10. Nutritional Analysis of SUPLEMEN-(First Author)-Tukiran

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Nutritional Analysis of Non-Dairy Milk Almond-Tempeh as a Multivitamin Supplement for the Elderly

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ABSTRACT

Increasing age in the elderly causes a decrease in physiological function and body resistance due to the degenerative process (aging). The elderly are susceptible to various diseases, both non-communicable diseases, and infectious diseases. Intake of highly nutritious food and beverages is needed to strengthen the immune system of the elderly can be through the consumption of milk. Generally, milk comes from cows called dairy milk. There is also milk derived from plants known as non-dairy milk, such as almond milk and tempeh milk. This research was a quantitative descriptive study to analyze the content of macro and micro nutritional values in almond-Tempe milk products on the presentation of the daily nutritional adequacy rate for the elderly. Almond-Tempe milk product is formulated from the substitution of 25% almond milk and 75% tempeh milk with the addition of Moringa leaf extract, beetroot, and broccoli as well as the addition of dates as a sugar substitute sweetener. The results of the nutritional value of almond-Tempe milk per serving to the percentage of RDA for the elderly showed the energy content of almond-Tempe milk had a percentage of 14.86-17.84 % per day for the elderly. The percentage of carbohydrates for the elderly was 13.05-15.62 % per day. The percentage of fat for the elderly was 23.45-26.06 % per day. The percentage of protein for the elderly was 7.15-7.89 % per day. The percentage of crude fiber for the elderly was 16.5-18.75 % per day. The content of vitamin E was 0.65 mg had been able to meet the needs of vitamin E based on the percentage of RDA for the elderly per day. The content of folic acid (vitamin B9) was able to provide 95.25 % of the folic acid percentage of RDA for the elderly per day.

Keywords: *Almond, elderly, non-dairy milk, nutrition, recommended dietary allowance (RDA), and tempeh.*

1. INTRODUCTION

Three groups of elderly according to BKKBN, namely the elderly beginning of the age of 45-54 years, pre-elderly people 55-59 years old, and the elderly are aged 60 years or older [1]. Increasing age in the elderly can reduce physiological functions due to degenerative processes and cause many non-communicable diseases to appear in the elderly. The degenerative process reduces the body's resistance so susceptible to infectious diseases. Internal aging factors in the elderly include decreased hormones, free radicals, diabetes mellitus, apoptosis, immunity decreasing, and genes. Efforts to slow down aging can be done by providing antioxidants that can multiply age-susceptibility up to four times and maintain the body's immunity by consuming vitamins, minerals selenium 100 mg, zinc 20 mg, vitamin E 200 mg [2]. In addition, the elderly also need to pay attention to their food and drink intake.

The intake of highly nutritious food and beverages is needed to strengthen the immune system of the elderly can be through the consumption of milk. However, the level of milk consumption in Indonesia is still low, at 16.23 kg/capita/year [3], because the production of Domestic Fresh Milk (SSDN) is only able to meet 22% of the milk intake needs in Indonesia. There is also milk that comes from plants, for example from the group of nuts such as soybeans, almonds, corn, peanuts, and so on. Milk derived from these

plants is known as non-dairy milk. Nuts as a source of vegetable protein also contain B vitamins, minerals, and fiber.

Soybean is not only processed into milk. In Indonesia, Soybean is also the main ingredient in making tempeh. Tempeh contains protein, vitamin B12, and antioxidant compounds identified as isoflavones, namely daidzein, genistein, glycitein, and factor-2 (6, 7, 4, trihydroxy isoflavones), and 3-hydroxyanthranilic acid. The compounds have a role in reducing free radical activity and are useful for cancer prevention, osteoporosis, atherosclerosis, and neurodegeneration as well as carotenoids, vitamin E, and vitamin C [4-5]. The contents of tempeh milk are higher compared to dairy milk and are good for those who have dairy-milk allergies because the amino acid composition of tempeh milk is almost the same as the amino acid composition of the acid amino dairy's milk [6]. Tempeh milk has advantages in terms of nutrition produced from the fermentation process by the fungus Rhizopus oryzae when compared to soy milk [7-8]. The amino acid content in tempeh is 24 times higher than soybean, in addition to protein efficiency and the value of healthy fatty acids is also better than soybeans. This is because the digestive enzymes that are produced by molds that grow in the fermentation process when making tempeh, will break down complex compounds (protein, fat, and carbohydrates) contained in soybeans into simple compounds. This makes tempeh easier to digest, absorb, and utilize its nutrients by the body compared to the nutrients in soybeans. Regular consumption of tempeh milk can reduce blood pressure in the elderly. Prebiotics produced from the fermentation process are beneficial in balancing the normal flora of the intestine and improving the absorption of water and electrolytes. This makes tempeh milk good for consumption by the elderly because it has high marine protein, it's very useful for the digestive process.

