

RESEARCH STUDY

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Development of Protein-Rich Canavalia Biscuit from Koro Sword Bean Base on Acceptance and Nutritional Content as Additional Food for Pregnant Women for Stunting Prevention

Pengembangan Biskuit Canavalia Kaya Protein Berbahan Dasar Tepung Kacang Koro Pedang terhadap Daya Terima dan Kandungan Zat Gizi sebagai Makanan Tambahan Ibu Hamil untuk Pencegahan Stunting

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ABSTRACT

Background: One of the efforts to overcome the problem of stunting in toddlers, especially in Central Lombok Regency, is to improve the nutritional status of mothers during pregnancy, especially mothers with chronic energy deficiency (KEK). The PMT program for pregnant women has been regulated in Regulation of the Ministry of Health Number 51 of 2016, where pregnant women with KEK conditions are given a nutrition improvement program that has been set by the government, namely by providing additional food (PMT) in the form of biscuits.

Objectives: Developing additional food products for pregnant women in the form of biscuits using local food ingredients sourced from the koro sword bean.

Methods: The research design used a randomized block design (RBD) with 3 treatments (K=3), 1 experimental unit and 3 repetitions, so the total number of trials was 3×1×3=9. Koro bean flour was also added to Canavalia Biscuit products with different doses, and then the results were analyzed, including tests of acceptability and nutrient content including energy, protein, fat, carbohydrates and calcium.

Results: The results showed that adding 50 g of jack bean flour increased the acceptability of respondents in terms of color, aroma, texture, and taste. The addition of 50 g koro bean flour to Canavalia biscuit products increases the nutritional content, including energy, protein, fat, carbohydrates as well as calcium. The best nutritional content of "Canavalia Biscuits" in the group with the addition of 50% mustard greens includes energy 479 kcal, protein 26 g, fat 21.82 g, carbohydrates 76.66 g, calcium 159.70 mg.

Conclusions: The proportion of the addition of jack beans flour affects the acceptability and increases the nutritional content of "Canavalia Biscuits" including color, aroma, texture and taste.

INTRODUCTION

Stunting is still a nutritional problem in Indonesia. Stunting is a situation where children under five years of age do not develop due to a continuous lack of healthy food intake so the child's height does not match the height of the child's age. Lack of food intake occurs from when the baby is in the womb until after the baby is born¹. Children with stunting conditions will be more susceptible to disease, and when they grow up, they are at risk of developing degenerative diseases. Stunting affects not only health but also children's intelligence levels. Stunting will have an impact and be related to disturbed mental health processes, which in the temporary period will affect mental capacity. Long-term

impact of stunting might reduce the capacity for better education and they will certainly lose job opportunities with better income². Therefore, the First 1000 Days of Life (HPK), which includes the first 270 days of pregnancy and the first 730 days after the baby is born, is the most effective period in efforts to prevent stunting in toddlers³.

Based on data from Indonesian Nutritional Status Survey (SSGI) in 2022, there are 21.6% of toddlers with stunted nutritional status according to the Height for Age (TB/U) index and the prevalence of stunting in West Nusa Tenggara Province has now reached 32.7%⁴. Of the 10 regencies and cities in West Nusa Tenggara Province, Central Lombok Regency ranks first in the incidence of

stunting with a percentage of 37%, with the highest figure being in the Muncan Health Center working area, namely 31.5% where the village with the highest stunting area is in Darmaji Village, Regency. Central Lombok. A total of 178 toddlers aged 6-59 months in Darmaji Village had stunting nutritional status⁵. Many factors cause stunting in toddlers. One of the influencing factors is the mother's nutritional status during pregnancy, which must be seen to estimate the upper arm circumference according to age (LILA/U) in each trimester of the mother's pregnancy¹. Apart from that, pregnant women who lack nutritional intake during their teenage years, especially during pregnancy and breastfeeding, also affect the development of their children's bodies and brains². Pregnant women are a group that is generally vulnerable to health problems. Nutritional problems that can occur in pregnant women include CED, where this can affect the growth and development of the fetus during the pregnancy process. Fetuses who experience malnutrition in the womb have a greater chance of being born stunted^{6,7,8,9}.

