

Provision of Local Food-Based Formula Using *Pila Ampullacea*, Tempeh, and *Moringa Oleifera* Leaves to the Acceptability and Nutrition Intake in Hemodialysis Patients

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ABSTRACT

Background: One of the actions that can be taken to overcome malnutrition in hemodialysis is to improve nutrient intake. It is necessary to provide local food-based formula using *Pila ampullacea*, tempeh with local soybean, and *Moringa oleifera* leaves for hemodialysis patients.

Objective: To analyze the effect of local food-based formula using *Pila ampullacea*, tempeh, and *Moringa oleifera* leaves to the acceptability and nutrition intake in hemodialysis patients.

Materials and Methods: This study was carried out in Dr. Sardjito Hospital, Yogyakarta, Indonesia from February to March 2020. Subjects were 54 maintenance hemodialysis patients who met the criteria of study. The independent variable was the provision of local food-based formula, while the dependent variable were the acceptability and nutrition intake.

Results: As many as 42.59% of subjects were able to consume all the formula given for three days and 50% of subjects have good acceptance of the local food-based formula. The effect of formula intake to the total intake of energy, carbohydrates, fiber, water, calcium, phosphorus, iron showed p-value <0.05, but p-value ≥0.05 for protein, fat, sodium, and potassium. The effect of the non-formula intake to the total intake for all nutrients showed p-value <0.05.

Conclusion: Most of the subjects have a good acceptance of the local food-based formula. Formula intake affects total intake of energy, carbohydrates, fiber, water, calcium, phosphorus, and iron, but does not affect total intake of protein, fat, sodium, and potassium. The total intake for all nutrients was affected by the subject's intake of non-formula sources.

Keywords: Acceptability; *Moringa oleifera* leaves; Nutrition intake; Snails (*Pila ampullacea*); Tempeh.

BACKGROUND

Hemodialysis patients are at high risk of experiencing protein energy wasting which increases morbidity and mortality (1). One of the actions that can be taken to overcome malnutrition in hemodialysis is to improve nutrient intake, which can be done by providing additional food during hemodialysis (2). Providing nutritional support to hemodialysis patients can increase protein intake, reduce inflammation, risk of arterial transplant events, cardiovascular events, depression, secondary hyperparathyroidism, and hypertriglyceridemia (3, 4, 5).

Functional food as nutritional support for hemodialysis patients can be made by using a mixture of snails (*Pila ampullacea*), tempeh, and moringa leaves. Each of these local food ingredients contains beneficial nutrients for hemodialysis patients, so that a mixture of the three can form a nutritional support formula that has nutritional content in accordance with the principles of the hemodialysis dietary requirements. The main principle requirements of the hemodialysis diet include the provision of high protein and calcium, but low in phosphorus (6). The priority of providing nutritional support for hemodialysis patients is given orally, which is reported to reduce mortality by up to 35% (7, 8).

Several previous studies related to providing nutritional support to hemodialysis patients have been carried out. Starting from the provision of animal protein sources only in the form of catfish abon which can

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reduce creatinine levels, increase albumin levels, and significantly improve nutritional status based on subjective global assessment, but it can not increase hemoglobin levels of hemodialysis patients (9, 10, 11, 12). The recommendation for protein fulfillment in hemodialysis patients is that 50% of protein needs are met from animal protein and the rest from vegetable protein, which is strengthened by the update of the KDOQI clinical practice guidelines for nutrition in chronic kidney disease in 2020 (13, 14). Previous research related to mixing eel flour as a source of animal protein and tempeh flour as a source of vegetable protein obtained the best proportion of 1:1 (15). Nugget made by mixing eel flour and tempeh flour with a proportion of 1:1 turned out to have a low glycemic index so it can be given to diabetic hemodialysis patients (16). However, these nutritional support products have poor organoleptic results, so a new local food formulation is needed which is predicted to be well received by hemodialysis patients.

