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Modification Of Hospital Formula Based On Yellow Pumpkin Flour (Curcubita Moschata) And Egg White Flour For Patients With Diabetic Nephropathy

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ABSTRACT

Background: *Diabetes mellitus is a metabolic disorder characterized by increased blood glucose levels, which can cause complications, one of which is diabetic nephropathy. One of the preventive therapies that can be carried out is administering an enteral formula high in protein and fiber. It is possible that yellow pumpkin and egg whites can help reduce the risk of developing diabetes.*

Research Purpose: *This research aims to develop hospital enteral formulas, determine their viscosity, analyze their nutritional content, and determine their organoleptic quality.*

Research Methods: *This research uses a quasi-experimental method, with the research design used as a static group comparison. Viscosity testing uses a viscometer, water, ash, protein, and fat. Carbohydrate content testing uses proximate analysis, and food fiber content testing uses the enzymatic method. Organoleptic testing uses a hedonic scale, and the panelists are semi-trained.*

Research Result: *The results showed differences in cholesterol levels before and after the study (p=0.00). The treatment group had a reduced cholesterol level of 57.8 mg/dL, and the control group had a reduced cholesterol level of 34.3 mg/dL. However, the benefits of green bean juice with cinnamon powder in lowering cholesterol levels were not statistically significant (p=0.074).*

Conclusion: *A modified formula based on pumpkin flour and egg white flour has the potential to be an alternative food for people living with diabetes.*

BACKGROUND

Diabetes mellitus (DM) is a degenerative disease that is still a concern throughout the world; epidemiological data from the International Diabetes Federation (IDF) reports that around 536.5 million people aged 20-79 years will have diabetes in 2021. IDF also noted that Indonesia is the country with the fifth-highest number of diabetes sufferers in the world. It is reported that there are around 19.5 million diabetes sufferers in Indonesia, and it is estimated that there will be an increase of 28.6 million diabetes sufferers in 2024 (IDF et al., 2021). Based on 2018 Riskesdas data, the age range of diabetes mellitus sufferers in Indonesia range from 15 to over 75 years, with the most extensive distribution being 55 to 74 years old at 39.2% (Kemenkes RI, 2018).

Diabetes mellitus develops due to the accumulation of metabolic abnormalities caused by decreased insulin secretion and function. This disease can affect the endocrine system, resulting in glucose intolerance and hyperglycemia (Hartoyo et al., 2011). Hyperglycemia in diabetes mellitus sufferers will cause activation of metabolic and hemodynamic pathways, which will stimulate the occurrence of diabetic nephropathy. Accumulation of the mesangial matrix, loss of podocyte cells, the thickness of the glomerular basement

membrane, endothelial damage, tubular atrophy, fibrosis, and renal artery hyalinosis will fail kidney function due to activation of this system (Satirapoj & Adler, 2014).

Selection/innovation of certain local food ingredients can be used to increase the content of certain nutrients, such as protein and fiber, suitable for diabetes mellitus sufferers. The main focus of therapy in people living with diabetes is to control blood glucose. It is hoped that these efforts can prevent or slow down the occurrence of complications (Inzucchi et al., 2015). Consuming foods high in protein can reduce appetite and increase feelings of fullness quickly, so glucose derived from digested protein does not increase plasma glucose concentrations but causes an increase in serum insulin response (Wijaya L., 2018). Foods high in fiber are also recommended for people with diabetes because they can improve blood glucose control (Silva et al., 2013).

Yellow pumpkin (Curcubita moschata) is known to have hypoglycemic effects by increasing serum insulin levels, reducing blood glucose, and increasing glucose tolerance (Wang PC et al., 2016). Yellow pumpkin is a good source of nutrients such as carotene (Andrejiova A. et al., 2016) and fiber (Hussain J et al., 2010). The total fiber of pumpkin flour in previous research was 14.81-35.32% (Trisnawati W et al., 2014). This shows that pumpkin is a food source of fiber and can potentially reduce the risk of developing diabetes (Naolia JV et al., 2011).

Egg white is the part of the egg with the highest albumin content. Increasing albumin levels can reduce HbA1c levels, and decreasing albumin levels can increase HbA1c levels (Gaputri & Pangalila, 2020). Egg whites also contain many nutrients, such as protease, alcalde, thermolysin, and pepsin. These nutrients can reduce plasma glucose, suppress triacylglycerol levels, and increase the production and sensitivity of the insulin hormone (Abidin & Riana, 2021).