Providing additional food, especially to vulnerable groups, is one of the supplementation strategies for overcoming nutritional problems¹⁰. Based on data from the 2014 Total Diet Survey (SDT), it is known that more than half of toddlers (55.7%) have an energy intake that is less than the recommended Energy Adequacy Rate (AKE)¹¹. In the group of pregnant women, both in remote and urban areas, more than half experience a lack of energy and protein intake. Therefore, providing additional food that focuses on macronutrients and micronutrients for pregnant women is very necessary to prevent Low Birth Weight (LBW) Babies and stunting of toddlers^{6,10}. In accordance with Minister of Health Regulation Number 51 of 2016 concerning Standards for Nutritional Supplementation Products, for KEK pregnant women, it is recommended that the nutrition improvement program determined by the government is PMT with a special formulation and fortified vitamins and minerals in the form of biscuits¹¹. PMT for pregnant women is intended as additional food, not as a replacement for daily food, thereby increasing calorie and protein intake during pregnancy¹². Based on the results of research by Zulaidah et al, in 2014, it was found that PMT was proven to have a significant effect on increasing baby birth weight¹³. Meanwhile, based on the results of Nurina's research in 2016, the PMT program succeeded in reducing the number of pregnant women who experienced KEK¹⁴.

One way to process PMT is by using local food sources of vegetable protein, especially nuts. Nuts are one of the mainstay products that can be produced in the West Nusa Tenggara region. Currently, the nuts that are generally developed are peanuts, green beans and soybeans. Apart from these three varieties, there are also local varieties of nuts such as cowpeas, winged beans and koro-koroan. Sword beans are a type of local legume in Indonesia which is widely developed in the East Java and West Nusa Tenggara (NTB) Provinces¹⁵. Currently, the handling and use of nuts as practical food as a source of protein of choice and with high financial value is still very limited. Specifically, local nuts are still not widely used as healthy food for pregnant women, especially jack beans¹⁵. Koro beans are nuts that are low in fat but high in protein and carbohydrates^{16,17}. The presence of quite large protein nutritional content in sword koro nuts opens up new opportunities for using sword koro nuts as raw material for Protein Rich Flour (PRF) products. Sword beans are also used as an intermediate product because they contain protein nutrients, so they can support community nutrition and have high economic value¹⁸. Referring to the high incidence of stunted toddlers in West Nusa Tenggara Province, especially Darmaji Village, Kopang District, West Lombok Regency, due to inadequate maternal intake during the pregnancy process, it is very important to carry out PMT. for pregnant women by providing protein-rich Canavalia Biscuits made from sword beans in the hope of reducing the incidence of CED pregnant women so that it can prevent the incidence of Low Birth Weight (LBW) babies and stunted toddlers. The research aims to develop additional food products through the use of local food ingredients such as protein in biscuits given to pregnant women with CED conditions.

METHODS

In this research, the author involved an experimental strategy in the laboratory with an experimental plan as a Completely Randomized Design or factors, namely the addition of sword bean flour (t), which consisted of 3 degrees of treatment, namely substitution of 0 g, 25 g and 50 g of sword bean flour with 3 repetitions. RAL is the simplest plan among other trial plans. Complete randomization without restrictions is the term for this pattern. RAL is used in experiments carried out in laboratories or on certain types of experimental materials whose properties are relatively the same¹⁹. The experimental design carried out can be seen in table 1 below:

Table 1. Experimental design Study Development of Protein-Rich Canavalia Biscuits Made from Sword Beans against Acceptability and Nutrient Content as Additional Food for Pregnant Women to Prevent Stunting

Experimental Unit	Repetition			Testing
T ₀	T ₀₁	T ₀₂	T ₀₃	Organoleptic acceptability, shelf life and nutritional content of Canavalia Biscuits
T ₁	T ₁₁	T ₁₂	T ₁₃	Organoleptic acceptability, shelf life and nutritional content of Canavalia Biscuits
T ₂	T ₂₁	T ₂₂	T ₂₃	Organoleptic acceptability, shelf life and nutritional content of Canavalia Biscuits

