

Effect of Tempeh-Date Biscuits Supplementation for Undernourished Older Adults

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Abstract

Underweight older adults problem had adverse effect on their health status and productivity. It will lead to chronic diseases and psychological illness, even death. The study aimed to investigate the effect of tempeh-date biscuits consumption on the nutritional status of undernourished older adults.

Non-randomized pre-post two group intervention involved 70 research participants aged over 60 years. The intervention group was given tempeh-date biscuits and the control group was given modified cassava flour tempeh-date biscuits for 4 weeks.

Nutrition knowledge, anthropometric, hemoglobin (Hb), and albumin were collected at pre-post-intervention. Mean Body Mass Index (BMI) of the intervention group was increased by slightly more 0.9 points than the control group (0.5 points).

There was significant difference in the increase mean BMI at both groups ($p = 0.000$). Mean Hb change of the control group was a little bigger (0.1 points) than the intervention group.

The increased mean albumin was the same in both groups (0.2 points). There were significant differences of increased Hb and albumin in the intervention group at post study ($p = 0.024$, $p = 0.000$, respectively). Tempeh-date biscuit and mocaf date biscuit are an alternative supplementary food for undernourished older adults.

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Introduction

Malnutrition in older adults is increasing due to prolonged lack of appetite (anorexia). Some studies showed that PEM (Protein Energy Malnutrition) in older adults can cause a higher risk of exposure to acute illness, death, and longer hospitalization (length of stay). Older people with low nutritional status are more susceptible to infectious diseases, immune at increased risk of deficiencies, reduced productivity, at high risk of complications of degenerative diseases, and death.¹ Increasing older-age population will also likely improve problem of PEM amongst this population.

A study on providing support in the form of trans-mural nutrition (diet/nutrient-rich foods, supplements, and nutritional counseling) for older adults with PEM showed a significant change in BMI.² A state of malnutrition that occurs in older

adults cannot be separated from food intake.³ A study conducted by Nisa (2006) showed that older adults with less energy intake will suffer from malnutrition at 14.8 times greater than the older adults who have sufficient energy intake.⁴ Other studies on support in the form of a special high-protein nutritional formula for older adults who experienced weight loss in five geriatric care units showed an increase in average weight of 5 kg in 143 older adults in the first year of research.⁵ Another nutritional support program involved the provision of supplementary food, such as bread fortified with vitamin D, in a nursing home in Romania, but this particular program was implemented to cause a change in bone mineral density.⁶

Improved nutrition in older adults with poor nutrition status/PEM can be achieved by using calorie-dense foods. The food can be given in the form of a snack that is offered between meals. The National Health and Nutrition Examination Survey (NHANES) reported that 84% of older adults consume a snack that contributes almost a quarter of their energetic needs per day, but most of these snacks are high in fat and sugar.¹ Things to consider in choosing

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a snack for older adults among others, are avoidance of high-fat foods, foods that are too sweet, and those high in sodium, as well as the selection of appropriate portion sizes.⁷

One form of food suitable for older adults with PEM is snack crackers because they can be given between two meals, such as breakfast and lunch. In addition to having a sweet taste, they are preferred by older adults. The function of the biscuits is not as a substitute for meals (food replacement) daily, but only as a supplement to food. Biscuits can be consumed with milk or sweet tea, which can provide additional energy for older adults with PEM. Unfortunately, until now, there has not been an intervention study on The Indonesian older adults with PEM involving supplementation with nutrient-dense biscuits, except the provision of supplementary food at the integrated health post for older adults (*posbindu*) in form of a complete meal meets the criteria of balanced nutrition. The last intervention studies in older adults conducted outside Indonesia involved limited supplementation of MSG (monosodium glutamate) in Japan. The purpose of the studies was to improve the flavor and taste of food for older adults, but these studies are still very limited.⁸ Therefore, it is necessary to conduct a study to assess the effectiveness of tempeh date biscuit consumption in improving the nutritional status of malnourished older adults, assessed by anthropometric (weight/height and BMI) and chemical measures (hemoglobin and albumin).

Methods

Study Design

The study design was a quasi-experimental (nonrandomized pre-post intervention studies) by using consecutive sampling. Ethical clearance was obtained from the Research Ethics Committee of the National Institute of Health Research & Development Ministry of Health. Informed consent form should be filled out by the research participants before the study. Older adults with PEM were selected as research participants and nonrandomized into two groups by consecutive sampling. Independent variables consisted of the older adults' characteristics including age, gender, education, employment, knowledge of nutrition, and intake of macronutrients (energy, protein, fats, and carbohydrate).

