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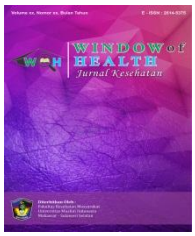

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Effect Of Consumption Of Soy Milk And Tempeh In Women Aged 20-30 Years With Premenstrual Syndrome

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ABSTRACT

There are 73.3% of women in Bekasi experiencing symptoms of premenstrual syndrome (PMS). Isoflavone can help with PMS symptoms. The aglycone form of isoflavones has high bioavailability. Analyze the consumption of tempeh and soy milk in reducing SPAF (Shortened Premenstrual Assessment Form) scores. The study used a quasi-experimental method with a pretest and posttest control group design. The intervention was giving soy milk and tempeh for 14 days before menstruation. The sampling technique was used purposive sampling as many as 30 women and divided into 3 groups. PMS symptom assessment using the SPAF questionnaire. The dependent variable in this study is PMS. The independent variables in this study were the consumption of soy milk and tempeh. And the cofounded variables in the study are physical activity, food intake, and stress factors. Data analysis will be carried out using paired t-tests, One-Way ANOVA, and ANCOVA. Consuming soy milk in the treatment group can reduce the SPAF score ($p = 0.003$). Meanwhile, there was no significant decrease in the group that consumed tempeh ($p = 0.105$). There was no significant difference in symptom reduction between tempeh and soy milk groups ($p = 0.818$). The influence of confounding variables ($R = 0.560$), namely physical activity ($p = 0.042$). Consumption of soy milk can significantly reduce SPAF scores, while the decrease in SPAF score on tempeh consumption is not significant. It is noted that there is another strong influence, namely high physical activity.

Keywords : PMS; premenstrual syndrome; soy milk; tempeh

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INTRODUCTION

Premenstrual syndrome (PMS) is a condition experienced by women with the appearance of several physical symptoms, emotions, and behavioral changes that occur before menstruation which sometimes interfere with daily activities, and symptoms will slowly disappear when menstruation comes.[1] The etiology of PMS is still unknown and there may be several causative factors. Factors such as culture, attitude, age, physical activity, diet, and lifestyle are possible causes of PMS.[2] PMS refers to several symptoms, the most common symptoms are categorized as physical, psychological, and behavioral.

An initial survey was conducted on 100 women of reproductive age in Bekasi aged between 20-30 years old. The initial survey used a questionnaire method related to PMS symptom management behavior. Based on the survey, it was found that WUS in Bekasi handled PMS symptoms by eating high-calorie foods (33.3%) and taking painkillers (16.3%) and the rest did not do anything.

PMS management includes lifestyle modifications including initiating physical activity, avoiding stressors, and managing sleep habits, especially during menstrual periods.[3] Dietary control is suggested by increasing the consumption of complex carbohydrates, increasing the consumption of vitamin B6, and foods containing isoflavones can also reduce symptoms.[4] Consumption of isoflavone-containing foods, especially in soy products, can reduce PMS symptoms because isoflavones are considered to have the same structure and activity as estrogen (phytoestrogen).[5] Soy protein contains a high concentration of isoflavones, up to 1 g/kg.[6] Research by Islami A in Surabaya, women with PMS symptoms consuming 300 ml of soy milk for 14 days before the next menstruation can reduce the physical and psychological symptoms of PMS but not significantly so researchers recommend consuming soy products with daily adequacy recommendations.[7] Another study by Novadela in Lampung, women with PMS symptoms consuming soy milk for 1-2 weeks before the next menstruation can reduce > 5 PMS symptoms to < 4 PMS symptoms. [8]

In one piece of literature, it is said, that soy products that have passed the fermentation process have higher bioavailability than those that are not fermented because these products do not rely on gut microbiota to digest them.[9,10] Research conducted in Japan, in women aged 20-45 years given isoflavone supplements containing fermented soy products consumed during 2 menstrual cycles.[11] Another study conducted in Thailand, this study looked at the effects of the consumption of Thai fermented soybean on estrogen hormone balance. Both studies showed that fermented soybean products can balance estrogen hormones in the body to reduce the incidence of PMS.

