38.1 ± 11,8		0.74
Fat							
Pre-intervention	39.7 ± 15.0	0.64	30.5 ± 9.9	*0.00	27.1 ± 6.4	*0.00	*0.03
Post-intervention	42.3 ± 14.0		41.3 ± 8.6		37.9 ± 9.6		0.63
Mean micronutrient:							
Calcium							
Pre-intervention	173.3 ± 109.4	0.08	464.5 ± 300.4	0,34	403.6 ± 353.9	0.07	0.59
Post-intervention	345.7 ± 321.1		522.4 ± 258.9		633.9 ± 424,0		*0.00
Ferrous							
Pre-intervention	4.3 ± 2.5	0.38	6.7 ± 3.7	0.90	5.1 ± 3.4	0.05	0.45
Post-intervention	5.4 ± 2.5		6.8 ± 2.8		8.3 ± 4.8		*0.02
Zinc							
Pre-intervention	2.9 ± 1.4	0.48	3.5 ± 1.6	*0.00	3.4 ± 1.4	*0.04	0.58
Post-intervention	3.3 ± 1.8		4.4 ± 1.5		5.3 ± 2.5		0.06
Vitamin A							
Pre-intervention	519.4 ± 313.1	0.62	599.4 ± 360.5	0.47	466.3 ± 485.7	0.25	0.67
Post-intervention	580.1 ± 412.7		761.9 ± 800.7		663.5 ± 382.7		0.36
Vitamin C							
Pre-intervention	15.0 ± 15.9	*0.02	32.8 ± 17.9	0.38	21.7 ± 28.8	*0.04	0.32
Post-intervention	28.2 ± 30.7		42.9 ± 45.9		47.6 ± 33.0		*0.00

*significant level at $p < 0.05$

within 6 weeks of intervention. The placebo biscuit group had the highest biscuit consumption compared to the tempeh and tempeh dates biscuit groups. There were no significant differences in total biscuit consumption between the three groups.

Macronutrient intake assessments included energy, carbohydrate, protein, and fat. Subjects in the placebo biscuits group had the highest energy and protein intakes, whereas the highest mean carbohydrate intake was in the tempeh biscuit group. The

highest mean fat intake was observed in the control group. There were significant differences in mean carbohydrate and fat intakes in the treatment and control groups, especially for the tempeh biscuit group at the last intervention. The placebo biscuit group had different mean intakes of protein and fat before and after intervention.

The intake of micronutrients, vitamin C, vitamin A, Zn, Fe, and Ca was assessed in this study. There were significant differences in vitamin C, Fe, and Ca intakes in the

treatment and control groups. The change in vitamin C intake was significantly different for Group I. Group II had a significant difference in Zn intake, while Group III experienced a significant difference in intake for both vitamin C and Zn.

DISCUSSION

Compliance of subjects to consumption of biscuits was observed through the daily home visit, recording the flow of biscuit distribution and collecting the empty plastic pack of the biscuits, and requesting the food record of mothers. Compliance to the procedures was also reflected in the gain in weight of children who consumed biscuits regularly and the twice a week nutritional status monitoring.

A limitation of the study was the small sample size. As the drop-out rate was large, the period of supplementation and follow-up was brief and could have led us to miss the beneficial effect of the high nutrient dense biscuits on growth indices in the overall cohort as the primary outcome. At the time the study began, there were 20 subjects in each group; however 5 subjects dropped out in the intervention group, 5 in the tempeh group, and 10 in the placebo group. Stated causal factors for dropping-out were boredom, moving house without a clear reason, and low motivation on the part of some mothers to support biscuit consumption of their children. Consequently, this resulted in a big variation in biscuit consumption in the three groups.

A major finding in the study is the change in nutrition status of the children. After 6 weeks of intervention, the under-nutrition status of under-five children with TB from the three groups, moved to normal nutrition. Excessive weight and height gain occurred in groups taking tempeh biscuits and placebo biscuits. The weight increase in the tempeh biscuits group was affected by the mother's knowledge of nutrition and

TB, as well as carbohydrate and fat intake. A huge height gain in the placebo biscuit group ensued because the protein and fat mean intake was great. In addition, the mean biscuit consumption was higher (1860 grams) than in both treatment groups during intervention. However, weight and height changes experienced by the treatment group were not as great as those in the control group, but there were differences in the means of those groups. The change was not as drastic as that in the treatment group, and may be attributed to the structure of the biscuits: the two layers of the tempeh dates biscuits as well as the firm texture may have made it difficult for children to chew, despite the biscuits being stirred together with warm water or milk or mixed with rice. Other factors include dropping out from the TB drug schedule and lack of mother's efforts to encourage consumption of tempeh dates biscuits among children.

