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The Effect of Variation in Composition of Almond, Corn, and Soybean on The Characteristics of Composite Vegetable Milk (Alcosoy)

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Abstract. This study aims to determine the effect of the composition of almond, corn, and soybean on composite vegetable milk (Alcosoy) and to determine the best almond, corn, and soybean ratio to produce the nutritional and sensory characteristics of composite vegetable milk (Alcosoy Milk). The experimental design of this research is using Completely Randomized Design (CRD) with four levels of ratio treatment almond, corn, and soybean, which are 1:1:1, 2:1:1, 1:2:1, dan 1:1:2. The treatment was repeated three times to obtain 12 experimental units. The obtained data analyzed by variance analysis, and the treatment affecting the observed parameters, the test continue with Duncan test. The result showed that the ratio of almond, corn, and soybean (Alcosoy) had a significant effect in content of protein, fat, fiber, total solids, calcium, potassium, Vitamin B_1, β-carotene, and antioxidant activity as well as the hedonic test of taste and aroma, but insignificantly on the hedonic test of color and appearance of composite vegetable milk. The best almond, corn, and soybean milk obtained from 1:1:2 ratio with 3.9 % of protein content, 2:1:1 ratio with 3.51 % fat and 2.58 % fiber content, and 1:2:1 ratio with 12.38 % was the largest total dissolved solids, the Sensory test with response to color and appearance from normal to somewhat like for all compositions, while the most preferred response to taste and aroma is the composition 2:1:1.

1. INTRODUCTION

In ancient times, milk has been used as a staple food for humans. Humans take milk from animals that have mammary glands, such as cows, horses and goats. However, according to nutritional needs and the development of the times, milk can also be obtained by making it from vegetable sources. Vegetable milks, among others, are sourced from almonds, corn and soybeans which are allegedly rich sources of macro-nutrients such as protein and essential vegetable fats, as well as rich in micro-nutrients, namely minerals, vitamins and antioxidants.

Almond

Almonds are nuts that are rich in nutrients and vitamins. Almonds have a larger shape compared to peanuts or other types of nuts. Almonds, or tonsils, or also almonds, are called superfoods because they are classified as foods that contain lots of nutrients. Almonds, which are rich in phytosterols, fiber, and alpha-tocopherol, can function to reduce cholesterol absorption, can also increase fiber intake, reduce lipid peroxidation. Almonds also contain extra vitamin E, B complex vitamins and omega-3 fatty acids. Consuming a handful of almonds every day provides a fairly high protein intake, so it will prevent excessive hunger.

Almonds (Prunus dulcis) have a lot of content including fiber, healthy fats, vitamin E, and several types of minerals. The various nutritional content makes almonds suitable as a healthy snack. Almonds are often used as snacks, to make cakes, coffee, and so on. Joan Sabate PhD., Head of Nutrition at Loma Linda University School of Public Health, quoted from Wikipedia, said almonds have nearly nine times more healthy monounsaturated fat than harmful saturated fat. With sufficient protein, fiber, calcium, iron, and also no cholesterol, these nuts are also one of the best sources of vitamin E which protects the body from the risk of stroke and cancer.

One of the derivative products from almonds is almond milk. The existence of almond milk (almond) is increasingly attracting public attention because it is believed to be healthier than other milk. Almond milk is considered a healthful alternative to milk, especially for people who are allergic to lactose or the protein in cow's milk. This type of milk is also the most frequently ogled by people who are on a diet to lose weight. The reason is, almond milk has a smaller number of calories than cow's milk. Almond milk does not contain cholesterol or saturated fat like cow's milk. The sodium content in milk is low, while the healthy fats (such as omega fatty acids) are quite high. These omega

fatty acids play an important role in preventing high blood pressure. In addition, according to the journal Nutrients (2018), almonds can reduce levels of low density lipoprotein (LDL), which is a risk factor for heart disease. In addition, almonds, which are rich in nutrients, are also healthy, so many have switched to consuming milk made from nuts to replace cow's milk or soy milk. Pure almond milk contains carbohydrates and a relatively low glycemic index, so it does not increase blood sugar levels significantly, this means that consuming almond milk can also indirectly reduce the risk of developing diabetes.