Numerous studies have investigated the relationship between soy isoflavone intake and the incidence of PMS. However, there has been a lack of research comparing the effects of consuming fermented versus non-fermented soy products. The use of soy milk as a non-fermented soy product is because soy milk has high daidzein isoflavones compared to other non-fermented products, which is 12 mg/glass.[7] While tempeh is a fermented product, there has been no research related to tempeh with

PMS symptoms, and tempeh has almost the same daidzein as soy milk, which is 12-15 mg / 100 grams.[7] Giving soy milk and tempeh is by the recommended daily intake of isoflavones, namely soy milk as much as 500 ml/day and tempeh 100 grams/day.[12] The purpose of this study was to analyze the difference in the effect of giving soy milk and tempeh on reducing PMS symptoms in women aged 20-30 years in Bekasi City.

METHODS

This study used a type of quasi-experimental research with a pre-post control group design. This research was conducted in Bekasi City during May-June 2021. This research has been presented to the Bioethics Commission, and informed consent for research respondents has been obtained from all subjects who participated in the study. In this study, there were no dropouts, so 30 subjects were divided into 3 groups. The subjects of this study used inclusion criteria, namely willingness to be a subject by filling out an informed consent sheet, age 20-30 years, unmarried during the study time, not using or taking hormone therapy / contraceptive drugs, not an athlete, and also not a vegan/vegetarian. The exclusion criteria were pregnant subjects, married subjects during the study, subjects who resigned, and subjects who did not regularly consume the given intervention. The sampling technique in this study used non-random sampling (purposive sampling). Research subjects will be grouped by matching groups with moderate-severe PMS symptom scales and normal-overweight nutritional status groups.

The dependent variable in this study was premenstrual syndrome (PMS). PMS was assessed using the Shortened Premenstrual Assessment Form (SPAF) questionnaire. The independent variable in this study is isoflavone intake, which is achieved by giving soy products, namely soy milk (non-fermented soy products), and tempeh (fermented soy products). Tempeh and soy milk were consumed for 14 days before the next menstruation began. Soy milk consumed by treatment subject 1 was liquid soy milk provided by the researcher with the brand "Soya Toya", which is a home industry, with soybeans used as much as ± 40 grams / 250 ml, so that it has the amount of isoflavones ± 32 mg / 250 ml. Soy milk consumed was 500 ml/day. Tempeh consumed by treatment subject 2 was tempeh commonly sold in the market, which is commonly called leaf tempeh. Each subject consumed 100 grams of tempeh every day for 14 days. Soy milk and tempeh were given 2 - 3 times a week by the researcher. Control subjects were not given anything but only received educational interventions using brochures containing the management of PMS symptoms. Educational intervention was also provided to both treatment groups. During the intervention time, the treatment group was asked whether or not they consumed the product today or any other soy products to see their compliance. Confounding variables in the study were physical activity, dietary intake, and stress factors. Physical activity assessment was calculated using the IPAQ-SF questionnaire with categorization.[13] Stress factors used in the DASS-21 questionnaire[14] In addition, macronutrient intake (carbohydrates, protein, and fat) and micronutrient intake (Magnesium, Vitamin B6, and Isoflavones) influence increasing or decreasing PMS symptoms. The subject's food intake was seen by doing a recall of a 3x24-hour method by

looking at energy adequacy, macronutrient adequacy (carbohydrates, protein, fat), daily sugar consumption adequacy, and micronutrient adequacy that affects the incidence of PMS, namely isoflavones, magnesium, and vitamin B6. Data normality testing used the Shapiro-Wilk test. Differences in PMS symptoms before and after the intervention in the three groups were analyzed using the Paired t-test. Differences in PMS symptoms (Δ PMS Symptoms) between the three groups were analyzed using the One-Way ANOVA test. The effect of soy milk and tempeh on PMS symptoms was analyzed using ANCOVA after controlling for confounding variables.

