

Utilization of edamame soybean (*Glycine max (L) Merril*) as modified of enteral formula high calories

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Abstract. Malnourished patients may experience a decrease in nutrient intake due to anorexia, nausea, and vomiting which can lead to further worsening the patient's condition. Insufficient nutritional intake causes undernutrition so it is necessary to administer a high calorie enteral formula to improve the nutritional status of the patient. The source of a grain-based protein based on dietary requirements is edamame. Edamame has a high protein content which reaches 36% higher than other types of soybeans. This study aims to analyze physical quality viscosity, determine the best treatment formulation, as well as the bioavailability of the best-treated protein with a standard hospital formula and analyze acceptability. Methods this study uses experimental laboratory. Added edamame flour treatment was 55%, 65%, 75%, 85%, and 95%. Conclusion the treatment of adding edamame flour as a modification material for high calorie formula gives a very real influence (Sig. < 0,01), the best treatment was obtained in the formula of high calorie modification of the third treatment edamame flour (P3) with the percentage addition of edamame flour 75%, and the formula for high calorie modification of edamame flour was not significantly different from the standard formula of the Hospital.

1. Introduction

Malnutrition in hospitals describes deficiencies, excess or imbalance of nutrients that affect inpatients due to complex interactions between disease, food and nutrition. The prevalence of malnutrition in Indonesia is still very large, namely in 2003 as many as 75% and in 2004 as much as 59.6%, the main cause of malnutrition in hospitals is because they do not get enough energy and protein intake. Adequate intake of nutrients for patients is needed to prevent the decline in nutritional status during hospitalization. Malnutrition can also occur before entering the hospital because of illness or insufficient nutritional intake, malnutrition can also occur after being hospitalized. The results of previous research studies showed that there was a decrease in nutritional status for 75% of patients during hospitalization. Nutritional therapy is an important part of the treatment and recovery process and can shorten the stay [Nurmala et al., 2014¹].

One of the complaints that patients often feel at home is a disorder of swallowing or dysphagia that is related to the patient's ability to eat, which in turn can result in a decline in nutritional status. The intervention recommended to overcome this situation is through the provision of a special diet. This special diet is an enteral formula given to patients with swallowing disorders to avoid malnutrition due to inadequate nutritional intake of patients due to decreased awareness and difficulty in swallowing. Food ingredients that can be used as a substitute for soybean flour in a high-calorie diet formula are edamame soy flour. Edamame is a food source of vegetable protein that has more protein



content than other types of plant foods. Edamame is a functional food that is very potential because it contains bioactive components including bioactive peptides, omega-3 fatty acids, isoflavones, sterols, and saponins, as well as high food fiber content in edamame soybeans which are proven to reduce LDL cholesterol and nutrients contained in more edamame easily digested by the body than yellow soybeans. [Almatsier, 2010²; Muaris, 2013³; Winarti, 2010⁴].

Based on the description above, the researcher analyzed the difference in making high-calorie formula modified edamame flour with standard hospital formula.

2. Materials and methods

This study uses experimental laboratory using a completely randomized design study. Added edamame flour treatment was 55%, 65%, 75%, 85%, and 95%. Each treatment was repeated 5 times so that there were 25 experimental units.

Table 1. Comparison of material composition at each treatment level

Food material	Unit	P1	P2	P3	P4	P5
Edamame flour	g	25,85	30,55	35,25	39,95	44,65
Skimmed milk powder	g	21,15	16,45	11,75	7,05	2,35
Canola oil	g	3	3	3	3	3
Coconut oil	g	2	2	2	2	2
Sugar Flour	g	6	6	6	6	6
Maltodextrin	g	4	4	4	4	4
Total	g	62	62	62	62	62

Description: Each treatment is dissolved with water until it reaches 200 ml

Data were analyzed by One Way Anova statistic test at $P = 0,01$ and continued with Duncan's Multiple Range Test (DMRT) test with real level 1% and processed with SPSS 18.0 for Windows. The best treatment determination test uses the Effectiveness Index test (De Garmo).

3. Results

Viscosity test results were analyzed statistically using One Way Anova test to determine whether there was an effect of adding edamame flour to the viscosity value of each treatment. Before the Anova test is performed, the data is first tested for normality to determine whether the data is normally distributed or not.

Table 2. The results of one way ANOVA test for the viscosity of high-calorie formula modified edamame flour

	Sum of Squares	df	Mean Square	F		Sig.
				F-count	F-Table	
Between Groups	4035,22	5	807,05			
Within Groups	945,76	24	39,41	20,48	2,77	,000
Total	4980,99	29				

Anova test results in Table 2. show that the treatment of adding edamame flour as a modified ingredient in high calorie formula has a very real effect ($F\text{-count} > F\text{-table}$) reinforced with the value of

Sig. <0.01. This shows that the percentage comparison of the amount of edamame flour and skim milk affects the viscosity of the formula for high calorie modification. So, the six treatments have real viscosity differences. From Table 2. then continued with Duncan's test to find out the comparison between treatments.