T₀: Treatment group without adding jack bean flour to Canavalia Biscuits (0 g); Q₁: Treatment group with a concentration of 25 g of jack bean flour added to Canavalia Biscuits; T₂: Treatment group with a concentration of 50 g of jack bean flour added

to Canavalia Biscuits; 1, 2, 3: Repetition of the experiment for making Canavalia Biscuits

Table 2. Ingredients Formula for Making Canavalia Biscuits Rich Sword Bean Based Protein against Receptivity and Content Nutrients as Additional Food for Pregnant Women to Prevent Stunting

Material	T ₀	T ₁	T ₂
Jack Bean Flour (g)	0	25	50
Margarine (g)	70	70	70
Chicken Eggs (g)	55	55	55
Refined Sugar (g)	60	60	60
Wheat Flour (g)	65	65	65
Full Cream Milk (g)	25	25	25
Cornstarch (g)	170	170	170

g: grams

The tools used in making Canavalia Biscuits are an oven, mixer, basin, plate, bowl, cutting board and biscuit mold, digital scale (cyprus), spoon and baking sheet. The tools used to test organoleptic properties are small plates, spoons, glasses, hedonic test forms and ballpoint pens. The method used to test energy content is by using the 2017 Indonesian Food Composition Table (TKPI) with method empirical as follows²⁷:

$$\text{Energy Value (g)} = \frac{\text{Bahan (g)}}{100 \text{ g}} \times \text{Energy Value of Material (TKPI *)}$$

Information:

*) Energy Value (calories/100 g of ingredient)

Then, tabulation and descriptive analysis were carried out. The protein content test used the semi-macro Kjeldahl method, while the calculation of the nutritional value of calcium using AAS, a leading method for metal analysis that uses the process of dissolving molecules into atoms (atomization) using energy from fire or electric current, was used to assess the sample methodology¹⁸. The ingredients used in making Canavalia Biscuits are jack bean flour, wheat flour, cornstarch, margarine, chicken eggs, powdered sugar, and full cream milk. The ingredients used in testing nutritional content are Canavalia Biscuit products. Data obtained from observations are presented in tabular form. To determine the organoleptic properties (color, aroma, taste, and texture) of each jack bean flour in the manufacture of Canavalia Biscuits, it was processed and analyzed using One Way Anova (ANOVA) statistical analysis at a confidence level of 95% ($\alpha = 0.05$). This statistical analysis was carried out using the SPSS 16.0 software program. If $p < 0.05$, then there is a significant effect and vice versa. If there is a significant effect, the data is analyzed further using the Tukey test to see which treatment causes the difference¹⁹.

Untrained panelists are panelists who have not been trained in carrying out organoleptic or sensory evaluations and tests. The untrained panelists consisted

of 30 students from the Nutrition Science Undergraduate Study Program at Nahdlatul Ulama University, NTB, who were selected based on inclusion criteria, including (1) interested in sensory organoleptic tests and want to participate, (2) not changeable in making decisions, (3) healthy body, free from ENT diseases, not color blind or psychological problems, (4) do not refuse the food product to be tested (not allergic), (5) not carrying out the test 1 hour after eating, (6) wait for a minimum of 20 minutes after smoking, eating chewing gum, food, and soft drinks, (7) not carrying out the test when you have influenza and eye pain, (8) do not eat very spicy food at lunch, if the test is done during the day, (9) do not use cosmetics such as perfume or lipstick and wash your hands with odourless soap whenever smell test. Untrained panelists can only calculate acceptability values through simple organoleptic tests such as preference, but may not be used for discrimination test information. Each panelist was given Canavalia Biscuits, which would be tested for color, aroma, texture and taste levels¹⁹.

RESULTS AND DISCUSSIONS

Organoleptic Properties

Objective did the Organoleptic test to determine the panelists' level of preference for the color, aroma, texture and taste of Canavalia Biscuit products. Organoleptic properties of Canavalia Biscuits are not much different, namely in terms of brownish yellow color, has a sweet and savory taste with a pleasant aroma of sword bean flour. Still, the pleasant aroma of sword acang koro sword is reduced due to the addition of cornstarch. In terms of texture, Canavalia Biscuits is A little dense, not too moist and not too dry, the texture of Canavalia Biscuits is not much different from each treatment. Texture is a feeling of pressure that can be understood through the mouth (when chewing, biting and swallowing) or through touch with the fingers²⁰. The average value and significance of organoleptic test results for Canavalia Biscuits with the addition of flour and sword bean can be seen in Table 3.