Almonds are one of the plants of the Rosaceae family and genus Prunus. Almonds contain a variety of nutrients and phytoprotective substances that beneficially influence human physiology. Almonds with a 100-gram serving provide more than 20% of the daily value of riboflavin, niacin, vitamin E, calcium, iron, magnesium, manganese, phosphorus, and zinc. The same serving size, almond is also a good source (10-19% RDI) of thiamine, vitamin B6, folate, Choline, and potassium minerals. Almonds also contain phytosterols such as beta-sitosterol, stigmasterol, campesterol, sitostanol, and campestanol, which have been associated with cholesterol-lowering properties. Almonds are also rich in dietary fiber, monounsaturated fats, and polyunsaturated fats that can potentially lower LDL cholesterol. [9].

Potential compounds contained in tempeh and almonds can be used as non-dairy milk. Non-dairy milk can be an alternative to dairy milk for people who are lactose intolerant or for the elderly who have digestive functions. In this study, plant-based milk was made from fortified milk and raw almonds with vitamin A, vitamin C, and vitamin E derived from beetroot, Moringa leaves, and broccoli.

2. METHOD

This research was descriptive quantitative using laboratory analysis. The research was conducted to describe the nutritional value content in almond-tempeh milk to the nutritional adequacy figures for the elderly. The research method used in this research consists of several stages, namely as follows:

1) Almond Milk and Tempeh Milk Making

Almonds used are almonds that had been sliced. Almonds were soaked in boiled water for 8 hours and drained until no water drips. Tempeh was diced and steamed for 15 minutes. Furthermore, almonds and tempeh were mashed using a slow juicer with the addition of water in the ratio of water and almonds 3:1. The resulting filtrate was filtered with a 100 mesh sieve to produce almond milk without sediment.

2) Vegetable Extract Making

The vegetables used in this study were root beetroot, broccoli, and moringa leaves. Each vegetable was washed thoroughly and winded to reduce it was moisture content and mashed so that it became sample powder. Furthermore, each sample powder of as much as 100 grams is macerated with 250 mL of sterile aqua for 4 hours and filtered with a vacuum pump so that the resulting macerate filtrate and yield. Macerate filtrate was evaporated with a rotatory vacuum evaporator at 50 °C with pressure adjusted for water solvent so that viscous extract is produced.

3) Making Beverage Supplements

The manufacture of health beverage supplements was done by determining the dosage of vegetable extracts namely beetroot as a source of B vitamins, especially folate; broccoli as a source of vitamin C; and moringa leaves as a source of vitamin A. Extract dose was calculated based on the needs of vitamin$ A, B, and C for the elderly, and maximized by the addition of 1 gram each vegetable extract in 100 mL of beverage supplements with a measure of 25% almond milk and 75% tempeh milk.

4) Testing macro and micro nutrition of beverage supplements

Macro nutrition testing on beverage supplements was conducted with protein content test analyzed using Kjeldahl test method, fat content analyzed using Weibull test method, carbohydrate content analyzed using Luff school test method, food fiber content analyzed using Gravimetric method. While micronutrient testing was conducted by testing the content of vitamins A, C and E analyzed with HPLC and vitamin B9 analyzed with UPLC.

3. RESULT

The elderly are the final stage of development in the human life cycle. The elderly will occur a process called aging, which is a process of slowly disappearing the ability of tissues to repair and maintain normal structures and functions that make the elderly unable to survive against spoils (including infections) and repair existing damage. Therefore, the elderly will progressively lose resistance to infection and accumulate more metabolic and structural distortions called degenerative disease. Efforts to slow down the aging process, prevent degenerative diseases and maintain immunity, namely paying attention to food intake and nutritional content of food ingredients.