The local food-based formula for hemodialysis patients in this study was made from a mixture of local food from snail, tempeh with Indonesian local soybean, moringa leaves, and several food additives such as corn sugar, canola oil, cinnamon powder, rice flour. This formula provides a daily energy contribution of 259.78 kcal, 16.37 grams of protein, 6.23 grams of fat, 34.68 grams of carbohydrates, 6.08 grams of fiber, 1538.32 mg of calcium (17). The nutritional content of the formula has met the requirements for oral nutritional support, which can be given with the addition of 10 kcal/kgBW and 0.3–0.4 grams of protein per kg of body weight every day from daily intake (18).

Local food-based formulas are given in the form of powder and the subjects can turn it into thick liquid food by adding 125 cc of hot water at 90–96°C. The product image is shown in figure 1. Consumers are increasingly interested in functional foods (19).



Figure 1. The local food-based formula product in the form of powder

The organoleptic quality study on local food-based formula products showed that most of the panelists liked the products made from snail, tempeh, and moringa leaves based on the organoleptic quality result. There was no difference between the organoleptic quality studies of the moderately trained panelists group and the trained panelists group in the aspect of color, texture, taste, and aroma. The organoleptic quality study was performed on healthy people (17). Although this local food-based formula is nutritious and meets the requirements of a hemodialysis diet, based on the results of the organoleptic test, it is known that the local food-based formula product is still slightly fishy, slightly unpleasant, and has a bitter after-taste. Therefore, it is necessary to analyze the acceptability and nutritional intake of hemodialysis patients by providing the oral nutritional support formula product. This study aims to analyze the effect of local food-based formula on the acceptance and nutrition intake of hemodialysis patients.

MATERIALS AND METHODS

This was an experimental research, which was conducted at Dr. Sardjito Hospital, Yogyakarta, Indonesia from February to March 2020. Subjects were 54 maintenance hemodialysis patients who were taken by purposive sampling, which were met the criteria of study. The inclusions criterias were maintenance hemodialysis patients 2 times a week with adequate hemodialysis, aged ≥ 18 years, having mild-to-moderate malnutrition based on the Dialysis Malnutrition Score (DMS), no allergy, and willing to be the subject. People with ascites, anasarca edema, having comorbid disease and blood pressure above 160/90 mmHg were excluded.

The independent variable of this study was the provision of local food-based formula, which was defined as the provision of local food-based formula to hemodialysis patients twice a day for three days. The dependent variables were the acceptability and nutrition intake. Acceptability was defined as the ability of hemodialysis patients to receive the local food-based formula which was known based on the food record form, and categorized into good acceptance (if the intake of local food-based formula was $\geq 75\%$) and less acceptance (if the intake of local food-based formula was $< 75\%$).

Nutrition intake was divided into total nutrition intake, formula-based nutrition intake and nonformula-based nutrition intake. Total nutrition intake was defined as the intake of energy, protein, fat, carbohydrates, fiber, water, calcium, phosphorus, sodium, potassium, iron from all foods, drinks, and supplement consumed by the patient, recorded using a 3-days food record form, calculated using Nutrisurvey software, compared to the patient's individual needs, then presented. Formula-based nutrition intake has the same definition as total nutrition intake, but the source of intake comes from the local food-based formula, while the sources of nonformula-based nutrition intake come from other than local food-based formula given.

Local food-based formulas are given in powder form weighing ± 36 grams per serving which can be diluted with 125 ml hot water at 90–96°C. Previous study showed that protein will be dissolved and denatured at a temperature of 100°C. The increase in heating temperature will cause the protein to be dissolved and denatured. Protein loses its binding power to water so that the water contained in the food will come out (20). Local food-based formulas are recommended to be consumed during the morning and evening interlude hours.

This study can be carried out with the ethical clearance from the Ethical Commission of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Indonesia Ref. No. : KE/FK/0989/EC/2019.

RESULTS

This study involved 54 subjects who were taken by purposive sampling. The sampling process is shown in Figure 2.