Table 3. Average value and the Significance of the Development of Protein-Rich Canavalia Biscuits Made from Sword Beans on Acceptability and Nutrient Content as Additional Food for Pregnant Women to Prevent Stunting

Organoleptic Test Parameters	Control	Treatment	Treatment	p-value
	T ₀	T ₁	T ₂	
	Mean ± SD	Mean ± SD	Mean ± SD	
Color	3.59 ± 0.74	4.11 ± 0.74	4.51 ± 0.50	0.001*

Organoleptic Test Parameters	Control	Treatment	Treatment	p-value
	T ₀	T ₁	T ₂	
	Mean ± SD	Mean ± SD	Mean ± SD	
Aroma	3.58 ± 0.80	4.10 ± 0.80	4.58 ± 0.61	0.009*
Texture	3.51 ± 0.73	3.71 ± 0.65	4.63 ± 0.48	0.012*
Flavor	3.64 ± 0.91	3.72 ± 0.90	4.74 ± 0.43	0.000*

ANOVA test; *) Significant if p-value <0.05; T₀: Treatment group without adding sword bean flour to Canavalia Biscuits (0 g); Q₁: Treatment group with a concentration of adding 25 g of sword bean flour to Canavalia Biscuits; T₂: Treatment group with a concentration of adding 50 g of sword bean flour to Canavalia Biscuits

Based on Table 3, it is known that the organoleptic properties, which include color, aroma, texture and taste, have a p-value <0.05. This shows that the addition of sword bean flour affects the organoleptic properties of Canavalia Biscuits. The color parameters of Canavalia Biscuits added with sword bean flour in the T₀ and T₁ treatments were favorable with an average value of 3.59 and 4.11 which added up to 4 was recorded on the liking value scale, and the T₂ treatment was very liked by the panelists with an average value of 4.51 rounded up to 5, which is included in the very liked value scale. The aroma parameters of Canavalia Biscuits, which added sword bean flour in the T₀ and T₁ treatments, were liked with an average value range of 3.58 to 4.10 adding up to

4, which was recorded on the liking value scale and in the T₂ treatment it was very liked by the panelists with an average score of 4.58 rounded to 5 was recorded on the highly favorable score scale. The texture parameters of Canavalia Biscuits added with sword bean flour in the T₀, T₁, and T₂ treatments were classified as very favorable with an average value range of 3.51 to 4.63 summed up to 5 which was recorded on the most preferred value scale. The taste parameters of Canavalia Biscuits added with sword bean flour in the T₀, T₁, and T₂ treatments were very favorable with an average value range of 3.64 to 4.74 adding up to 5 which was recorded on the most preferred value scale.

Table 4. Further Testing of Research Results Development of Protein-Rich Canavalia Biscuits Made from Sword Beans on Acceptability and Nutrient Content as Additional Food for Pregnant Women to Prevent Stunting

Further testing	Organoleptic Test Parameters	Treatment		
		T ₀	T ₁	T ₂
Tukey HSD ^α	Color	0.310	0.001	0.013
	Aroma	0.310	0.005	0.020
	Texture	0.106	0.006	0.030
	Flavor	0.100	0.005	0.015

Tukey's test; *) Significant if p-value <0.05; g: grams; T₀: Treatment group without adding sword bean flour to Canavalia Biscuits (0 g); T₁: Treatment group with a concentration of adding 25 g of sword bean flour to Canavalia Biscuits; T₂: Treatment group with a concentration of adding 50 g of sword bean flour to Canavalia Biscuits

Based on further tests, it was discovered that the treatment with the addition of 25 g and 50 g sword bean flour (T₁) showed a significant difference where the p-value < 0.05. This proves that the more sword bean flour added to the processing of Canavalia Biscuits in the T₂ treatment group, the better the organoleptic properties produced in terms of color, aroma, texture and taste.