Based on the description above, it can be concluded that there is a need to develop local food ingredients, namely pumpkin and egg whites, into enteral food with a liquid consistency to help provide an alternative enteral food high in protein and fiber for diabetes mellitus sufferers. This research aims to prepare an enteral formula made from pumpkin flour and egg white flour, determine the viscosity of the formula, and analyze the formula's nutritional content and organoleptic quality.

MATERIAL AND METHODS

Research Design

The research was a quasi-experiment, with a static group comparison as the research design. It was carried out in December 2023 at the Food Ingredient Science Laboratory (IBM), while the chemical test analysis took place at the Nutrition Laboratory, Faculty of Public Health, Airlangga University, Surabaya.

Research Subjects

This study's population was an enteral formula high in protein and fiber. The samples included hospital enteral formulas, enteral formulas high in protein and fiber based on egg white flour and pumpkin flour, and commercial formulas for diabetes with impaired kidney function.

Data Collection/Materials and Tools

This study used test equipment to determine the physical characteristics, organoleptic quality, and value of hospital enteral formulas high in protein and fiber based on egg white flour and pumpkin flour and commercial formulas for diabetes with impaired kidney function. The test equipment used is adjusted to the standards and type of test being carried out. The results of using test equipment as an instrument will produce primary data in this research.

The stages of the data collection procedure in this research were making a modified enteral formula for egg white flour and pumpkin flour, conducting experiments on making a modified enteral formula for egg white flour and pumpkin flour, processing a modified enteral formula for egg white flour and pumpkin flour. Physical Characteristics Test (Viscosity), Organoleptic Quality Test (Color et al., and Texture), and Nutritional Value Test (Energy, Protein, Fat, Carbohydrates, and Food Fiber).

Data Analysis

Physical Characteristics Test (Viscosity)

Determination of viscosity in this study was carried out for hospital enteral formulas, enteral formulas based on egg white flour and pumpkin flour, as well as comparative commercial formulas, which were carried out using a Brookfield Viscometer where the viscosity can be detected and directly seen on the monitor display in cP (centipoise) units. The stages of the viscosity test process begin by preparing a sample of 200 ml of hospital enteral formula, an enteral formula based on egg white flour and pumpkin flour, and a comparative commercial formula in a beaker. The viscometer was then turned on, spindle no. 3. The beaker containing the sample was placed under the spindle by rotating the revolver until the spindle was submerged in the sample solution. The next step is to adjust the spindle rotation to a speed of 60 rpm. The viscosity results can be seen on the viscometer monitor display after the spindle rotates for 1 minute.

Nutritional Value Test

The nutritional value test uses proximate analysis, a chemical analysis method that identifies nutritional content such as energy, protein, fat, carbohydrates, dietary fiber, and additional water and ash content in enteral formulas based on egg white flour and pumpkin flour. Proximate analysis is carried out according to the method for each parameter and modified according to the procedures applicable to each testing laboratory.

Organoleptic Test

The organoleptic test included color, flavor, taste, and Texture, which were analyzed using the Hedonic Scale with a hedonic scale of 1 to 4, consisting of 1 = Very dislike, 2 = Dislike, 3 = Like, and 4 = Very Like. The panelists used for the organoleptic test were 20 trained personal panelists. Semi-trained panelists have received training on conducting general sensory testing, namely 20 students majoring in nutrition at the Health Polytechnic, Ministry of Health, Malang.

Data processing and analysis were performed using statistical tests using the SPSS 16.0 program. After statistical tests were carried out, the data was analyzed descriptively comparatively using sentences to explain the statistical test results obtained. The data processed and analyzed are Physical Characteristics Data and Nutritional Value Data. Data from organoleptic tests were analyzed using the Friedman non-parametric difference test with the Wilcoxon advanced test.

RESULTS

The results of this research are enteral formula products high in protein and fiber with the addition of other supporting ingredients. In making enteral formulas high in protein and fiber, the use of 24% egg white flour (15 grams), 5% pumpkin flour (3.3 grams), 54% full cream milk (33.3 grams), 8% sugar (5.0 grams), and maltodextrin 8% (5.0 grams) of the total weight of the formula ingredients, namely 62 grams. The formula produced from this research, namely an enteral formula high in protein and fiber based on egg white flour and pumpkin flour, shows a light yellow color where the color comes from pumpkin flour, a typical milky flavor, and a slightly sweet taste obtained from the constituent ingredients, namely maltodextrin, and sugar. The hospital formula shows a white color like milk; the flavor and taste are typical of fresh milk. The commercial formula for diabetes mellitus with impaired kidney function (Nephrisol) shows a white color like milk, a distinctive flavor, and a taste of vanilla from its vanilla flavoring. This formula has different physical characteristics and nutritional value, as an enteral formula is high in protein and fiber, which will be explained in this discussion. The presentation of the formula is adjusted to the respective serving size, namely 62 grams with the addition of 200 ml water for the high protein and fiber enteral formula based on egg white flour and pumpkin flour, 250 ml for the hospital enteral formula, and 67 grams with the addition of 200 ml water for the formula commercial. Based on the results of this formula, the differences in the physical characteristics of enteral formulas high in protein and fiber based on egg white flour and pumpkin flour, hospital formulas, and commercial formulas can be explained.