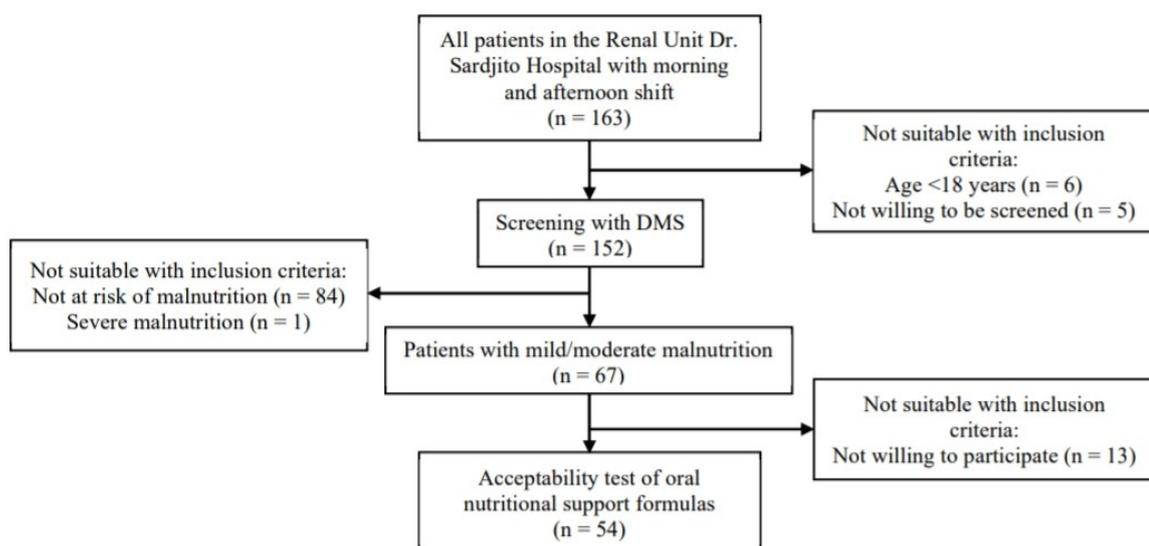


Figure 2. The flow of research

Subjects were given the local food-based formula for three days. Acceptability test was carried out for three days because the interdialytic time is between 3-4 days and a person's acceptability to food or drink could be seen within 3 days of administration. Subjects were asked to record food and drinks consumed during the three days using the food record form. Acceptance and nutritional intake of research subjects were evaluated on the fourth day. The subject's acceptance of the local food-based formula is shown in Figure 3.

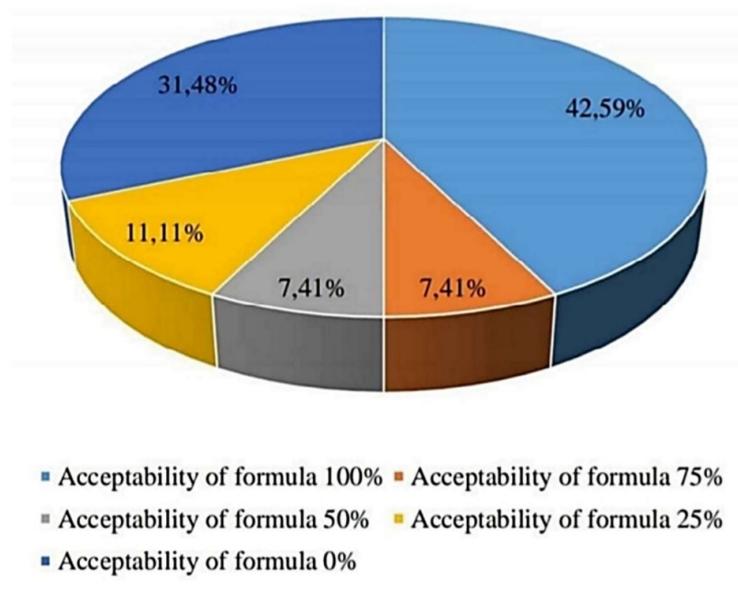


Figure 3. Acceptability of local food-based formula in hemodialysis patients

The results of the acceptance test reported that most of the subjects (42.59%) were able to consume all the local food-based formula given for three days. A small proportion of subjects (7.41%) were able to consume 75% and 50% of the local food-based formula provided by the researchers. There were 31.48% of subjects who did not consume the local food-based formula at all because they felt nauseous and vomited when they smelled the product.

Hemodialysis patients who are categorized as having good acceptance of the local food-based formula are those who are able to consume an average of at least 75% of the product given for three days. As many as 50% of subjects had good acceptance of the local food-based formula.