Corn

Corn is a staple food besides rice which also has an important position after rice. Corn contains nutrients that are also important for the body such as carbohydrates and fats. Carbohydrates in corn consist of sugar, starch, crude fiber and pentosan for this starch consists of amylose and amylopectin content and for sugar in the form of sucrose. Corn is the most productive cereal crop in the world, which is grown in high temperature areas, with cob maturation determined by the accumulated heat obtained by the plant (Iriany, 2008). Apart from being a source of carbohydrates, corn is also an important source of protein in Indonesia. Corn contains many functional food components such as dietary fiber needed by the body, essential fatty acids, isoflavones, minerals (Ca, Mg, K, Na, P, Ca, and Fe). Anthocyanins, beta-carotene (provitamin A), and others (Suarni, 2015). The main nutritional component of corn is 72-73% starch, with amylose: amylopectin ratio of 25-30%: 70-75%, while glutinous corn or waxy corn (waxy corn) has amylopectin levels reaching 100%. The content of simple sugars (glucose, fructose, sucrose) is 1-3% (Suarni 2015). According to Rochani (2007), corn has various types, namely composite *lamuru* corn, *sukmaraga* corn, hybrid corn, *bisi* corn, pioneer corn, white *srikandi* corn, and sweet corn.

Corn milk is one of the processed corn products that has been widely developed because it has nutritional benefits and does not contain allergens (lactate), so it is safe for consumption for people with lactose intolerance. Corn milk is obtained by grinding corn kernels which have been boiled in water. The results of the mill are filtered to obtain a filtrate which is then pasteurized and flavored to enhance the taste. Corn milk is one of the probiotic drinks (additional) that can maintain the condition of the body to stay healthy so it is not susceptible to disease.

As a probiotic drink, corn milk can provide the additional energy needed by the body because it contains carbohydrates. The advantage of corn milk compared to cow or soybean milk is that the raw materials are easily obtained at prices that are not too high (Muhajir 2014).

soya bean

Soybean (Glycine max L. Merr) is the cheapest source of protein in the world. In addition to producing good quality oil, various types of soybeans in Indonesia have a protein content of 30.53-44%, while the fat content is 7.5-20.9%. Judging from the percentage of soybean use in the world, it is estimated that around 40% of total production is used as human food, especially in East and Southeast Asia, 55% as animal feed, and only 5% is used as industrial raw material, especially in developed countries. Processed soybean products mostly consist of products that are not fermented. Some of these products are soybean oil and its processed products, such as soy flour, isolate and soy protein concentrate, as well as synthetic meat or TVP (Texturized vegetable protein) (Purwaningsih, 2007). Soybeans contain protein reaching 35-38% greater than green beans. In addition to high protein, soybeans also contain vitamins B1, B2, niacin, pyridoxine, vitamins E and K (Jariyah, 2017).

Soymilk is called milk because this drink has a yellowish white color similar to milk. Soymilk is actually a natural by-product of tofu making. Soy milk is one of the processed soy products obtained by extracting soy protein, then diluting it to obtain an appearance that resembles cow's milk. Soymilk can be used as a substitute for milk for people who are lactose intolerant, vegan, or have their own health and environmental reasons. This drink was first made in China and is known as *doujiang*. Since the 19th century, soy sauce is commonly served as breakfast along with other snacks

The amino acid composition of soy milk has the same amino acid composition as cow's milk. In 100 g of liquid soy milk there is a water content of 88.60%. The water content can change according to the amount of water added to dissolve the soy milk which affects its viscosity. In addition to water

content, liquid soy milk also contains calories of 52.99 Kcal, 4.40% protein, 3.50% fat, 3.80% carbohydrates, and several minerals such as calcium, phosphorus, sodium, iron, and ash (Maris , 2021).