RDA or recommended dietary allowance is the average amount of nutrients that must be obtained by a person every day according to age group, gender, body size, and activity to

prevent nutritional deficiencies. Various types of nutrients in the RDA showed that the nutrient that decreases with age is energy. The energy needs of men and women in Indonesia are not much different, especially during the productive age group. The RDA for the elderly according to Permenkes No. 28 the Year 2019 is around 2,150-1,800 Kcal for men and 1,800-1,550 Kcal for women [10].

Table 1. Recommended dietary allowance (RDA) for elderly

Age Group	Energy (Kkal)	Carbohidrat (gr)	Protein (gr)	Fat (gr)	Fiber (gr)	Vit.A (RE)	Vit. B9 (mcg)	Vit. C (mg)	Vit. E (mcg)
Man									
65-80 th	1800	275	64	50	25	650	400	90	15
Women									
65-80 th	1500	230	58	45	22	600	400	75	20

Recommended food ingredients and foodstuffs should be avoided are taken into consideration in choosing ingredients, such as protein selection. The selection of good proteins for the elderly is important for protein synthesis in the body. In the elderly, there is a lot of cell damage that must be replaced immediately. The selection of foods that contain high-quality and easy-to-digest protein, for example, the protein in nuts. In addition, lactose-containing milk should be considered given the declining digestive condition of the elderly. So the alternative milk intake that can be used is non-dairy milk that does not contain lactose but has proteins that resemble dairy milk.

Non-dairy milk in this study was made from tempeh milk substituted with almond milk in a ratio of 3:1. According to [11], research regarding the effect of the proportion of almond filtrate and tempeh filtrate in beverage supplements on organoleptic tests showed that F3 with a ratio of 3:1 (75% tempeh filtrate and 25% almond filtrate) was the selected formula that met the organoleptic test criteria.

Table 2. Nutritional Comparison of Dairy milk and non- Dairy milk (100 g)

Content	Milk[4]	Soy milk[3]	Tempeh milk[1]	Almond milk[2]	Almond-tempeh milk
Water content	N/A	N/A	89.2%	N/A	N/A
Ash content	N/A	0.84%	0.09%	0.70%	N/A
Energy	124 Kcal	57,36%	40,24 %	55,4%	107,01 Kcal
charbohydrate	9,2 gr	4,28%	9,32%	4,50%	14,37%
Fat	6,8 gr	3,20%	1,12%	3,40%	4,69%
Protein	6,6 gr	2,36%	0,22%	1,30%	1,83%
Fiber	0 gr	3,20%	1,72%	1,25%	1,65%
Vit. A	N/A	N/A	N/A	N/A	ND
Vit.C	N/A	N/A	N/A	N/A	ND
Vit. B9	N/A	N/A	N/A	N/A	381,60 mcg
Vit. B12	0,22 µg	N/A	N/A	N/A	N/A
Vit. E	N/A	N/A	N/A	N/A	0,65 mg

3.1 Energy

The need for calories for the body will decrease with age due to reduced physical activity in the elderly. The body will do metabolism during activities. Metabolism is the body's ability to break down nutrients and convert them into energy or store them as fat for energy reserves. If the number of calories is not balanced with the activities performed then weight can increase.

Table 2 showed the calorie content of dairy milk was higher than non-dairy milk. While the energy content in almond-Tempe milk products was higher than other non-dairy milk. The energy value in milk depends on the carbohydrate, protein, and fat content. The calorie requirement for the elderly based on RDA is 1800 Kcal/day for men and 1500 Kcal/day for women, while the calories contained in the beverage supplement from almond-tempeh milk/250 ml, was 267.525 Kcal. The result was able to meet the energy needs of the elderly per day by 14.86% for men and 17.84% for women.

3.2 Carbohydrates

Carbohydrates are the main source of energy for the human body. The function of carbohydrates for the body is to prevent the emergence of ketosis, excessive breakdown of excessive body protein, loss of minerals, and useful in the metabolism of fats and proteins. However, excess carbohydrate consumption and low physical activity in the elderly will increase the energy intake then stored by the body as fat reserves. Accumulation of body fat in the abdomen will cause central obesity, while accumulation in blood vessels will block blood circulation and form plaque (atherosclerosis) had an impact on hypertension and coronary heart disease [13].