Analysis Result

Physical Characteristics Test

The analysis of physical characteristics in this study was the first test carried out on enteral formulas high in protein and fiber based on egg white flour and pumpkin flour, hospital formulas, and commercial formulas because it is one of the essential things that the processed enteral formula can have acceptability. The maximum (Huda & Kusharto, 2014). This aims to ensure that standardization of the formula can be

adequately fulfilled, namely regarding viscosity. The results of the characteristic test on the formula can be seen in Table 1.

Table 1. Physical Characteristics (Viscosity) of Enteral Formula

Enteral Formula	Value (nP)
Hospital Formula	20
Modified Formula	12
Commercial Formula	22

Source : Primer Data

Table 1 shows that the viscosity value in the modified enteral formula is 12 nP; this formula meets the requirements according to (ADA, 2002), namely 1-50 nP. Using egg white flour and pumpkin flour influences the viscosity of the modified enteral formula. This is because the more flour used, the higher the concentration of the enteral formula, which affects its high viscosity. This is based on research conducted by Pratiwi and Noer (2014), which states that factors influencing viscosity are liquid concentration, temperature, pressure, and molecular weight. Viscosity is an important thing that must be considered when making an enteral formula to show the flowability of the food.

Nutritional Value Test

Analysis of nutritional content is carried out using a proximate test, which involves testing the levels of ash, water, protein, fat, carbohydrates, dietary fiber, and energy. The proximate test is expressed in grams, where in this study, the food sample used was an enteral formula high in protein and fiber based on egg white flour and pumpkin flour. The nutritional content of hospital enteral formulas is analyzed using the Food Ingredient Composition List (DKBM) approach, and commercial formulas are analyzed by looking at the nutrition facts on the packaging. DKBM can be used as a measuring tool to convert food ingredients into nutritional value because the nutrient content data collected in the DKBM book results from analysis carried out by the Center for Nutrition Research and Development. Several research results also show that the proximate test results of a food ingredient are similar to the nutritional value of the food ingredient listed in the DKBM. The following nutritional value for each serving size of the enteral formula can be seen in Table 2.

Table 2. Nutritional Value of Hospital Enteral Formula for Each Serving Size

Component	Value
Energy (kkal)	235,7
Protein (g)	8,0
Fat (g)	13,7
Carbohydrate (g)	19,7
Dietary fiber (g)	0,0

Source : Primer Data

Table 3. Nutritional Value of Modified Enteral Formula Egg White Flour and Yellow Pumpkin Flour for Each Serving Size

Component	Value
Energy (kkal)	246,7
Protein (g)	45,8
Fat (g)	1,9
Carbohydrate (g)	10,4
Dietary fiber (g)	15,4

Source : Primer Data

Table 4. Nutritional Value of Commercial Enteral Formula (Nephrisol) for Each Serving Size

Component	Value
Energi (kkal)	300,0
Protein (g)	5,0
Lemak (g)	10,0
Karbohidrat (g)	49,0
Serat pangan (g)	3,0

Source : Primer Data

Based on the table above, the modified enteral formula has a higher energy content than the hospital formula but not higher than the commercial enteral formula (Nephrisol). The difference between the hospital enteral formula and the modified enteral formula is 11 kcal, and between the modified enteral formula and the commercial enteral formula is 53.3 kcal. The differences in results were due to the energy content of the three formulas being influenced by the macronutrient content in each formula (protein, fat, and carbohydrates).

The protein test discovered that the modified enteral formula had a higher protein content than the hospital and commercial formula (Nephrisol). The difference between the protein content of the modified enteral formula and the hospital enteral formula is 39 g, and the difference between the protein content of the modified enteral formula and the commercial enteral formula is 42 g. The factors causing differences in protein content are influenced by the ingredients used in each formula. The modified enteral formula adds egg white flour as a protein source apart from whole cream milk.

The modified enteral formula has a lower fat content than the hospital and commercial formulas (Nephrisol). The difference between the fat content of the modified enteral formula and the hospital formula is 11.8 g, and between the fat content of the modified enteral formula and the commercial enteral formula is 8.1 g. The cause of these differences is the nature of the constituent ingredients used in each formula, especially vegetable oils.