Organoleptic Properties (Color)

Color is a very important factor in understanding the quality and acceptability of food. In general, assessing the quality of a food ingredient is related to color, because the color is visible in the very beginning. Color is a very important aspect to pay attention to in a dish, in the art of serving, color is the single most important factor that will determine the selling price of a dish, and combining attractive colors can enhances the taste of dishes^{16,21}. Based on the results of research on the substitution of sword bean flour (Canavalia ensiformis) on the organoleptic properties of Canavalia Biscuits as a portion of additional food for pregnant women to prevent stunting where the color aspect in the T₀ 0 group g, 25 g and 50 g with the substitution of sword bean flour was liked by the panelists with scores ranging from (3.59-4.51) rounded to 4 and 5, namely included in the scale of

like and really like. Based on the Average level of color preference, the substitution of sword bean flour 50 g is the n most popular treatment. The Canavalia biscuits used in this research have a brownish-yellow color, which is produced by mixing wheat flour, cornstarch, sword bean flour, margarine and egg yolk. As a result, the final color of the biscuit will be brownish yellow.

Canavalia biscuits are baked until golden brown using low heat or by checking the oven temperature until it shows 150°C. Because the biscuits are placed on the baking sheet at the same time and placed on the bottom baking sheet, the edges of the baking sheet will cook faster than the biscuits placed on the top baking sheet, so the cooking time for the resulting Canavalia Biscuits is not the same. The reason is that the oven only has bottom heat, so it will speed up the cooking of the biscuits in the bottom pan. Canavalia biscuits need to be baked between 30 and 40 minutes. The color produced in each biscuit treatment was yellow and slightly brownish so there was a real difference between treatments 0 g, 25 g and 50 g in Canavalia Biscuit color.

This organoleptic assessment is carried out for one day for the color assessment to be carried out directly when the samples are distributed to the panelists and provide a value for the Biscuit product. Canavalia

directly on the questionnaire distributed. This organoleptic test observation is carried out until the product samples that have been distributed are finished and have been assessed. Based on research results in 2015, Akyunin reviewed the color of the steamed brownies, the substitution of 20%, 30% and 40% sword bean flour showed that the panelists' color preferences were higher in the 40% substitution of sword bean flour²⁰. Meanwhile, in Nursalma's 2021 research on the color aspect with the substitution of 75 g, 125 g and 175 g of sword bean flour on the organoleptic properties of milk pie in terms of color, the results showed that the panelists liked the milk pie with the substitution of 75 g of sword bean flour, because The greater the substitution of sword bean flour in milk pie products, the darker the color of the milk pie¹⁶.

Organoleptic Properties (Aroma)

Aroma, also called odour, is often associated with substances that can evoke the impression of food simply through its smell and has a strong influence in triggering feelings of hunger. The scent is often an element that has multiple uses on food, such as repairing damage, increasing marking food, or influencing consumer perceptions of the dish²². Based on the results of research on the substitution of sword bean flour (*Canavalia ensiformis*) on the organoleptic properties of *Canavalia Biscuits* as an additional food for pregnant women to prevent stunting where the aroma aspect in the T₀ 0 group g (without the addition of sword bean flour) with a score of (3.58) rounded to 4, including on the liking scale, treatment 25 g with a score of (4.10) rounded to 4 included in the liking and treatment scale of 50 g with a score of (4.58) rounded to 5, including on the very like scale. Based on the average level of liking for aroma, The most preferred treatment is 25 g and 50 g substitution of sword bean flour.

According to Nursalma's research in 2021, it is known that in processed milk pie foods, the amount of substitute for sword bean flour decreases as the amount of sword koro flour used increases. Milk pie treated with 0% koro sword flour has the highest organoleptic value¹⁶. There was no real difference between the 125% and 175% jack bean flour substitution treatments. However, there are differences between peanut flour substitution treatments 0% and 75%. Based on research Akyunin in 2015, the average value for steamed brownie products for all treatments was (3.33) to (3.63) and was classified as having a distinctive brownie aroma²⁰. The highest value was obtained from the treatment (control) of 3.63, while the lowest average value was obtained from the treatment with a 30% sword bean flour substitution concentration of 3.33.