RESULTS

Characteristics of Research Subjects

Table 1 shows the characteristics of age, occupation, nutritional status, physical activity, and stress factors.

Table 1. Characteristics of Research Subjects

	Soy Milk Group	Group Tempeh	Control	n	%
Age					
20-25 Years	10	9	10	29	96,7
26 - 30 Years	0	1		1	3,3
Jobs					
Student	9	6	10	25	85,3
Work	1	4		5	16,7
Nutrition Status					
Normal	9	9	9	27	90
Overweight	1	1	1	3	10
Physical Activity*					
Low	4	5	5	14	46,7
Medium	2	1	3	6	20
Weight	4	4	2	10	33,3
Stress Factors**					
Normal	1		2	3	10
Lightweight		1		1	3,3
Medium	1	1	1	3	10
Weight	1		1	2	6,7
Very Heavy	7	8	6	21	70

Description: *Calculated using IPAQ-S ** Calculated using DASS-21

Based on the results of Table 1, the characteristics of the research subjects were mostly 20-25 years old (96.7%), with most of the students (85.3%) having normal nutritional status (90%). The research subjects had moderate—to—heavy physical activity (53.3%) and stress factors in the very heavy category (70%). Table 2 describes the physical activity characteristics and stress factors of the research subjects.

Table 2. Description of Physical Activity and Stress Factors of Research Subjects

	Soy Milk Group	Tempeh Group	Control	p
	Mean ± SD	Mean ± SD	Mean ± SD	
Physical Activity (MET minutes/week)	1734±2543,13	1331,2±1728,7	617,05±621,7	0,390[a]
Stress Factors	28,50±15,50	23,70±9,79	19,70±13,37	0,337[a]

Description: [a]One-Way ANOVA

Based on the results of Table 2, the physical activity of the treatment group has an average of 1300-1700 MET-minutes / week, which is included in the category of heavy activity, which means that it has an intensity time of ± 60 minutes/week. The mean score of stress factors in all research subjects was > 17, which means the subject has a weighty stress factor. In physical activity and stress factors, there were no significant differences in the three groups. The characteristics of eating habits during the intervention of the research subjects can be seen in Table 3.

Table 3. Characteristics of Eating Habits at Intervention of Study Subjects

	Soy Milk Group	Tempeh Group	Control	p
	Mean ± SD	Mean ± SD	Mean ± SD	
Energy Adequacy (%)*	65,91 ± 7,48	76,85 ± 11,72	64,46 ± 15,90	0,062[a]
Carbohydrate Adequacy (%)*	53,10 ± 8,10	67,12 ± 14,54	57,04 ± 14,37	0,055[a]
Protein Adequacy (%)*	120,39 ± 15,21	132,09 ± 24,03	91,55 ± 34,77	0,005[a]
Fat Adequacy (%)*	76,29 ± 17,50	81,57 ± 15,99	73,11 ± 18,99	0,560[a]
Magnesium Sufficiency(%)*	76,56 ± 23,66	67,50 ± 19,60	39,88 ± 28,68	0,003[b]
Vitamin B6 Adequacy (%)*	66,15 ± 17,44	76,91 ± 16,61	48,46 ± 19,51	0,005[a]
Glucose Adequacy (%)**	63,96 ± 30,60	90,04 ± 39,76	77,54 ± 29,80	0,242[a]
Isoflavone Adequacy (mg)***	61,75 ± 15,70	55,26 ± 12,12	12,66 ± 13,79	<0,001[b]

Description:
*AKG 2019, **Sugar Consumption Guidelines/day KEMENKES, ***BPOM Daily Isoflavone Consumption
[a]One Way ANOVA Test[b] Kruskal Wallis

Based on Table 3, it is known that the percent adequacy of the nutritional needs of the subjects according to the age group and gender of the AKG 2019. Percent adequacy of energy, carbohydrate, fat, magnesium, and vitamin B6 was classified as mild deficit (< 60%) in all three groups. High protein intake in the treatment group (<110%), as well as isoflavone intake by the recommendations in the treatment group (<50 mg/day). There were significant differences in the intake of protein, magnesium, vitamin B6, and isoflavones in the three groups (p<0.05). The characteristics of PMS symptoms of the study subjects before and after the intervention can be seen in Table 4.