The modified enteral formula's carbohydrate test results showed a lower carbohydrate content than the commercial formula (Nephrisol) but higher than the hospital formula. The difference between the carbohydrate content of the hospital formula and the modified formula is 9.3 g, and between the carbohydrate content of the modified formula and the commercial formula is 38.6 g. The nutritional content of the essential carbohydrate source ingredients caused the difference in carbohydrate content in the three enteral formula samples.

The dietary fiber content obtained from the test results shows that the modified enteral formula has a higher value than the hospital enteral formula but is lower than the commercial formula (Nephrisol). The difference between the dietary fiber content of the modified enteral formula and the hospital enteral formula is 15.4 g, and the difference between the dietary fiber content of the modified enteral formula and the commercial enteral formula is 12.4 g. The differences in results were caused by the content of the constituent ingredients in each formula, especially in the modified enteral formula, which was given the addition of pumpkin flour.

Organoleptic Test

The results of the organoleptic analysis of the level of preference for the modified enteral formula can be seen in Table 5. The organoleptic parameters assessed were color, flavor, taste, and Texture.

Table 5. Mean Results of Organoleptic Test Analysis of Enteral Formula

Enteral Formula	Color	Flavor	Taste	Texture
P1 (FRS)	3,55 ± 0,51	2,90 ± 0,71	2,50 ±0,68	3,00 ± 0,56
P2 (FM)	2,75 ± 0,71	3,00 ± 0,64	2,50 ± 0,76	3,15 ± 0,58
P3 (FK)	3,55 ± 0,51	3,35 ± 0,74	3,30 ± 0,97	3,45 ± 0,68
	p=0,000*	p=0,236*	p=0,001*	p=0,029*

*Description: *Data analysis with Friedman*

Statistical analysis using the Friedman non-parametric difference test showed that the type of enteral formula affected the enteral formula's color, flavor, taste, and Texture. Further analysis using the Wilcoxon test showed that the color of the P2 formula was significantly different from the other formulas, the taste of the enteral formula was not significantly different between the three, and the taste of the P3 formula was significantly different from the other formulas. The Texture of the P1 and P3 formulas showed a significant difference from the other formulas. Overall P3 enteral formula was the most preferred formula with the highest average values for the parameters flavor (3.55 ± 0.51), taste (3.35 ± 0.74), and Texture (3.45 ± 0.68). This is followed by enteral formulas P2 and P1.

DISCUSSION

Physical Characteristics (Viscosity)

The viscosity test results show differences in the magnitude of the viscosity in the three formulas. Changes in viscosity in liquid foods can occur during the heating or cooling. Increasing temperature is the main factor influencing the decrease in viscosity in all types of liquid food (Pratiwi & Noer, 2014). The temperature of the enteral formula in the three samples showed that at P1 (48°C), P2 (54°C), and P3 (50°C), with the viscosity test results for the enteral formula P2 showing a lower value compared to formulas P1 and P3. Temperature and viscosity have an inverse ratio; the higher the temperature, the lower the viscosity. Other factors besides temperature that can affect viscosity are the concentration of solid materials and the molecular weight of the liquid (Santosa, 2013).

Based on the viscosity standard for enteral formulas according to ADA (2002), which is 1-50 nP, the three enteral formulas for diabetes mellitus with impaired kidney function, namely hospital enteral formulas, modified enteral formulas, and commercial enteral formulas (Nephrisol) have met the requirements with formula viscosity results in 20 nP, 12 nP, and 22 nP. The viscosity standards for enteral formulas aim to ensure smooth administration of the sonde and avoid complications. High viscosity can interfere with the smooth administration of liquid food through a tube. At the same time, low viscosity can trigger related complications such as diarrhea, nausea, and gastroesophageal reflux (GER) (Suswan, 2018). Based on the explanation above, the three enteral formulas have different viscosity values but meet the viscosity standards for enteral formulas. Therefore, the three formulas have the same suitability for consumption by patients.

Nutritional Value

Energy Content and Energy Density

The energy content of the three formulas is the energy content for one administration of enteral formula, namely hospital formula (250 ml), modified enteral formula, and commercial enteral formula (200 ml). Suppose a patient is given an enteral formula with a frequency of six or eight times. In that case, the energy is around 1800 kcal in a hospital enteral formula, 1900 kcal in a modified enteral formula, and 2400 kcal in a commercial formula. This energy can meet the patient's basal energy needs. If the frequency of administration is increased, energy intake and fulfillment will also increase. This study adjusted the amount of fluid used to 1 cc = 1 kcal (Sobariah et al., 2005). The energy density of the modified enteral formula for egg white flour and pumpkin flour is by the enteral formula requirements, namely between 1-2 kcal/ml. High energy density is necessary for diabetes mellitus patients with impaired kidney function functions to prevent malnutrition and fluid restrictions to prevent ascites and edema (Marfuah & Ruhyana, 2017).