Tools and Materials

A structured questionnaire was used in this study, including socio-demographic characteristics of older adults (age, ethnic group, educational background, and occupation), knowledge of nutrition, food consumption records in the last 24 h, and anthropometric data on weight and height. Digital scales with a precision of 0.1 kg were used to obtain weight, and height was measured using a microtoise to the nearest 0.1 cm, media including flip charts and leaflets, were used for counseling older adults on balanced nutrition.

The tools to make tempeh-date biscuits and mocaf tempeh-date biscuits included a dry cake pan, a gas oven, wooden flattened tools, a mixer, cookie cutters, digital scales, a large basin of aluminum cookie dough that had been whipped with a mixer, and a large wooden spoon to mix the ingredients evenly throughout the flour. Tempeh-date biscuits ingredients were: wheat flour, tempeh flour, dates jam, margarine, white sugar, and egg yolk.

Mocaf tempeh dates ingredients consisted of modified cassava flour, tempeh flour, dates jam, white sugar, and egg yolk. Each 50 gram of tempeh-date biscuits was prepared to provide energy 245 kcal, 30.9 gram of carbohydrate, 4.81 gr of protein, and 11.35 gr of fat. While 50 gr of mocaf tempeh-date biscuits contains of 247.5 kal of energy, 30.9 gr of carbohydrate, 2.9 gr of protein, and 11.9 gr of fat.

Research participant

Research was carried out in the region of three selected *posyandu* in Depok City, West Java Province. This selection of districts is based on the fairly high prevalence of older adults with a low BMI.⁹ Inclusion criteria for the research participant were the following: elderly women and men at least 60 years of age, having a BMI <18.5 kg/m², not currently undergoing treatment or suffering from certain chronic diseases and infection, not having dementia, and willing to eat only tempeh date biscuits in the treatment group and mocaf tempeh date biscuits in the control group as a snack during the study. The exclusion criteria for the study sample were the following: dementia, undergoing treatment for or suffering from certain chronic diseases.

The calculation of sample size to obtain the required number of samples in the study according to the proportion of the population used the formula for hypothesis testing in different proportions.¹⁰ By using the proportion of

data from previous studies ($p = 0.67$), the number of samples is obtained from the calculation of 80 samples (becomes 40 for each sample in the treatment group and the control group). Each research participant in the control group and the intervention group consumed 50 gr of biscuit per day during 120 days of intervention. Their compliance observed by the trained enumerators who recorded their food intakes twice a week by visiting their home. Weight and height measurements undertaken by the enumerators bi-weekly. The nutrition education for older adults also given at the same time after the anthropometric measurement.

Data Analysis

Basic data analysis includes frequency demographic distribution (gender, age), knowledge of balanced nutrition, historical of illness in the last year, educational background, occupation, income, and daily physical activity of older adults. Data were analyzed in SPSS version 13. The description of the variables is presented in the form of graphs and tables. Food consumption data to assess the adequacy of energy intake, carbohydrate, protein, and fat were analyzed by Nutrisurvey and then compared to the nutritional adequacy rate of older adults.¹¹ Bivariate analysis by paired *t*-test was performed to assess the change in mean weight and height as well as knowledge of balanced nutrition of older adults from pre- to post-intervention.

Results

Table 1 illustrates that the number of research participants aged below 65 years and those aged above 65 years both in the two groups were nearly equal (51.4% and 48.6%, respectively). Almost all research participants involved in this study were female (88.6%), and most research participants had a low level of education, ranging from not attending school at

all to not finishing primary school. Half of the study research participants did not work (71.4%). The rest worked as private employees, vendors, and others.

From a total of 70 older adults who meet the criteria for inclusion in this study, there were changes in the nutritional status from pre- to post-intervention consisting of weight, height, BMI, Hb, and blood albumin (Table 2). The intervention group consisted of 33 older adults who consumed tempeh date biscuits. A total of 37 older adults were given mocaf tempeh date biscuits in the control group. The research participants of the intervention group had an increase in mean body weight of 0.9 kg and the control group research participants had an increase in mean of body weight of 0.6 kg over the 2-month intervention. There were no changes in mean height in either group at the end of the study. There was a significant difference in weight from pre- to post-intervention in both groups ($p = 0.000$).