Table 4. Characteristics of PMS Symptoms of Research Subjects

	Soy Milk Group	Tempeh Group	Control	n	%	Mean
Symptoms Before						
Medium	4	4	4	12	40	32,2
Weight	6	6	6	18	60	
Symptoms After						
Lightweight	4	2		6	20	
Medium	4	5	5	14	46,7	26,2
Weight	2	3	5	10	33,3	

In Table 4, 60% of subjects had severe symptoms before the intervention. PMS symptoms before the intervention had a mean score of 32,2. After the intervention, 46.7% of subjects had moderate symptoms with a mean score of 26,2.

Effects of Soy Milk and Tempeh Consumption on PMS

Table 5. Effect of Pre-Post Intervention on SPAF Score

		Mean±SD	P-value
Control	Pretest	29,60±3,565	0,782[a]
	Posttest	29,30±4,296	
Soy Milk	Pretest	34,10±9,061	0,003[a]
	Posttest	23,70±6,147	
Tempeh	Pretest	33,20±6,596	0,105[a]
	Posttest	27,20±9,114	

Description:
[a] Paired t-Test

Based on the results of the table above, it is found that the value of the soy milk group is $p < 0.05$, which means that H0 is rejected, namely, there is a relationship between the provision of soy milk products and the reduction of SPAF scores. In the milk group, the value of $p > 0.05$, which means H0 is accepted, that is, there is no significant relationship between tempeh consumption and a decrease in SPAF scores.

Table 6. Difference in SPAF Score between the Three Groups

	Soy Milk Group	Tempeh Group	Control Group	p
	Mean ± SD	Mean ± SD	Mean ± SD	
ΔSPAF Score	-10,40 ± 8,222	-6,00 ± 10,530	-0,030 ± 3,335	0,028[a]

Description
[a]One Way ANOVA Test

Table 6 showed that there was a significant difference in the change in SPAF score (ΔSPAF score) between the three groups ($p < 0.05$). In the soy milk group, the score decreased by 10 points, and the tempeh group declined by 6 points. While in the control group, there was a decrease of 0.03 points.

Table 7. Effect of Soy Milk and Tempeh Feeding on ΔSPAF Score

Group		P
Control	Soy Milk	0,029[a]
	Tempeh	0,104[a]
Soy Milk	Tempeh	0,818[a]

[a] Post Hoc Test

Post Hoc test results showed the effect of soy milk and tempeh was significant in the soy milk-control treatment ($p < 0.05$). Changes in PMS symptoms in this study were influenced by independent variables (consumption of soy milk and tempeh) and confounding variables (physical activity, stress factors, macronutrient intake, magnesium intake, vitamin B6 intake, and daily sugar

consumption), so bivariate tests were needed to determine the effect of variables on research subjects in the soy milk group with controls.

The results of bivariate analysis using the Pearson test showed that 2 variables had $p < 0.05$, including physical activity ($p = 0.016$) ($r = 0.552$), and stress factors ($p = 0.026$) ($r = - 0, 439$). Then the variables were further analyzed using the ANCOVA test to determine the effect of these variables on changes in SPAF scores.