The fat content is directly proportional to the energy density of a formula. A food's carbohydrate, fat, and protein content determines its energy value. Fat produces nine kcal/g, higher than carbohydrates and protein, which produce four kcal/g (Plauth et al., 2013). The decrease in energy content and energy density in the modified formula is related to the decrease in fat content and the increase in the ratio of egg white flour and pumpkin flour. Modified enteral formulas with the lowest fat content also have lower energy content compared to commercial formulas. Based on this, it can be interpreted that reducing the fat content in the enteral formula affects reducing the energy content and energy density.

Protein Levels

According to PERKENI 2021, protein requirements are 0.8 g/kgBW/day or 10% of energy requirements, and 65% should have high biological value in pre-dialysis patients. Protein restriction in diabetic nephropathy patients prevents increased intraglomerular pressure and hyperfiltration, worsening kidney failure (Ko et al., 2017). Kidney failure disrupts fluid balance and body biochemistry, resulting in vascular hyperpermeability; this mechanism increases the loss of albumin through urine accompanied by diabetic macular edema (Hammes et al., 2015). However, protein intake in patients also needs to be paid

attention to, considering that one of the protein functions is to repair damaged body tissue. Hence, attention must be paid to protein administration to prevent the catabolism of protein as energy.

Egg white flour was chosen as a source of protein because of its fat and protein content. The fat content in 100 grams of egg white is 0 grams, while the protein is 10.8 grams. Egg whites are the part of the egg with the highest albumin content. The albumin content in egg whites is 95%, which helps replace and repair damaged tissue. Additionally, egg whites contain complete essential amino acids with a digestibility value of 90% (Dharmayanti, 2019).

The analysis results of protein levels in modified enteral formulas differ from hospital enteral and commercial formulas. The three formulas have different characteristics and constituent ingredients, so their protein content is also different. In the research results, the protein content of the modified formula was higher compared to the hospital and commercial formulas. The use of different constituent ingredients causes the difference in protein content between the two formulas. The protein source in the modified formula is 53.7% full cream milk protein, and there is an additional protein source from egg white flour, namely 24.2%.

Meanwhile, the hospital's enteral formula comes from fresh milk, namely 94.3%, and rice bran oil, 1.9%. The protein sources in the commercial formula are vegetable oil, amino acids, and whey protein concentrate (Kalbe Nutritionals, 2017). The protein contained in the modified enteral formula serving size is 10%, which meets the protein content requirements for diabetes mellitus patients with impaired kidney function, namely 0.8 g/kgBB/day or 10% of total energy requirements (PERKENI, 2021). If, in a case, a patient receives an enteral formula with six or eight administrations, the patient's daily protein intake will be so excessive that it cannot be given more than one administration per serving size (62 grams/200 ml).

Fat Content

Research results show that the fat content per serving size of the modified enteral formula is lower than that in hospital and commercial formulas. Each formula's fat content per serving size, namely for the hospital enteral formula, is 13.7 g, the modified enteral formula is 1.9 g, and the commercial enteral formula is 10 g. The difference in fat content of the modified enteral formula is significantly different from other enteral formulas because the modified enteral formula does not use oil as a fat source, and the use of whole cream milk is 53.7%. The fat content in the modified formula still does not meet the requirements for diabetes mellitus patients with impaired kidney function, namely 15-20% of total energy, even with a frequency of administration of 8x/day (PERKENI, 2021).

Carbohydrate levels

Carbohydrate content refers to the number of monosaccharides, disaccharides, and polysaccharides in every 100 grams of food. This amount can be determined both quantitatively and qualitatively. Carbohydrates are a source of energy for individual life activities besides protein and fat (Siregar, 2014). Determination of carbohydrate content in the modified enteral formula in this study used the by-difference method, namely calculations from the results of determining water, ash, fat, and protein content with the assumption that substances other than these components are carbohydrates (Lestari et al., 2014). Meanwhile, determining the carbohydrate content of hospital formulas uses empirical calculations and commercial formulas by looking at the nutrition facts on product packaging.

Carbohydrates are organic compounds formed from carbon, oxygen, and hydrogen atoms. They have become the primary energy source for human metabolism; the amount of energy that can be produced by 1 gram of carbohydrates is 4 kcal. Apart from being an energy source, carbohydrates also function as food reserves and provide a sweet taste to food (Gropper et al., 2009). The carbohydrate sources in the modified enteral formula are whole cream milk, granulated sugar, maltodextrin, and pumpkin flour.