Table 2 showed the carbohydrate content of almond-Tempe milk products was higher than other non-dairy milk and dairy milk due to the addition of dates in almond-Tempe milk as a sugar substitute sweetener. Dates were a fruit that had a sweet taste from high amounts of fructose and glucose, were monosaccharide carbohydrates. Fructose had a low glycemic index compared to glucose and sucrose so it

did not cause blood sugar levels to rise drastically and was safe for consumption by the elderly, most of whom had problems with blood sugar levels [13].

The carbohydrate requirement for the elderly based on RDA was 275 g/day for men and 230 g/day for women, while the carbohydrate contained in the beverage supplement of almond-tempeh milk/250 mL was 14.37% or equivalent to 35.93 g. The result was able to meet the carbohydrate needs of the elderly per day by 13.05% for men and 15.62% for women.

3.3 Fat

Fat is a macronutrient that serves as the largest contributor of energy, protecting organs in the body, dissolving vitamins, and regulating body temperature. Intake of fat derived from food if less will have an impact on the lack of caloric intake or energy for the process of activity and metabolism of the body. Low fat intake followed by reduced energy in the body will cause changes in body mass and tissues as well as impaired absorption of fat-soluble vitamins [17]. However, excessive fat consumption in the elderly, especially saturated fats, can increase blood cholesterol levels, LDL, and decrease in HDL or increase in triglyceride levels in the blood as an independent factor against heart disease [18].

Table 2 showed the fat content of dairy milk was higher than non-dairy milk, while almond-Tempe milk products have a higher fat content than other non-dairy milk. Tempe milk contained unsaturated fatty acids such as oleic acid, linoleic acid, and linolenic acid [19]. The composition of fatty acids of almonds was beneficial because monounsaturated fatty acids (MUFA) dominate and saturated fat content (3. 7 g per 100 g of almonds) were the lowest of all nuts. The total fat content consists of 62% MUFA and 24% polyunsaturated fatty acids. The cholesterol-lowering efficacy of nuts in human studies is often higher than expected based on fatty acid exchange and high MUFA content [20].

The fat requirement for the elderly based on RDA was 50 g/day for men and 45 g/day for women, while the fat contained in the beverage supplement from almond-tempeh milk was 4.69% or equivalent to 11.73 g. The result was able to meet the fat needs of the elderly per day by 23.45% for men and 26.06% for women.

3.4 Protein

Proteins in the body are very useful for building and maintaining cells, such as muscle cells, bones, enzymes, and red blood cells. The total protein intake that humans need will decrease according to the change in a person's age. This is related to the decrease in the function of body cells in humans. However, in other sources, the need for protein intake remains because the process of regeneration of the body will continue to run according to the rate of cell regeneration that occurs. Some studies have found that older or older people need greater protein intake to maintain nitrogen balance. However, the relationship of decreased protein intake can have a major effect on the decrease in cell function, so there is often a decrease in muscle mass, decreased endurance to disease, etc. While the need for protein will increase when an elderly person is in a clinical condition such as severe infection, fever, or surgery.

Table 2 showed the protein content of dairy milk was higher than non-dairy milk. While almond-Tempe milk products have a lower protein content than soy milk. Tempe was made through the fermentation process of soybeans, many of the nutrients in soybeans had changed to become more soluble in water and easy to digest. Almost half of the protein content of soybeans during fermentation was broken down into smaller, water-soluble products such as peptides and amino acids [21], so as shown in Table 2, the protein content of tempeh milk was slightly lower than soy milk as well as almond milk tempeh.

The protein requirement for the elderly based on RDA is 64 g / day for men and 58 g / day for women, while the protein contained in the beverage supplement of almond-tempeh milk was 1.83% or equivalent to 4.58 g. The result was able to meet the needs of elderly protein per day by 7.15% for men and 7.89% for women.

3.5 Fiber

Fiber is one of the important substances that the elderly need, since lack of fiber can cause constipation. Constipation is one of the digestive problems that are often experienced by the elderly. To prevent and overcome these digestive system problems, the intake of elderly fiber must be high. Fiber or dietary fiber is a compound polysaccharide or lignin that is not able to be digested or hydrolyzed in the body by digestive enzymes, so it will remain intact when it reaches the intestines (colon), this causes when consuming fiber it can slow down the glycemic response, this slow glycemic response is what makes IG values low [22]. Fiber is also needed to control the levels of fat and sugar in the blood, to reduce the risk of heart disease and type 2 diabetes. Almonds include nuts that contain insoluble dietary fiber.