Table 1. Effect of formula intake and non-formula intake on total intake of hemodialysis patients

Nutrient	Unit	Mean ± SD			R ²	
		Formula intake	Non-formula intake	Total intake	Formula intake on total intake	Non-formula intake on total intake
Energy	kcal	8,5 ± 7,3	71,2 ± 24,6	79,7 ± 25,9	*0,096	*0,920
Protein	g	14,9 ± 12,6	74,4 ± 30,3	89,3 ± 33,0	0,158	*0,854
Fat	g	6,1 ± 5,3	83,1 ± 34,8	89,2 ± 34,8	0,004	*0,977
Carbohydrate	g	8,2 ± 7,1	64,1 ± 25,4	72,3 ± 27,2	*0,140	*0,933
Fiber	g	11,1 ± 9,0	21,3 ± 17,0	32,4 ± 19,7	*0,263	*0,791
Water	ml	25,5 ± 21,3	79,8 ± 31,1	105,3 ± 42,6	*0,512	*0,773
Calcium	mg	56,0 ± 45,7	85,2 ± 43,8	141,3 ± 58,1	*0,445	*0,397
Phosphorus	mg	7,2 ± 6,1	67,0 ± 27,6	74,2 ± 28,8	*0,088	*0,956
Sodium	mg	2,0 ± 1,6	18,5 ± 14,8	20,4 ± 14,8	0,021	*0,992
Potassium	mg	2,8 ± 2,3	35,2 ± 13,2	38,0 ± 13,7	0,048	*0,983
Iron	mg	31,7 ± 25,8	34,4 ± 16,8	66,0 ± 34,1	*0,772	*0,464

*p-value is significant based on linear regression analysis

R² = the effect of the independent variable on the dependent variable, showed in %

The results reported in Table 1 show that formula intake affects the total intake of energy, carbohydrates, fiber, water, calcium, phosphorus, and iron (p-value <0.05), but does not affect the total

intake of protein, fat, sodium, and potassium (p -value ≥ 0.05). However, the magnitude of the effect of formula intake on total nutrient intake is reported to be insignificant, so it is necessary to analyze the effect of non-formula intake on total intake. Analysis of the effect of non-formula intake on total intake was carried out to compare the magnitude of the effect of formula intake and non-formula intake on total intake.

The results of the analysis reported that the total intake for all nutrients was affected by the subject's intake from non-formula sources, including supplements (p -value < 0.05). The magnitude of the effect of non-formula intake on the total intake on average was greater than the magnitude of the effect of formula intake on total intake for all nutrients except calcium and iron.

DISCUSSION

The intake of the subject formula in this study depends on how much the subject accepts the local food-based formula given by the researchers. The acceptability of food is the acceptance of food served that can be accepted by consumers, the measure of the success of food management is that the food served is acceptable and the food is consumed without leaving food leftovers. Acceptance itself as a measure of patient satisfaction (21).

Acceptability of food is directly related to the interaction of food with consumers at any given moment. The factors that influence acceptance include consumer characteristics, sensory characteristics of food and taste factors. Consumer characteristics include consumer expectations, consumer innovation, consumer knowledge and trust, and consumer attitudes towards healthy and functional foods. In sensory characteristics, there are effects of aroma, appearance, taste, and texture on food acceptance (22).

Knowledge of composition, functional properties and to some extent processing steps influence whether a food product will be accepted or rejected by consumers (23). Consumers consume functional foods for health benefits such as disease prevention and access to the protective properties of food. The main factor that encourages the acceptance of functional food is its health characteristics (24). In this study, the subjects have known about the composition of the ingredients used to produce local food-based formulas, as well as the benefits that will be obtained when consuming these products, so as to increase acceptance of the local food-based formula products given.

The patient's acceptance of food affects the nutritional status of the patient. The low food acceptance will have a negative impact on nutritional status, clinical physical condition, and patient recovery (25).

This study shows quite good results, where 50% of the subjects have a good acceptance of local food-based formula products. Clinical formula intake had an effect on increasing the intake of protein, water, and calcium in subjects. The average intake of protein and water from non-formula sources alone is still in the low category ($< 80\%$ of the need), but after adding the oral nutritional support formula, the total intake of protein and water of the subject is good (80-110% of the needs are met).