Table 3. Test results of the duncan viscosity formula of high-calorie formula modified edamame flour

Treatment		N	Subset for alpha = 0,01			
Dimension 1	K		1	2	3	4
		5	2,18			
	P1	5	5,48			
	P2	5	9,36	9,36		
	P3	5		18,32	18,32	
	P4	5			23,91	
	P5	5				35,84
	Sig.		,10	,03	,17	1,00

Means showing for groups in a homogeneous set.

a. Uses Harmonic Mean Sample Size = 5,00.

The high calorie formula modification of the best edamame flour from the six formulas (P1 - P5) was determined from the results of the effectiveness index test. The results of ranking the importance of variables on product quality and the weight of each variable are obtained from the opinions of 30 respondents. After knowing the ranking of each variable, then the variable weight and the normal weight of each variable can be determined. Next is to determine the best and worst value of each variable for each treatment. Then the best treatment can be determined by calculating the value of effectiveness (Ne) and the result value (Nh) of each treatment. Determination of the best treatment based on the highest number of results (Nh).

Table 4. Determination of the best treatment

Treatment	P1	P2	P3	P4	P5
Number of Nh	0.19	0.22	0.25*	0.04	0
Rating	III	II	I	IV	V

Remarks *: Best Treatment

The results of the determination of the best treatment is the formula for high calorie modification of the first treatment of edamame flour (P3) with the percentage addition of edamame flour 75% then carried out a proximate test to determine the nutrient content of the formula consisting of water content, ash content, fat, protein, and carbohydrates, and testing of food fiber content. The results of the nutrient level test for the formula of high calorie modified edamame flour 75% (P3) can be seen in Table 5.

Table 5. Nutritional composition of high-calorie formula modified edamame flour per 100 g

No	Nutritional Composition	Value
1	Energy (kcal)	465,53
2	Protein (gram)	38,50
3	Fat (gram)	19,57
4	Carbohydrates (gram)	33,85
5	Water (gram)	4,13
6	Ash (gram)	3,94
7	Food Fiber (gram)	3,27

Table 6. Value of physical quality and chemical quality of standard hospital formulas and high calorie formula modified edamame flour (per 100 g)

No.	Parameter Mutu	Formula Diet Standar RS	Formula tinggi kalori Modifikasi Tepung Edamame
Mutu Kimia:			
1	Energi (kkal)	421,88	465,53
2	Protein (gram)	16,88	38,50
3	Lemak (gram)	14,38	19,57
4	Karbohidrat (gram)	57,19	33,85
Mutu Fisik:			
5	Viskositas (cp)	2,2	18,3

Table 7. Test results T formula of the standard hospital diet with a high calorie formula modified edamame flour

	Paired Differences			t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean			
Hospital Standard Diet Formula	102,50	179,73				
Formula for High Calorie Modification of Edamame Flour	113,73	192,20	117,68	,095	8	,902

T test is known the results of different tests between the standard formula of the Hospital with the formula of high calorie modification of edamame flour, obtained results that the value of physical quality (viscosity) and chemical quality values (energy, protein, fat, carbohydrates, and dietary fiber,) between the two formulas are not significantly different indicated by the value of Sig. > 0.01. So the formula for high calorie modification of edamame flour is not significantly different from the standard formula of the Hospital.

4. Discussion

Edamame is a food source of vegetable protein that has more protein content than other types of plant foods. Edamame is a functional food that is very potential because it contains bioactive components including bioactive peptides, omega-3 fatty acids, isoflavones, sterols, and saponins, as well as high food fiber content in edamame soybeans which are proven to reduce LDL cholesterol [3;4].

Enteral nutrition formula is a nutrient given to patients who cannot meet their nutritional needs through the oral route. Enteral nutrition is the therapy of giving nutrients through the gastrointestinal tract using a special tube / feeding tube. The method of administration can be through nasogastric route or nasal intestine (nasoduodenal or nasojejunal route). Giving nutrients can also be done by bolus or infusion through an enteral infusion pump. Enteral nutrition is a method of feeding that is simpler, cheaper, and rarely causes complications. Early enteral nutrition can reduce catabolic responses, reduce infectious complications, improve patient tolerance, maintain intestinal integrity, maintain an immunological response, be more physiological, and provide the right source of energy for the intestine at the time of illness. Proper administration of enteral nutrition will provide the patient with nutrients in a form that can be used by his body's metabolism without causing gastrointestinal disorders such as intestinal cramps or diarrhea [5; 6]. Energy is needed by the body for basal metabolism, especially for patients who experience hypermetabolism, which requires high energy to prevent malnutrition. The energy value in food depends on the amount of carbohydrates, proteins, and fats in these foods. The energy value of the high-caloric formula modification of edamame flour was higher than the standard RS diet formula, because the energy value of the high-calorie formula was modified by the greater edamame flour, which was 465.86 kcal / 100 g (Laboratory Test Results). So that the formula for high calorie modification of edamame flour meets the energy requirements of high calorie formula. The protein value of the formula for high calorie modification of edamame flour was higher than the standard formula protein RS. This is because the high-calorie formula protein value modified by edamame flour is greater than 38.50 g / 100 g (Laboratory Test Results). The high protein content of the formula of high calorie modification of edamame flour meets the requirements of high calorie formula protein, and is appropriate if given to patients who are not allowed to eat solids, patients before and after surgery, infectious patients, breastfeeding mothers and in adolescents during growth, and to increase body weight.