Composite Milk

Milk is one of the drinks produced by animals and has many nutrients. But unfortunately, not everyone is suitable to drink processed products from these animals. In fact, according to research, Asian people tend to have lactose intolerance problems, even though lactose is the main carbohydrate component in animal milk. After consuming this drink, people who have lactose intolerance can feel bloated or even diarrhea.

If anyone, including people who have this lactose intolerance problem, can consume plant-based milk, meaning milk from plants as a substitute. So, what vegetable milks can we try, and what are the nutrients. Vegetable milks that can be consumed include almond milk, soy milk, rice milk, wheat milk, cashew milk, green bean milk, and so on. These vegetable milks can be consumed in single or mixed form, we call mixed vegetable milk composite vegetable milk. Composite vegetable milk generally has a more complete nutritional value than single vegetable milk, because each other complements and covers the advantages and disadvantages of its nutritional components. Composite milk is a mixture of several sources of plant-based milk ingredients.

2. METHOD

Material

Almonds, Corn, Soybeans, Dates, CMC, and Chemicals for analysis of levels of protein, fat, fiber, calcium, potassium, and antioxidant activity.

Tool

The tools used for processing consist of blenders, filter cloths, blanchers, pans, chemical glass, jar bottles, stirrers, hand refractometers, thermometers, measuring flasks, digital scales, and chemical analysis instruments such as a UV-spectrophotometer. Vis 20D plus, a set of tools for analysis of levels of protein, fat, calcium, potassium, fiber, and antioxidant activity.

Experimental design

This study used a completely randomized design (CRD) with almond, corn and soybean composition treatment consisting of 4 levels, including k1 (1:1:1), k2 (2:1:1), k3 (1:2:1), and k4 (1:1:2). This treatment was repeated 3 times to obtain 12 experimental units. The data obtained were analyzed by means of variance and treatment that affected the observed or analyzed response parameters, followed by Duncan's test (Steel and Torrie, 1993).

Research Implementation

a. Manufacture of almond, corn, and soybean (alcosoy) milk
   1. Soak the almonds for 12 hours in clean water (until they're submerged), then drain
   2. Corn with shells is boiled until cooked, cooled, then shelled, until cooked shelled corn is obtained
   3. Soybeans are soaked in 0.5% NaHCO3 solution for 12 hours, boiled soybeans in 0.5% NaHCO3 solution for 30 minutes, skin removed and washed, then drained.
   4. Each of the almonds, shelled sweet corn and soybeans above is weighed according to the composition of 1:1:1; 2:1:1;1:2:1); and 1:1:2 so that the total is 600 grams.
   5. 600 g of the above mixture is added with 3000 ml of water and blended with a blender, then filtered using 2 layers of filter cloth to obtain alcosoy milk
   6. Alcosoy milk is then added with date juice until the sugar content is 10 ºBrix and 0.2% CMC
   7. Then alcosoy milk is packaged in jar bottles and grouped according to the composition of each ingredient

b. Alcosoy milk with each ingredient composition was then analyzed for chemical responses, namely protein content (SNI 01-2891-1992), fat (SNI 01-2891-1992), fiber (SNI 01-2891-1992), calcium

(complexometry), potassium (AAS), thiamine / Vit B1 (Alkalimetry), β-carotene (Spectrophotometry), total dissolved solids (SNI 01-3830-1995), and antioxidant activity (DPPH Method), as well as hedonic sensory test/color preference , taste, aroma, and appearance (Soekarto, 1985)

3. RESULTS AND DISCUSSION

The average response values for protein, fat, fiber, and total dissolved solids in alcosoy milk can be seen in Table 1, and the average response values for calcium, potassium, thiamine/vitamin B1, β-carotene and antioxidant activity levels can be seen in Table 2, as well as the average value of the response to sensory effects can be seen in table 3.

Table 1. Results of the analysis of the average levels of protein, fat, fiber, and total dissolved solids in response to alcosoy milk.