Organoleptic Properties (Texture)

The texture is defined as a sensory evaluation element with complex properties and has a material structure consisting of three components, namely mechanical (hardness and elasticity), geometry (sandy and crumbly) and mouthfeel (oily and watery). Each food ingredient has a unique texture, which can be described as a level of hardness, flexibility or crunchiness based on the physical condition, size and shape of the cells it

contains²³. Based on the research results, there are significant differences in the organoleptic properties of the *Canavalia Biscuit* texture in both the T₀ 0 group g (without the addition of sword bean flour), treatment group T₁ (addition of 25 sword bean flour g) and treatment group T₂ (addition of 50 g of sword bean flour) where p-value = 0.012. This difference can be seen from the texture of *Canavalia Biscuits* denser and softer compared to the T₀ 0 group g (without adding sword bean flour). Based on the average level of liking for texture, the panelists really liked the T₂ treatment group, namely the addition of 50 g of sword bean flour, where the average score was 4.63 rounded up to 5, including on the very like scale.

The main component of flour that affects the surface is protein. If flour and water are combined, the proteins in the flour will actually separate the gluten, making the dough stretchy and releasing gas. A smaller amount of gluten makes the dough less able to hold gas, so the dough pores become smaller. After baking is complete, the dough will become tough because the dough does not rise properly²³. In Lestari's research in 2016, the white bread items substituted for sword bean flour were treated at 5%, 10%, 15%, 20%, 25% and 30%, which showed that the substitution for sword bean flour was not significantly different in relation to the substitution for bean flour. Sword bean 10% and 15%, while the 15% treatment was basically different from the 20%, 25% and 30% treatments, where the highest organoleptic test value was found in the 5% jack bean flour substitution treatment. Of course, the more ko ro bean flour is used, the denser the surface of the bread will be, and it is much different from white bread in general²³.

Based on research Akyunin in 2015, in steamed brownie products with respect to the texture aspect, sword bean flour substitution of 20%, 30% and 40% resulted in an average level of preference for all treatments, namely (3.38) to (3.67) which would be classified in the wet and dense texture category²⁰. The highest average texture value was obtained from the 20% sword bean flour substitution treatment of (3.67), while the lowest value was obtained from the 40% sword bean flour substitution treatment. From Nursalma's research in 2021, the findings of the hedonic test carried out on milk pie food products, the 75% treatment had the highest panelist mean score for milk pie compared to sword bean flour in terms of texture. According to statistical test findings, all treatments for milk pie differed significantly from each other¹⁶.

Organoleptic Properties (Taste)

Taste is the result of taste, which includes sweet, salty, sour and bitter tastes produced by ingredients found in food¹⁷. Based on the results of research on the substitution of sword bean flour for the taste of *Canavalia biscuits* where in the substitution treatment, 25 g and 50 g sword bean flour got a high score, namely 3.72 to 4.74 , rounded up to 4 and 5, including on the like and really like scale because the taste of *Canavalia Biscuits* was delicious and not too sweet so the panelists liked it, but in the control treatment 0 g (without the addition of sword bean flour) got a low score of 3.64 rounded to 4,

including on the liking scale due to the taste of Canavalia Biscuits it was too sweet so the panelists didn't really like this because there was no addition of sword bean flour.

According to Akyunin's 2015 research on steamed brownie products regarding the taste aspect, sword bean flour substitution of 0%, 20%, 30%, and 40% said that the panelists' liking for the taste of steamed brownies had the highest average values found in the 20% and 40% substitutions, namely (3.58) in the sweet taste category and the lowest average value in the 30% treatment, namely (3.29) but still in the sweet taste category²⁰. According to research Sustainable in 2016, in the substitution of sword bean flour in white bread products at various percentages (5%, 10%, 15%, 20%, 25%, and 30%), the 5% treatment had the greatest influence. The average score was (4.90), while the 25% treatment obtained the lowest average value (3.23). Meanwhile, the 10% treatment was not significantly different from the 5%, the 15% treatment was significantly different from the 20%, 25% and 30% treatments, and the 5% treatment was not significantly different from the 10%. The real change occurred with the use of more and more jack bean flour, resulting in white bread that tasted less and less like the previous white bread²³.