Table 8. Factors Affecting the SPAF Score

Variables	p[a]	Adjusted R^2
Corrected Model	0,001	
Physical Activity	0,042	0,560
Stress Factors	0,086	
Groups	0,013	

Description: Dependent variable: Δ change in SPAF score
[a]ANCOVA test,b Soy Milk Group, Control

The results of the ANCOVA analysis showed a significant corrected model value, which means that physical activity, stress factors, and treatment groups have a simultaneous influence on changes in SPAF scores. The covariate physical activity ($p = 0.042$) has a linear relationship with changes in SPAF scores, while the covariate stress factor ($p = 0.086$) shows no linear relationship with changes in SPAF scores. To continue the ANCOVA testing for the treatment group while controlling for physical activity, we found a significant difference in SPAF scores between those who consumed soy milk and those who did not, after accounting for physical activity ($p = 0.013$).

DISCUSSION

In this study, the subjects were 20-25 years old. Women aged 20-25 years have a higher risk of STDs than those below. The incidence of PMS tends to increase with age and joins the same climacteric symptoms when approaching menopause.[7] Research conducted in Korea shows that women aged 18-49 years have irregular menstrual cycles and unusual menstrual periods, and the incidence of PMS is as much as 18.4%.[15]

The nutritional status of the subjects was mostly normal. This is shown in each group, where 90% of subjects have a normal nutritional status. Every 1 kg/m2 in Body Mass Index (BMI) is associated with an increased risk of STDs.[16] Research in Turkey shows that every 1 kg/m difference in BMI2 in each research subject can increase the risk of PMS events by 3%.[17] In physical activity, most of the subjects had moderate-to-heavy physical activity. Too little and too heavy physical activity can increase the risk of PMS.[2,6,18] One study showed that women active in physical activity have higher PMS scores than sedentary women.[2,7,19] Also, the subject's stress factor is classified as a lot in the very heavy category. High stress can reduce the serotonin hormone in the body, which, if sustained, will

increase the risk of PMS.[2,8,20] As research conducted in Aceh, women with severe PMS have severe stress, as many as 87.5% of research respondents.[20]

The incidence of premenstrual syndrome is influenced by several factors, one of which is food intake. There are differences in the intake of protein, magnesium, vitamin B6, and isoflavones in the treatment group and the control group. The intake of protein, magnesium, vitamin B6, and isoflavones in the treatment group is sufficient because soy milk and tempeh have a high content of protein, magnesium, vitamin B6, and isoflavones, so that the treatment group subjects can fulfill daily adequacy. The content of soy milk in 100 grams is a protein of 3 - 4.69 grams, magnesium 18,6 – 29,2 mg, and Vitamin B6 0,03 – 0,075 mg.[21] The content of tempeh in 100 grams is protein 20,3 grams, magnesium 81 mg, and vitamin B6 0,215.[21] Micronutrient deficiencies can increase the risk of PMS. Vitamin B6 can reduce the incidence of PMS by affecting the hormone serotonin, as well as magnesium. Magnesium can inhibit PGF2α and increase muscle relaxation and vasodilation.[22]

Before the intervention, most of the subjects' symptoms were severe. After the intervention, most subjects' symptoms became moderate. In the treatment group, soy milk and tempeh experienced the highest change in SPAF score by 29 points. In the control group, there was also the highest decrease of 5 points. The symptoms that were most reduced by the research subjects were reduced abdominal pain and pain or swelling of the breasts.

One of the treatments for PMS symptoms is consuming foods that contain isoflavones. Isoflavones that have high bioavailability are isoflavones in the form of aglycones (daidzein and genistein).[23] Foods that have isoflavones in the form of aglycones are soybeans. Soy products that are processed by the heating process will increase daidzein levels, one of which is soy milk.[24] Soy milk has the highest level of daidzein (12 mg/1 cup) than other products. Soy products that undergo a fermentation process will have higher daidzein levels than those that are not fermented. Tempeh, which is a fermented soy product, has daizein levels of 12-22 mg/100 grams.[24]

Based on the results of the analysis of the effect of giving soy milk and tempeh on PMS symptoms conducted for 7-14 days on 20 respondents of the treatment group, research shows that soy milk can significantly reduce SPAF scores. However, the consumption of tempeh had no significant effect on reducing the SPAF score. The number of SPAF scores from the tempeh group decreased compared to the control group. There is a significant difference between the soy milk group and the control group in terms of changes in SPAF scores.