Composition of Almonds:Corn:Soybeans	Protein Content (%)	Fat level (%)	Rate Fiber (%)	Content of Total Dissolved Solids (°Brix)
k_1 (1:1:1)	3,45 [b]	2,46 [b]	1,62 [ab]	10,77 [b]
k_2 (2:1:1)	3,72 [c]	3,51 [d]	2,58 [c]	10,61 [ab]
k_3 (1:2:1)	2,20 [a]	1,65 [a]	1,24 [a]	12,38 [c]
k_4 (1:1:2)	3,90 [d]	2,94 [c]	2,00 [b]	10,55 [a]

Information :

The mean value followed by different letter notations in the same column shows a very significant effect (P<0.01)

Based on table 1 above which is the result of the *alcosoy* milk test on the response to protein content that the composition of almond : corn : soybean shows a significant difference from one another, where the highest protein content is with a composition of 1:1:2, which is 3.90%. This can be interpreted because the composition of soybeans is more than almonds and twice as much corn, so the protein content is produced higher when compared to other compositions. Besides that, the protein content in soybeans is the highest, around 32.35% compared to almonds (21.26%) and corn 9.50 - 11.20%. While the second highest protein content in *Alcosoy* milk is the one with a composition of 2:1;1 which is equal to 3.72%, this can be interpreted that the composition of almond milk is greater than that of corn or soy milk, so the protein content of Alcosoy milk is greater than that of composition 1 :1:1 and 1:2:1.

The results of the *alcosoy* milk test on the response to fat content showed that the composition of almonds : corn : soybean showed a significant difference from one another, where the highest fat content was with a composition of 2:1:1, which was 3.51%. This can be interpreted because the composition of almonds is more than soybeans and twice as much corn, so the resulting fat content is higher when compared to other compositions. Besides that, that the fat content in almonds is the highest around 49.90% compared to soybeans (19.94%) and corn 7.00 - 8.25%. While the second highest fat content of Alcosoy milk is the one with a composition of 1:1;2 which is equal to 2.94%, this can be interpreted that the composition of soy milk is greater than that of corn or almond milk, so the fat content of Alcosoy milk is greater than that of composition 1 :1:1 and 1:2:1.

The results of the *alcosoy* milk test on the response to fiber content showed that the composition of almond : corn : soybean showed no significant difference for the composition 1:2:1 and 1:1:1, and there was no significant difference for the composition 1:1:1 with 1 :1:2, while for the composition 2:1:1 with the other compositions it shows a real difference. Where the highest fiber content is with a composition of 2:1:1 which is equal to 2.58%. This can be interpreted because almonds have a fiber content of 9.00 – 12.00% which is relatively higher than soybeans and corn, as well as twice as much composition as soybeans and corn.

The results of the *alcosoy* milk test on the response to total dissolved solids (TPT) showed that the composition almond : corn : soybean showed no significant difference for composition 2:1:1 and 1:1:2, and there was no significant difference for composition 1: 1:1 with 2:1:1, while for the composition 1:2:1 with the other compositions it shows a real difference. Where the highest TPT content is for the composition 1:2:1 which is equal to 12.38 ºBrix. This can be interpreted because the 1:2:1 composition of the portion of corn is twice as much, so the TPT (sugar) content shows more than almonds or soybeans. Based on the Indonesian National Standard (SNI) number 01-3830-1995 concerning soy milk, the protein content for soy milk is at least 2%, so the results of the study show that all treatments comply with SNI.

Table 2. The results of the analysis of the average levels of Calcium, Potassium, Vit B1, β-carotene, and antioxidant activity in response to alcosoy milk.