Indicator	n	%
Sex:		
Male	8	11.4
Female	62	88.6
Age:		
High risk (< 65 y.o)	34	48.6
Non high risk *(< 65 y.o)	36	51.4
Highest level of education:		
Low (no schooling up to not graduated from elementary/ junior high school)	2	80.0
Middle (graduated from senior high school/academy)	42	20.0
Working status:		
No	50	71.4
Yes:	1	2.9
Private employee		
Merchant	2	1.4
Others	17	24.3

Table 1. Sociodemography characteristic of the research participant (n = 70)

Indicator	Intervention (n=33)			P value	Control (n=37)			p-value
	Pre	Mid	Post		Pre	Mid	Post	
Weight (kg)	36.3 ± 4.4	36.5 ± 4.3	37.2 ± 4.8	*0,000	37.4 ± 5.3	37.5 ± 5.6	38.0 ± 5.8	*0.000
Height (cm)	148.3 ± 6.9	148.3 ± 6.9	148.3 ± 6.9	-	149.2 ± 8.1	149.2 ± 8.0	149.2 ± 8.1	-
BMI (kg/m ²)	16.6 ± 1.0	16.9 ± 1.0	17.5 ± 1.4	*0,000	16.7 ± 1.4	17.0 ± 1.6	17.2 ± 1.9	*0.000
Haemoglobin	12.3 ± 1.2		12.4 ± 1.2	*0.024	11.9 ± 1.6		11.9 ± 1.6	0.217
Albumin	3.8 ± 0.3		4.0 ± 0.3	*0.000	3.7 ± 0.3		3.9 ± 0.3	*0.000

Table 2. Change mean of nutritional status by anthropometric and biochemical indicators

*p value < 0.05

The mean BMI value of the research participants in the intervention group increased slightly more (0.9 points) compared with the research participants in the control group (0.5 points). There were significant differences in the mean BMI increase in both research participant groups ($p = 0.000$). The mean Hb change at the end of the study in the intervention group was slightly larger (0.1 points) than that in the control group of which the value was fixed. The increase in mean albumin in both groups was the same: 0.2 points. A significant difference was found in the increase in Hb and albumin in the research participants of the intervention group ($p = 0.024$ and $p = 0.000$, respectively). The significantly different increase in Hb was not found in the research participants of the control group ($p = 0.217$).

Table 3 illustrates the change in the mean intake of macronutrients (energy, carbohydrates, fats, and proteins) and micronutrients (vitamin A,

zinc, iron, and sodium) in the intervention group and the control group. The mean increase in energy intake in the control and intervention groups was 275.7 kcal and 412.6 kcal, respectively. The mean carbohydrate intake in the intervention and control groups was 36.8 and 26.5 g, respectively. The intervention and control groups had increases in mean fat intake of 24.4 g and 17.8 g, respectively. The difference in the mean increase in vitamin A intake in the intervention group was higher (567.2 IU) than in the control group (421.5 IU). The mean Zn intake in the intervention group was slightly larger (1.3 g) than that in the control group (0.6 g). Significant differences in mean energy intake, carbohydrate, protein, fat, vitamin A, sodium, and zinc before and after the interventions were found in the research participants of the intervention group. The control group had significant differences in energy intake, fat, vitamin A, and zinc between pre- and post-intervention.

Type of nutrition	Control Group (n=37)			Intervention Group (n=33)		
	Pre	Post	p value	Pre	Post	p-value
Energy (cal)	1093.6 ± 273.5	1369.3 ± 414.5	*0.01	1139.9 ± 397.1	1552.5 ± 609.3	*0.001
Carbohydrate (gr)	154.0 ± 38.4	180.5 ± 76.4	0.09	151.8 ± 49.3	188.6 ± 81.2	* 0.01
Protein (gr)	4.4 ± 11.8	38.1 ± 10.5	0.25	33.8 ± 14.7	44.6 ± 19.5	*0.004
Fat (gr)	38.4 ± 17.3	56.2 ± 17.8	*0.00	45.0 ± 22.2	69.4 ± 42.6	*0.01
Vitamin A	430.4 ± 333.6	851.9 ± 973	*0,04	406.2 ± 271.7	973.4 ± 258,5	*0.02
Sodium	318.5 ± 426.7	331.1 ± 237.7	0.90	343.9 ± 313.9	479.3 ± 337.0	*0.04
Fe	68.1 ± 2.4	102.0 ± 37.9	0.17	71.6 ± 5.2	99.0 ± 10.9	0.216
Zinc	3.9 ± 1.5	4.7 ± 1.5	0.07	3.8 ± 1.6	5.1 ± 2.2	*0.002