The carbohydrate content per serving in the modified enteral formula is 10.4 g (4.9% of energy requirements), lower than the hospital and commercial formula. The requirements for carbohydrate levels, according to PERKENI, 2021 are 45-65% of total energy requirements, where the carbohydrate levels produced by the modified formula do not meet the requirements even though the frequency of formula administration is 8x. Each formula's carbohydrate level difference is due to the different carbohydrate sources used. The hospital enteral formula uses food sources of carbohydrates from 250 ml of fresh milk, 5 grams of granulated sugar, and 5 grams of maltodextrin; the modified enteral formula uses a carbohydrate source of

33.3 grams of whole cream milk, 5 grams of granulated sugar, 5 grams of maltodextrin, and 3.3 grams of pumpkin flour; as well as commercial enteral formulas sourced from milk powder.

Dietary Fiber

One of the plant components humans can consume is non-starch, polysaccharides, and lignin in plant cell walls, which consist of carbohydrates not digested by the body, namely dietary fiber. Carbohydrates in fiber are resistant to digestion and absorption in the small intestine and large intestine, which will then undergo complete or partial fermentation (Mary, 2013). The dietary fiber content in the three enteral formulas is the most critical component in the formula because dietary fiber is what will prove that the two formulas are classified as a type of formula with high fiber, which can function as a fiber supplement to meet the daily fiber needs of patients with constipation, weight management and lack of fiber intake due to certain illnesses or medications (Nestle, 2020).

In enteral formulas, the fiber in food needs to be considered because it can make enteral administration difficult via NGT (Rizqiya & Syafiq, 2019). The research results show that the dietary fiber content per portion of the modified enteral formula is higher than that of the hospital formula but lower than that of the commercial formula. This is because the hospital formula has no source of fiber, whereas, in the modified formula, the fiber content is obtained from pumpkin flour.

Consider using ingredients in the form of flour or powder because if you use ingredients that are not in the form of powder, there are concerns that it will make it challenging to administer enteral formulas via NGT and reduce the product's shelf life if produced commercially. From the results of this research, when the enteral formula is passed into the NGT, the enteral formula can pass through the 18 fc NGT tube without difficulty, and there are no blockages. There are no obstacles in giving it. The dietary fiber content in enteral formulas based on egg white flour and pumpkin flour cannot be used as a characteristic or advantage of the formula because it does not meet the daily fiber consumption requirements, namely 25-30 g/day. However, the fiber content in the modified formula can help meet the fiber needs of patients with indications of constipation, weight management, and lack of fiber intake due to certain diseases or medications (Nestle, 2020).

Organoleptic

Color Parameters

Color is one of the parameters first seen by the eye, determining the consumer's or panelist's perception of food. Color is the first impression because it uses the sense of sight. Attractive colors invite the panelists' tastes to taste a product (Winarno FG, 1997). As for color parameters, the hospital enteral and commercial formula had the most favorable color with a score of 3.55 ± 0.51 compared to the modified formula. The characteristics of the modified enteral formula produced are yellowish-white due to the addition of pumpkin flour, which is different from hospital enteral formulas and commercial formulas, which are a typical milky white color.

Panelists preferred the whiter color of the enteral formula. The white color in hospital enteral formulas and commercial formulas comes from fresh milk and powdered milk, which have whiter color characteristics than whole cream milk in enteral formulas that have been added with egg white flour and pumpkin flour because of the carotene content, which causes the color of the enteral formula—yellowish modification. The brewing process using hot water can also cause the color of the modified enteral formula to become brownish due to the Maillard reaction, which is a reaction between carbonyl groups (reducing sugars) and amino groups (amino acids, peptides, and proteins) when both are heated or stored for a relatively long time. In dairy products, this process starts from condensing lactose with the free amino acid residue lysine in milk protein (glycosylation) (Tehrany & Sonneveld, 2009).

Flavor Parameters

Flavor is one of the parameters used in a sensory or organoleptic test, which uses the sense of smell. The flavor is acceptable if the flavor produced has a specific flavor (Lamusu D, 2018). The flavors in the enteral formula of the ingredients used are mainly milk flavor and pumpkin flour. The results of the organoleptic values show that the commercial formula has the most preferred flavor with the highest score of 3.35 ± 0.74 compared to the other two formulas. The characteristic of the commercial enteral formula

produced is that it has a vanilla flavor. In contrast, the modified enteral formula has a slightly unpleasant flavor, so the panelists do not like the resulting flavor.