Almond Composition: Corn: Soybean	Rate Calcium (ppm)	Rate Potassium (ppm)	Rate Vit. B1 (ppm)	Rate β-carotene (ppm)	Antioxidant Activity (ppm)
k_1 (1:1:1)	385,25 ^{b}	618,90 ^{c}	40,54 ^{b}	20,62 ^{b}	94,23 ^{b}
k_2 (2:1:1)	430,24 ^{c}	528,41 ^{b}	52,45 ^{c}	17,48 ^{a}	88,42 ^{a}
k_3 (1:2:1)	124,28 ^{a}	380,55 ^{a}	21,80 ^{a}	24,60 ^{c}	108,25 ^{c}
k_4 (1:1:2)	427,40 ^{c}	746,26 ^{d}	37,42 ^{ab}	18,22 ^{ab}	93,80 ^{b}

Information :

The mean value followed by different letter notations in the same column shows a very significant effect (P<0.01)

Based on table 2 above which is the result of the *alcosoy* milk test on the response of calcium levels that the composition almond : corn : soybean showed no significant difference for composition 2:1:1 and 1:1:2, but showed a significant difference for composition 1 :1;1 and 1:1:2, where the highest calcium content is in the 2:1:1 composition which is 430.24 ppm. This can be interpreted because the composition of almonds is more than soybeans and twice as much corn, so that the calcium content is produced higher when compared to other compositions. The calcium content of almonds and soybeans is almost the same, which is around 260 – 280 mg/100 g, while the calcium content of corn is relatively less, which is around 30 – 40 mg/100 g.

Alcosoy milk test results for the response of potassium levels showed that the composition of almonds : corn : soybean showed a significant difference from one composition to another, where the highest potassium content was the composition (1:1:2), which was 746.26 ppm. This can be interpreted because the composition of soybeans is more than twice as much almonds and corn, besides that the potassium content in soybeans is relatively more, namely 1797 mg/100 g, so that the potassium level produced is higher when compared to other compositions. Meanwhile, the second highest potassium content in *Alcosoy* milk is the one with a composition of 1:1; 1 which is 618.90 ppm. It can be interpreted that this composition contains potassium derived from soybeans which is still quite dominant, so that the potassium content in *Alcosoy* milk is greater than the composition 2:1:1 and 1:2:1.

The results of the *alcosoy* milk test on the response to vitamin B1 levels showed that the composition of almonds : corn : soybean showed no significant difference for the composition 1:2:1 and 1:1:1, and there was no significant difference for the composition 1:1:2 with 1:1:2 and 1:1:1 with 1:1:2, while for the composition 2:1:1 with the other compositions it shows a real difference. Where the highest levels of vitamin B1 were in the 2:1:1 composition, which was 52.45 ppm. This can be interpreted because almonds contain vitamin B1 from soybeans and corn, which is 4.7 mg / 100 g. also the portion of the composition is twice as much as soybeans and corn.

Alcosoy milk test results for the response of β-carotene levels showed that the composition of almond : corn : soybean showed no significant difference for the 2:1:1 and 1:1:2 composition, and there was no significant difference for the 1:2:1 composition with 1:1:1, while for the composition

1:2:1 with the other compositions it shows a real difference. Where is the highest β-carotene content in the 1:2:1 composition which is equal to 24.60 ppm. This can be interpreted because corn has a 100-120 ppm higher β-carotene content than almonds and soybeans. Besides that, the portion of the composition is twice as large as almonds and soybeans.

Alcosoy milk test results on the response of antioxidant activity that the composition of almond : corn : soybean showed no significant difference for the composition 1:1:1 and 1:1:2, but showed a significant difference for the composition 2:1;1 and 1: 2:1, where the most active (best) antioxidant activity is at a composition of 2:1:1 which is 88.42 ppm. This can be interpreted because the composition of almonds is more than soybeans and corn and twice as much, so that the antioxidant activity is the most active when compared to other compositions. As it is known that a drink or food that has a good value of antioxidant activity is the one whose value is getting smaller. Measurement of antioxidant activity was carried out at the IC50 value, which is a number that indicates the concentration of the test sample (ppm) which provides a DPPH reduction of 50%. The category of antioxidant strength if the results of the analysis <50 are very strong categories, concentrations of 50-100 ppm are strong categories, concentrations of 101-150 ppm are medium categories, and concentrations of 151-200 ppm are weak categories. So the composition almond : corn : soybean 2:1:1, 1:1:1, and 1:1:2 is in the strong category, while the composition 1:2:1 is in the medium category. Based on the treatment of the almond : corn : soybean composition carried out in this study, it can be categorized as a drink that is beneficial to health.