Table 2 showed that dairy milk does not contain fiber, while the highest fiber content in non-dairy milk is soy milk. Almond-Tempe milk products are made from substitutes for almond milk and tempeh milk which have low fiber content. The difference in crude fiber content of soy milk and tempeh is due to a decrease in fiber content due to the fermentation process in tempeh. The decrease in crude fiber in tempeh is due to the fermentation process in soybeans by microbial activity producing cellulase and other enzymes that can break down complex bonds of crude fiber into simpler ones. Crude fiber components such as cellulose, hemicellulose, and lignin are used for microbial growth activity so that crude fiber will decrease [23].

The fiber requirement of the elderly based on RDA was 25 g/day for men and 22 g/day for women, while the fiber contained in the beverage supplement of almond-tempeh milk was 1.65% or equivalent to 4.13 g.

The result was able to meet the needs of elderly fiber per day by 16.5% for men and 18.75% for women.

3.6 Micronutrient

Based on table 2 showed the highest vitamin content in almond-tempeh milk was vitamin E of 0.65 mg/100 mL. The vitamin E needs of the elderly based on RDA are 15 mcg/day for men and 20 mcg/day for women. The content of vitamin E in almond-tempeh milk had met the vitamin E needs of the elderly per day. The source of vitamins derived from almonds was one of the nuts that had a high content of vitamin E [24].

Vitamin E was a fat-soluble vitamin with antioxidant activity and naturally found in some foods. The activity of vitamin E in the immune system was inseparable from antioxidant activity to prevent free radicals in the body. Vitamin E also played a role in maintaining the integrity of cell membranes, providing anti-inflammatory effects, and as an immunomodulator [25].

Furthermore, the content of vitamin B9 (folic acid) in almond-tempeh milk was 381.60 mcg / 100 mL. The vitamin B9 need for the elderly based on RDA is 400 mcg / per day for both elderly men and women so that the content of vitamin B9 in almond-tempeh milk had been able to meet the needs of vitamin B9 per day by 95.25% for elderly men and women. The source of vitamin B9 in almond-tempeh milk comes from beetroot, wherein 100 grams of fresh beetroot contains about 109 mcg. In addition, some vitamin B9 is also obtained from tempeh which is the result of fermentation of soybeans using rhizopus oligosporus inoculum for 48 hours which has the potential as a natural folic acid (vitamin B9) fortifikan [26].

B vitamins were water-soluble and not stored in the body, so intake of B vitamins through food is necessary. In general, B vitamins play an important role in regulating the inflammatory response. B vitamins, in general, assist immune response activity, reduce the number of proinflammatory cytokines, improve respiratory function, and maintain endothelial integrity. Mikkelsesn, 2019 reported that the use of vitamins B6 and B9 could upregulate iL-10, an immunosuppressive cytokine that can inactivate macrophages and monocytes and inhibit T cells [25].

The testing of vitamins A and C in almond-tempeh milk was not detected. This is due to the limited detection in the testing of vitamins A and C in almond-tempeh milk. Therefore, it is necessary to improve the formulation with the addition of moringa leaf extract concentration chosen as a source of vitamin A and broccoli extract as a source of vitamin C.

4. CONCLUSION

Nondairy-milk milk products with the substitution of almond milk 25% and tempeh milk 75% in a 250 mL serving have various macronutrient and micronutrient contents that can meet the daily RDA percentage for the elderly. The energy content of almond milk, tempeh has a percentage of elderly energy AKG per day at 29.73 % -35.67%. The results of the analysis of almond-tempeh milk on the percentage of recommended dietary allowance (RDA) for the elderly showed that the total energy in almond-tempeh milk was 14.86-17.84%, the total carbohydrate in almond-tempeh milk was 13.05-15.62%, the total fat in almond-tempeh milk was 23.45-26.06%, the total protein in almond-tempeh milk was 7.15-7.89% and the total fiber in almond-tempeh milk was 16.5-18.75% for a day. The content of vitamin E in almond-tempeh milk was 0.65 mg has been able to meet the needs of vitamin E based on the percentage of recommended dietary allowance (RDA) for the elderly. Folic acid (vitamin B9) content was sufficient 95.25% of the percentage of recommended dietary allowance (RDA) for the elderly.

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