The isocoumarin content in pumpkin produces the delicious taste of pumpkin, which causes an unpleasant/bitter taste. According to Rubatzky and Yamaguchi (1998), the oil pockets in the intercellular spaces of the pericycle of pumpkin contain essential oils, which cause the characteristic flavor of pumpkin. Meanwhile, the egg white flour used does not produce a fishy smell because it uses flour instead of fresh egg whites. Processing egg whites into flour is one way to reduce/eliminate the distinctive flavor of egg whites (Hidayat, 2015). Adding whole cream milk can overcome the unpleasant taste of modified enteral formula.

Taste Parameters

Taste is one factor or parameter determining consumer acceptance of a product. Taste is a sensation that arises from a combination of ingredients or product composition (Lamusu, 2018). In this study, the taste of the enteral formula was obtained from a combination of the flavors of the ingredients used in making the enteral formula. The commercial enteral formula had the highest score of 3.30 ± 0.97 compared to the other two. This shows that vanilla flavoring in commercial formulas can increase acceptance in terms of formula taste.

Meanwhile, the modified enteral formula with the addition of egg white flour and pumpkin flour had a lower level of preference, which could be due to the reduction in the typical sweet taste of pumpkin due to the flouring process. Yellow pumpkin has a distinctive taste, so using yellow pumpkin can provide a typical sweet taste of pumpkin (Kristiastuti & Afifah, 2013). However, the drying treatment causes the volatile compounds in the pumpkin to evaporate along with the water during drying. When water evaporates from the surface of the heated material, several small volatile substances will be carried away (Wirakartakusumah et al., 1992). This causes the taste after drying to be reduced when compared to fresh pumpkin so that the modified enteral formula tastes like pumpkin and tends to taste like whole cream milk.

Texture Parameters

The Texture of the enteral formula is related to the touch or sensation that occurs when it comes into contact with the taste organs in the mouth. Apart from that, the Texture referred to in this case is the viscosity of the enteral formula. Texture is also considered as important as other parameters because it will influence food taste. In this study, the Texture of the enteral formula produced was classified as runny or liquid-like liquids or enteral formulas. The Texture of the commercial enteral formula is the most preferred, with the highest score of 3.45 ± 0.68 compared to the other two formulas.

Based on the interview results, according to the panelists from the three treatments, there were no significant differences in Texture or viscosity. According to the panelists, the viscosity of the enteral formula is considered good, namely, not too thick and not too runny. A too-thick texture will make it challenging to administer the enteral formula to patients if given using an NGT. In contrast, a too-thin texture indicates that too much fluid was used in making the enteral formula. This can impact the amount of energy in the enteral formula. Too much fluid can cause the stomach to be full of fluid, but the actual energy intake still does not meet needs. According to the panelists, the viscosity of the enteral formula made is relatively good. This was also proven when the enteral formula was tried on an 18 fc NGT tube; the solution could pass through the tube well without any obstacles.

Apart from the viscosity aspect, the panelists also mentioned that the enteral formula presented still contained powder or dust from the ingredients used. This can be caused by a lack of stirring during enteral formula processing so that the ingredients in the form of powder, especially pumpkin flour, have dissolved partially. Another possibility that causes this powder-like Texture could be that the filter used in the process of filtering enteral formula ingredients is not small enough so that solids in the powder remain.

CONCLUSIONS

The modified enteral formula has the same suitability for consumption by diabetes mellitus patients with impaired kidney function. There are differences in physical characteristics (viscosity), differences in nutritional value (energy, protein, fat, carbohydrates, and dietary fiber), and there are differences in the level of preference (color, flavor, taste, and Texture) of modified enteral formulas with hospital formulas and commercial formulas.

RECOMMENDATION

Future research is expected to be able to modify the composition of formula ingredients, especially regarding the dosage of protein source ingredients, how to process ingredients, the shelf life of enteral formula, as well as carrying out food safety tests, especially regarding metal and microbial contamination.

REFERENCES

... & Magliano, D. J. (2022). IDF Diabetes Atlas: Global, regional, and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes research and clinical practice, 183, 109119.

ADA (American Diabetes Association). 2002. Management of Dyslipidemia in Adults with Diabetes. Diabetes Care. 25 (1): 74-77.

Ayu, R. (2020). Commercial Enteral Formula. Accessed from https://ahligizi.id/blog/2020/21/formula-enteral-komersial.html on December 31, 2023.

Dharmayanti L. The effect of consuming steamed egg whites on the healing of Post Sectio Caesarea suture wounds. J Nursing and Midwifery. 2019;2(3):6– 10.