Table 3. The results of the analysis of the average value of the hedonic test for color, taste, aroma, and appearance in response to alcosoy milk.

Composition of Almonds : Corn : Soybeans	Color	Flavor	Aroma	Appearance
k_1 (1:1:1)	4,92 ^{b}	5,68 ^{b}	5,44 ^{bc}	4,84 ^{a}
k_2 (2:1:1)	4,50 ^{a}	6,89 ^{c}	5,65 ^{c}	4,95 ^{a}
k_3 (1:2:1)	4,86 ^{b}	5,70 ^{b}	5,28 ^{b}	4,78 ^{a}
k_4 (1:1:2)	4,74 ^{ab}	4,28 ^{a}	4,25 ^{a}	4,90 ^{a}

Information :

The mean value followed by the same letter notation in the same column showed no significant effect (P>0.05). 1=dislike very much, 2=dislike, 3=rather dislike, 4=normal, 5=rather like, 6=like, and 7=like very much.

Based on table 3 above which is the result of the sensory (hedonic) test of alcosoy milk on the organoleptic response that the composition of almond : corn : soybean showed no significant difference for color parameters, except for the composition 2:1:1 with 1:2:1 showing a real difference, overall for color parameters can be categorized all panelists rate normal to somewhat like. Based on the test of taste parameters, all panelists assessed that there was a significant difference, except for the 1:1;1 composition treatment with 1:2:1 panelists assessed that there was no significant difference. Overall the panelist's assessment of the taste response of *alcosoy* milk showed the liking category, except for the composition of 1:1:2 the panelists rated it from normal to rather like, this may be due to the composition of soybeans being twice as much as the others, so the unpleasant taste of soybeans still felt by the panelists. *Alcosoy* milk test results for aroma parameters for composition treatment 1:1:1 with 1:2:1 and composition 1:1:1 with 2:1:1 panelists assessed that there was no significant difference, but the composition treatment was 2:1:1, 1:2:1, and 1:1:2 panelists assessed that there was a significant difference, overall panelists rated the treatments 1:1;1, 2:1;1, and 1:2:1 rather like to like the aroma, except the 1:1:2 composition treatment panelists rated normal to rather like, this might be because the portion of soybeans was twice as much as almonds and corn, so the unpleasant aroma was still felt. The results of the *alcosoy* milk test on the appearance parameters of all panelists showed that there was no significant difference in the assessment. For all treatments the composition of the

almond : corn : soybean panelists gave an assessment of the appearance parameters from normal to slightly like.

4. CONCLUSION

Based on the results of ANOVA analysis and further tests on the response to the protein and fat content of *alcosoy* milk from all treatments, variations in the composition of almonds, corn and soybeans produced significant differences, and the highest protein and fat content was those with a composition of 1:1:2, namely each -respectively by 3.90% and 2.94%. In general, the response to fiber content showed a significant difference, the 2:1:1 composition showed the highest fiber content, namely 2.58%. Likewise, the response to the total dissolved solids content in general showed a significant difference, the 1:2:1 composition showed the highest total dissolved solids content, namely 108.25%. Based on the results of ANOVA analysis and further tests on the response to the content of calcium, potassium, vitamin B1, β-carotene, and antioxidant activity from the composition variation treatment in general showed a significant difference. The highest content of calcium and vitamin B1 is the composition 2:1:1 which is 430.24 ppm and 52.45 ppm respectively, the highest potassium content is the composition 1:1:2 which is equal to 746.26 ppm, while the composition is 2:1:1 is the most active antioxidant content that is equal to 88.42 ppm. Based on the results of ANOVA analysis and further tests on color sensory response and appearance, the results showed that they were between normal to somewhat like, while the taste and aroma responses showed a slight liking to liking, the appearance/appearance response of all composition treatments showed no significant difference.

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