The food intake of the subjects in this study was known based on the results of the 3-days food record. The use of the 3-days food record method to determine the food intake of subjects in this study was in accordance with the 2020 Kidney Disease Outcomes Quality Initiative (KDOQI) recommendations regarding the use of the 3-days food record method to assess the nutritional intake of hemodialysis patients (14).

The nutritional requirements used as a comparison for the intake of subjects in this study are based on the KDOQI recommendations for 2020. The recommended protein intake for hemodialysis patients aged ≥ 18 years with a stable metabolic condition is 1.0–1.2 g/kg body weight per day. Recommended energy intake of 25-35 kcal/kg body weight per day based on age, sex, level of physical activity, body composition, achievement of expected weight status, and the presence or absence of comorbidities or inflammation in the hemodialysis patient's body (26).

Calcium intake in hemodialysis patients should be considered based on input from dietary calcium, calcium supplements, or calcium-based binders and concurrent use of vitamin D analogues and calcimetics to avoid hypercalcemia or excess calcium (14). The results of this study indicate that the average intake of calcium from non-formula sources alone is in the good category, but after adding oral nutritional support formulas, the average total calcium intake is actually excess ($> 110\%$ requirement). This is because the subjects are still consuming 3x500 mg of calcium-based phosphate binders per day, so that it makes a big contribution to the calcium intake of hemodialysis patients.

The hemodialysis patient's phosphorus intake should be limited. Dietary potassium intake should be adjusted to maintain serum potassium within the normal range. The fulfillment of potassium from food intake or supplemental potassium is based on the patient's individual needs and the doctor's judgment. Sodium intake should be limited to less than 100 mmol/day (or < 2.3 g/day) to lower blood pressure and

improve fluid volume control in the body. Reducing dietary sodium intake was undertaken as an additional lifestyle modification strategy to achieve better volume control and desired body weight (14).

The results of the analysis of the subject's intake showed that the average intake of total energy, carbohydrates, fiber, phosphorus, sodium, potassium, and iron was still in the low category (<80% requirement) even though it had been added with a nutritional support formula. The average total fat intake was in good category, although the contribution of fat intake from formula was only very small. These results indicate that the compliance of hemodialysis patients in fulfilling nutritional intake is still not good.

The process of hemodialysis can remove most of the waste products in a short time, but some beneficial nutrients are also lost from the body through this process such as protein and water soluble vitamins. Uremia can be accompanied by symptoms of anorexia, nausea, and impaired absorption of food, so as to reduce the nutritional intake of hemodialysis patients. Diet therapy management is very important to maintain hemodialysis stability. Hemodialysis patients need adequate intake of energy, protein, sodium, potassium, phosphorus, and water (26, 27).

The application of dietary management management increases the survival rate of hemodialysis patients and increases the adequacy of hemodialysis, but can cause increased psychological distress in the patient. Many difficulties may be experienced by hemodialysis patients in the practice of diet therapy management. These practical difficulties are related to changes in individual eating habits such as lack of family support, changes in taste, and lack of knowledge (28, 29). Knowledge, family support, attitudes, and behavior can influence dietary adherence of hemodialysis patients in fulfilling nutritional intake according to the recommended dietary therapy (30). Adherence appears to be a multidimensional phenomenon that is patient-related, socioeconomic conditions, therapy-related, health care-related factors and contributes to non-adherence to dietary guidelines and treatment of hemodialysis patients (31).

CONCLUSION

Most of the subjects were able to finish the local food-based formula for three days. As many as 50% of subjects have a good acceptance of the local food-based formula. Formula intake affects total intake of energy, carbohydrates, fiber, water, calcium, phosphorus, and iron, but does not affect total intake of protein, fat, sodium, and potassium. The total intake for all nutrients was affected by the subject's intake of non-formula sources, including supplements. The magnitude of the effect of non-formula intake on the total intake on average was greater than the magnitude of the effect of formula intake on total intake for all nutrients except calcium and iron. Further research is needed to determine the effect of provision of oral nutrition support formula to nutrition status, immune status, and inflammation status of hemodialysis patients.

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