Table 3. Change mean macro-micronutrient intakes

*p value < 0.05

Discussion

The female research participants were still dominant due to higher life expectancy in women than men.¹² The comparison of the percentage of research participants at aged high risk of exposure to degenerative diseases was the same as the non-high-risk age. Most research participants' educational background was low. This findings are consistent with the large number of older adults who were not in school. The research participants who were no longer working were more comparable to those who still work as tradespeople, private employees, etc. These findings do not correspond with the fact that the percentage of older adults who were still working were less than 50%.¹³ Older adults are quite active economically in the labor market because of economic necessity.¹⁴

The intervention group had slightly larger weight gained than those in the control group. This is in line with similar studies conducted in malnutrition in older adults in selected nursing homes.^{15,16} Weight gain difference in the present study with the two previous studies may be due to the differences in length of the two interventions. The longer the intervention studies are carried out, the greater is the weight gain that occurs in older adults. The intervention group had slightly larger increased BMI than those in the control group. The findings of this study are in line with the therapeutic intervention of the elderly in the US.¹⁷ However, these finding are in contrast with those of a study in Denmark.¹⁸

The main difference between tempeh-date biscuits and mocaf tempeh-date biscuits are on the macronutrient contents. Mocaf contains less energy, protein, and fat than wheat flour.

Each 100 gr mocaf has energy 358 kcal, 0.19 gr protein, and 0.02 gr fat. While 100 gr wheat flour contains energy 365 kcal, 8.9 gr protein, and 1.3 gr fat.¹⁹ Weight gain in the intervention group was influenced by macronutrient (energy, carbohydrates, protein, and fat), vitamin A, and zinc intake. Tempeh-date biscuits contains higher protein and zinc than mocaf tempeh date biscuit. Stimulation of food intake for older adults can be improved by providing energy-dense foods as a snack.^{20,21} Energy requirement of older adults ranged from 1425 to 1900 calories for women and 1525 to 2325 calories for men. It must be provided by a snack from 285–465 calories a day.¹² The energy provided from both tempeh date biscuits and mocaf tempeh date biscuits were enough to meet energy from snacks. The intervention group had a greater increase in mean Hb at the end of the study. This might be due to the higher content of Fe (iron) in tempeh-date biscuits compared with mocaf tempeh date biscuits. The high content of iron as a conductor of oxygen from the lungs to the tissues to the Hb of red blood cells automatically increased the blood Hb concentration rapidly.

Limitation of the study

One of the obstacles encountered during the course of the research was that some of the research participants who participated in this study dropped out part way through the study. There were seven research participants in the intervention group and three research participants in the control group who withdraw from the study for reasons of feeling bored, finding that the biscuits were tasteless, causing them to lose their appetite, going to their hometown without the certainty of coming back, worrying that they would become fat because of the increased appetite, and being edentulous, making it difficult to eat biscuits due to their inability to chew them, although the biscuits were quite soft. The length of the study, which was originally planned to last for 2 months, was shortened to 1 month due to the month of fasting (*Ramadhan*).

Older adults do not want to eat biscuits during *sahur* (pre-dawn meal time) and fast-breaking time. This can also lead to biased research data because the condition of older adults who are fasting can reduce the consumption of biscuits every day, which can certainly cause a change in weight, Hb, and albumin. In addition, the difficulty of finding malnourished older adults in the community as well as the length of the secondary

data of underweight elderly obtained from the elderly community health center coordinator in Pancoran Mas Sub-district at Depok City caused a postponement of primary data collection from April-May, 2014 to June-July, 2014.

Some older adults felt worried when giving blood for Hb and albumin examination at the beginning and end of the study. They were afraid that the blood drawing would be painful, so the laboratory staff explained that there would no side effects nor from the procedure. Another obstacle faced by the research team was the difficulty communicating with some of the older adults as a result of reduced hearing and visual capacity of the older adults. This was addressed by speaking in their ear in a loud voice and with eye contact. Another obstacle found in the field is the difficulty older adults have recalling the food eaten during the previous 24 h (24-h food recall). Enumerators should restate the type of food that has been eaten by older adults to confirm what they have said.

Conclusions

Both groups had mean gained weight, BMI, Hb, and albumin at post study. There were significant differences between the two groups for anthropometric and biochemical indicators, namely weight, BMI, and albumin, except Hb at the intervention group. Between the two groups, the intervention group had significant difference in macronutrients (energy, protein, carbohydrate, and fat) and micronutrient intakes (vitamin A, natrium, and ferrous) at post study. Energy, fat, and vitamin A intakes had significant difference at the control group after the study. The study should be followed up by other study involving the participants with tuberculosis, other infectious disorders or anemia as such conditions also affect appetite, weight gain and nutritional status.

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Conflict of Interest and Funding Disclosure

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