In the present study, it was observed that after 1.5 months of supplementation, there was no statistical difference between the intervention group and placebo in terms of weight and height gain, z score, and Hb. However, weight and height gains before and after the intervention in each group are in line with the study on potato meal supplementation for malnourished children in India over a 3-month period which saw significant differences in weight and height (Peerkhan *et al.*, 2009). However, the highest weight gain in tempeh biscuits group is in contrast with the study on underweight children in Depok City (Fatmah *et al.*, 2012). Though the present study showed an increase in weight gain (1.3 kg) in the tempeh dates biscuit group, differences in weight change in the Indian and Depok studies compared with the present study is probably caused by TB as a concomitant infectious disease. Adequate nutrition intake during disease treatment is not likely to escalate children's weight during the six months of treatment. Weight gain generally comes from fat mass, while fat-free mass includes

protein and may take longer (Karnovsky & Sbarra, 1960; Beisel & Fiser, 1970). Furthermore, the status of TB is different in subjects who are in the intensive phase, the advanced phase or even almost completing the advanced treatment. Probably, most subjects in the tempeh dates biscuits group were in the middle of the advanced phase or almost finishing this phase.

A rapid difference in hemoglobin change after the intervention was probably caused by most subjects crying and resisting blood extraction. Consequently, laboratory staff resorted to extracting blood even when they were crying. Additionally, during blood extraction, it was found that some of the subjects had fever, upper respiratory track infection, and diarrhea, affecting their desire to eat. A higher Hb mean at post-intervention in the tempeh dates biscuits group might be caused by the high contents of Fe and vitamin C in the dates. Vitamin C has a role in hemoglobin production in the blood by helping the absorption of Fe from foods for processing into red blood cell. The findings of this study are similar to the study on multivitamin supplementation that contains B complex vitamin, vitamin A, and vitamin C for Tanzanian's under-five children over a 8-week period. There was an escalation of 1.2 points of Hb mean at the end of the study (Saurabh, 2011).

In the present study, the increase in albumin serum and hemoglobin in the treatment and control groups is in line with the study on biscuits fortified with Fe and Zn and made from a combination of tempeh and bran for anemic and underweight children (Kurnia 2010). There was no significant difference in weight gain, but there was an increase in albumin and hemoglobin levels. The present study was supported by the study on high protein biscuit intervention on malnourished under-five children (Sah, Sah & Ambady 1972; Peerkhan, 2009). Both these studies succeeded in showing the significance of albumin serum and hemoglobin change after

an intervention period of 3 and 9 months. If we assess the difference in outcome between these two studies and the present study, study duration and the presence of a concomitant infectious disease such as TB determine the significance. Concomitant infectious diseases influence nutrition intake largely because of absorption and metabolism disorder. Moreover, children with TB and Fe deficiency could experience decreased blood circulation to tissues. In an anemic condition, hemoglobin level lower than 11 mg/dl will be followed by low albumin level in the blood (McMuray 1981).

Hemoglobin level improvement at the end of the intervention was observed in the tempeh dates biscuits group. A high level of Fe and vitamin C are found in the dates biscuits. Fe level in dates regulates the formation of hemoglobin in red blood cells and prevents anemia primarily for pregnant women. Zn could increase children's appetite. Vitamins A and C, as antioxidant agents, contribute to increased immunity. Nonetheless, iron deficiency anemia (IDA) was often found in children with TB who previously had anemia; so they become more susceptible to TB or vice versa (Krishna *et al.*, 2009).

The albumin level before and after intervention for each group showed no statistical difference, but the albumin level inter-group post-intervention showed a statistically different result ($p=0.000$). Protein Energy Malnutrition (PEM) children with TB have reduced serum protein levels especially albumin in PEM due to the consumption of a protein deficient diet. High energy and protein diet thorough biscuit supplementation in the study on PEM children with TB can increase albumin serum level. However, the difference in energy and protein contents in each biscuit (placebo, tempeh, and tempeh dates) did not influence the albumin level after intervention in each group.

Zinc intake had a different role at pre-intervention and post-intervention in the

tempeh biscuits group. As Zinc contributes to vitamin A metabolism, Zn deficiency will impair retinal binding protein (RBP) synthetics and retinal plasma. Zn supplementation will benefit vitamin A metabolism that is important to normal T and B lymphocyte functions, macrophages activity, and the formation of the antibodies on TB children. Tempeh dates and placebo biscuit groups had significant differences in weight, height and Z-score gains before and after intervention. There is a relation between vitamin C deficiency and the occurrence of TB disease; TB could increase in severity if vitamin C deficiency occurs (Krishna *et al.*, 2009).

CONCLUSION

Weight, height, Z score W/A, and albumin changes in the treatment and control groups had a significant difference, except in the case of hemoglobin level. The greatest weight and height changes in the tempeh and placebo biscuit groups were influenced by mothers' knowledge on TB and nutrition, as well as carbohydrate, protein, and fat intakes. The study should be followed up by another study focusing on the TB children currently in an intensive treatment phase of the first two months because excessive weight gain will occur at this phase. The duration of the intervention should be longer, perhaps 3 months. In addition, it is important to assess the post-intervention immunology status at about one or two months after the end of the study. A similar study needs to be conducted on anemic children to assess if hemoglobin status can be improved by the consumption of dates jam.

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