The fat contained in the formula for high calorie modification of edamame flour is higher than the fat in the standard hospital formula. This is due to the fat value of the formula with high calorie modification of edamame flour which is greater than 19.57 g / 100 g (Laboratory Test Results). However, despite its high fat content, a source of fat in a high-calorie formula, modified edamame flour is an essential fatty acid that is good for the body, namely omega-3 fatty acids found in edamame soybeans and omega-9 fatty acids found in canola oil and coconut oil. According to Winarti [4], soybeans are low in saturated fatty acid content, soybean fat contains 15% saturated fatty acids, while around 60% is unsaturated fat. Omega-3 fatty acids found in soy can reduce bad cholesterol or LDL and can also increase good cholesterol in the body, HDL. Based on research, omega-9 has a protective power that can reduce LDL blood cholesterol, increase HDL cholesterol greater than omega-3 and omega-6. Diets based on canola oil have been shown to reduce plasma cholesterol levels compared to diets containing higher levels of saturated fatty acids [7]. Canola oil consumption also affects biological functions that affect the risk of disease. Canola oil contains lower levels of saturated fatty acids (about 6%) than other oils and contains high levels of unsaturated fatty acids. Canola oil (*Brassica napus* L.) has high nutritional value and vitamin E content is useful for skin care. Coconut oil has a natural sweetness from coconut and contains 92% saturated fatty acids (in the form of triglycerides), most (about 70%) are lower saturated chain fatty acids known as medium chain fatty acids (MCFAs). MCFAs are not common to different vegetable oils with lauric acid at 45-56%. Various fractions of coconut oil have medium chain triglycerides and are excellent solvent for flavours, essences, emulsifiers etc. Its metabolism is different from that of the normal vegetable oils containing long chain fatty acids [8].

The carbohydrate formula high in calories modified by edamame flour is lower than carbohydrates in the standard formula of the hospital. This is because the high carbohydrate formula modified carbohydrate value of edamame flour is 33.85 g / 100 g (Laboratory Test Results). However, the high-calorie carbohydrate formula modification of edamame flour is not less than 10% of the standard hospital formula energy. This means that the formula for high calorie modification of edamame flour still meets the requirements of the carbohydrate formula for stroke diet.

The high-calorie formula modified edamame flour has met the requirements of enteral formula according to [AsDI, 20059] as follows:

- a. Formula energy content is high in calories, modification of edamame flour 1 kcal / 1 cc liquid.
- b. The nutrient content of the high calorie modification formula has been balanced,
- c. The raw material for edamame flour is easily absorbed, because food in the form of flour is easier to digest compared to fresh ingredients.
- d. Contains dietary fiber which is 3.27 g.
- e. The high-calorie formula is modified by lactose-low edamame flour because it contains only a little milk.
- f. High-calorie formula modified edamame flour does not contain cholesterol
- g. The high-calorie formula modified with edamame flour contains balanced nutritional value, enough vitamins and minerals.

The high-calorie formula modified with edamame flour is the enteral formula given by NGT to patients who are not allowed to eat solids, patients before and after surgery, infectious patients, breastfeeding mothers and in adolescents during growth, and to increase body weight ,also to meet daily needs and to prevent malnutrition. The suggestion of presenting this formula to meet nutritional needs in a day is given as much as 62 g, and in a day given as much as 5 meals to get energy as much as 1500 kcal. The presentation method is 62 g of formula added with warm water at a temperature of 70°C until it reaches a volume of 200 ml, and obtained an energy density of 1 kcal / 1 ml enteral formula according to the requirements of enteral formula.

5. Conclusion

The conclusion of the treatment of adding edamame flour as a modified ingredient in a high calorie formula gives a very real influence Sig. <0.01, the best treatment was obtained in the formula of high calorie modification of the third treatment edamame flour (P3) with the percentage addition of edamame flour 75%, and the formula for high calorie modification of edamame flour was not significantly different from the standard formula of the Hospital. Based on the conclusions above, For further research, it is necessary to test the osmolality, Serum amyloid A (SAA) proteins, and to be given to patients who are allowed to eat solid food, before and after surgery, infectious patients, nursing mothers and adolescents during growth, and to increase body weight.

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