There are differences in the suitability of the research with previous studies. The suitability of soy milk consumption in reducing PMS symptoms, following research by Novadela in Lampung and Nora in Yogyakarta, where both studies showed significant results in the provision of soy milk on pain intensity in adolescents.[8] Soy isoflavone diets containing 14% of energy derived from 6.5% soy protein, or equivalent to consuming > 5 mg isoflavones/day, can effectively reduce circulating levels of 17β-estradiol and progesterone during the menstrual period.[25] In the soy milk treatment group, the adequacy of isoflavone intake was included in the sufficient category, with an average intake of 61.75

mg/day, with a percentage of soy protein intake of ± 10%. So, soy milk taken as much as 500 ml/day can reduce SPAF scores. The difference in the results of the effect of tempeh consumption in relieving PMS symptoms is different from the existing theory, possibly due to several things, one of which is the way tempeh is processed. Processing tempeh by frying can increase the bioavailability of tempeh, but if tempeh is fried with deep-frying techniques, the amino acids in tempeh will be reduced, so that the possibility of isoflavone compounds can also be reduced.[26] Research conducted in Malaysia decreased isoflavone levels by 45% with the deep-frying method and 30% with the pan-frying technique.[26] In addition to the cooking process, the storage method can also affect isoflavone levels in tempeh; tempeh that is at room temperature for a long time will reduce its isoflavone levels.[26] Cooking tempeh with additional seasonings such as soy sauce can increase tempeh isoflavone levels.[26] The subjects almost entirely processed tempeh by deep-frying and only fried with flour so that it could affect the results of the study.

The etiology of PMS can be caused by age, marital status, genetic factors, physical activity, stress, and lifestyle such as eating habits, smoking, and alcohol consumption. The research subjects experienced a decrease in the average PMS symptoms after the intervention, namely 26,2 points. Based on the results of the multivariate test, it was found that physical activity was the influence of the difference in the decrease in SPAF scores in the soy milk group with the control.

Physical activity can have a positive impact on PMS symptoms based on the theory that regular exercise may help reduce premenstrual syndrome. Engaging in regular exercise can boost the production of endorphins, which can lead to feelings of relaxation and calmness. The hormone endorphin plays a role in regulating estrogen levels. Therefore, women who exercise regularly during PMS may experience an increase in estrogen levels, which can help alleviate symptoms through the action of endorphins. Conversely, in women who do not exercise regularly, the estrogen hormone will increase higher, thus increasing the risk of PMS.[27] The physical activity of the research subjects was quite high, 55% had a moderate-heavy physical activity category. Research on adolescents in Bangkalan shows that doing aerobic activity for 4 times a week within 30 minutes will reduce PMS symptoms, especially pain in the body.[27] Subjects have regular exercise activities every morning such as walking, cycling, and yoga. In the soy milk group, 5 people routinely did physical activity 2-3 times a week for 1-2 hours, compared to the control. So physical activity can be an influence in changing the SPAF score of the research subjects.

This study shows that women who experience PMS symptoms can consume soy products such as soy milk and tempeh. The limitations of this study are that the intervention time was only carried out in one menstrual cycle, the estimation of isoflavone intake was only obtained from soy products and the data collection of food intake was only carried out during the intervention. Further research on isoflavone consumption is necessary, including testing the correct amount of isoflavones consumed. and the processing of processed soybeans consumption, such as boiled processing is better than fried [24]

CONCLUSIONS AND RECOMMENDATIONS

Consuming 500 ml/day of soy milk for 14 days significantly reduced SPAF scores, but providing 100 grams/day of tempeh had no significant effect. Changes in SPAF scores in soy milk and tempeh consumption were not significantly different. Other variables, namely physical activity, affect changes.

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