Gaputri F, Pangalila F. Relationship between albumin levels and HbA1c in type 2 diabetes mellitus patients at the Royal Taruma Hospital, West Jakarta for the 2018-2019 period. Tarumanagara Med J. 2020;2(2):263–7.

Gropper, S et al., 2009, Advanced Nutrition and Metabolism Fifth Edition. Belmont: Wadsworth.

Hammes, M. S., Watson, S., Coe, F. L., Ahmed, F., Beltran, E., & Dhar, P. (2015). Asymmetric dimethylarginine and whole blood viscosity in renal failure. Clinical Hemorheology and Microcirculation, 59(3), 245-255.

Hawa, I. I., & Murbawani, E. A. (2015). Effect of Administration of Enteral Formula Based on Yellow Pumpkin (Cucurbita moschata) on Postprandial Blood Glucose Levels in Diabetes Mellitus Rats. College Journal of Nutrition, 4(4), 387–393. https://doi.org/10.14710/jnc.v4i4.10115.

Hidayat, M. N. (2015). Utilization of the Effervescent Effect in Making Egg White-Based Instant Drinks. Technoscience: Science and Technology Information Media, 9(2), 205-220.

Huda, N. and Kusharto, C. M. (2014). Alternative Liquid Food Formulation Based on Catfish Meal (Clarias gariepinus) as a Protein Source [thesis]. Faculty of Human Ecology, Bogor Agricultural Institute, Bogor.

Kalbe Nutritionals. (2017). Kalbe Nutritionals General. http://www.kalbenutritionals.com/id/tangan-kami/umum/. Accessed December 31, 2023.

Kristiastuti, D., and Afifah, C.A.N. 2013. Basic Knowledge of Indonesian Cakes and Drinks. Surabaya: Unpress.

Lamusu D. Organoleptic test of Jalangkote purple sweet potato (Ipomoea batatas L) as an effort to diversify food. J Food Processor. 2018;3(1):9–15.

Lestari, L. A., Puspita, M. S., Fasty, A. U. (2014). Nutrient Content of Typical Yogyakarta Foods. Yogyakarta: Gadjah Mada University Press.

Marfuah, U., & Ruhyana, M. A. N. (2017). The relationship between compliance with fluid intake restrictions and the incidence of ascites in chronic kidney failure patients undergoing hemodialysis at RS Pku Muhammadiyah Unit Ii Yogyakarta (Doctoral dissertation, Universitas' Aisyiyah Yogyakarta).

Mary E. B. (2013). The Science of Nutrition and Diet in Relation to Diseases for Nurses and Doctors. Yogyakarta: Essensia Media Foundation (YEM).

Maryoto, A. (2019). Benefits of Fiber for the Body. Semarang: Alprin.

Mulyaningsih, M., & Handayani, S. (2021). Detection of Diabetic Ulcers and Examination of Blood Sugar Levels in Diabetes Mellitus Sufferers in Surakarta. Gemassika: Journal of Community Service, 5(2), 148-157.

Nurjanah., Sabri, S., Asadatun, A. (2019). Knowledge of Raw Materials for the Aquatic Products Industry: Practical Guide. Bogor: IPB Press.

PERKENI, 2015, Management and Prevention of Type 2 Diabetes Mellitus in Indonesia, PERKENI, Jakarta:13.

Plauth, M., Cabre, E., and Riggio, O. (2013). ESPEN guidelines on enteral nutrition: Liver disease. Clinical Nutrition.

Pratiwi, L. E. and Noer, E. R. (2014). Microbiological Quality Analysis and Viscosity Test of Enteral Formula Based on Yellow Pumpkin (Curcubita moschata) and Duck Eggs. College Journal of Nutrition 3(4): 954-955.

Ritz., & Orth, S. 2019. Nephropathy in Patients with Type 2 Diabetes Mellitus. N Engl J Med, 1127-1133.
Santosa, E. B. (2013). Effect of Addition of Various Types and Concentrations of Milk on Sensory Properties and Physicochemical Properties of Pumpkin Puree. Journal of Food Technoscience 2(3).
Siregar, N. S. (2014). Carbohydrate. Journal of Sports Science. 13(2):38-44. Smeltzer, S. C. and Bare, B. . (2013) Textbook of Medical Surgical Nursing.
Sobariah, E. & Anita, M. (2005). Enteral feeding guide. Jakarta: Indonesian Dietitian Association.
Suswan, W. (2018). Physical and Chemical Characteristics of Fruit Enteral Formula Based on Material Formulation [publication manuscript]. UNIMUS Nutrition Study Program.