Nutrient Content Test

Test the nutritional content of Canavalia Biscuit products. This was carried out at the Analytical Laboratory of Mataram University. Comparison of laboratory test results between Canavalia Biscuits in the T₀ group (without the addition of sword bean flour) with the substitution of sword bean flour 25 g and 50 g p there are Canavalia Biscuits can be seen in Table 5. The method used in the energy content test is by using TKPI 2020 with the following empirical methods²⁷:

$$\text{Energy Value (g)} = \frac{\text{Bahan (g)}}{100 \text{ g}} \times \text{Energy Value of Material (TKPI *)}$$

Information:

*) Energy Value (calories/100 g of ingredient)

Then, tabulation and descriptive analysis were carried out. Meanwhile, to calculate the value of the protein nutrient content using the semi-macro Kjeldahl method and for the calcium nutrient content using the AAS method, the leading method for metal analysis which uses the process of dissolving molecules into atoms (atomization) using energy from fire or electric current, is used to assess the methodology sample²⁷.

Table 5. Test Results for the Nutrient Content of Canavalia Biscuits per 100 g Development of Protein-Rich Canavalia Biscuits Made from Sword Beans on Acceptability and Nutrient Content as Additional Food for Pregnant Women to Prevent Stunting

Sample Code	Energy (kcal)	Protein Content (g)	Fat Content (mg)	Carbohydrate Content (g)	Calcium Level (mg)
T ₀	437	14.5	21.54	75.54	119.7
T ₁	458	20.2	21.68	76.63	139.7
T ₂	479	26.0	21.82	76.66	159.7

g: grams; kcal: kilo calories; mg: milli gram; T₀: Treatment group without the addition of sword bean flour (0 g); T₁: Treatment group addition of 5 g sword bean flour; T₂: Treatment group added 50 g sword bean flour

Table 6. Nutrient Composition of PMT for Pregnant Women according to the Republic of Indonesia Minister of Health Regulation Number 5 of 2016

Nutrient content according to the standards of the Indonesian Minister of Health Number 5 of 2016 for pregnant women				
Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)	Calcium (mg)
450	Minimum 10	Minimum 20	Maximum Sucrose 20 Maximum Fiber 5	250-450

g: grams; kcal: kilo calories; mg: milli gram

Based on tables 5 and 6, it is known that the total energy (kcal) in the group (T₀) without the addition of sword bean flour is 437 kcal. This is not in accordance with the standard nutritional composition of additional food for pregnant women according to the Republic of Indonesia Minister of Health Regulation Number 5 of 2016, where The standard for fulfilling PMT calories for pregnant women is 450 kcal¹¹. Meanwhile, the total energy in the treatment group with the addition of 25 g of sword bean flour (T₁) was 458 kcal. The total energy in the Canavalia Biscuit-making group with the addition of 50 g of sword bean flour was 479 kcal; this shows that the energy needs met by giving Biscuits Canavalia for pregnant women is in accordance with the nutritional composition standards according to the Republic of Indonesia Minister of Health Regulation Number 5 of

2016, namely more than 450 kcal. The energy content of Canavalia Biscuits was highest in the T₂ treatment group with the addition of 50 g sword bean flour with an energy value of 479 kcal/100 g Canavalia Biscuits¹¹.

The protein nutritional content for the Canavalia T₀ Biscuit group (without the addition of sword bean flour) is 14.5 g/100 g of Canavalia Biscuits. This meets the standards for the composition of protein nutritional content of additional food for pregnant women, which is based on the Minister of Health's Regulation standards. RI Number 5 of 2016 fulfils the protein content in additional food for pregnant women, namely a minimum of 10 g¹¹. Likewise with Canavalia Biscuits, the treatment with the addition of 25 g (T₁) and 50 g (T₂) of jack bean flour, where the protein nutritional content in these biscuits has met the standards for protein nutritional

content for additional food for pregnant women according to the 2016 Republic of Indonesia Minister of Health Regulation, where respectively 20.2 g/100 g Canavalia Biscuits and 26 g/100 g Canavalia Biscuits¹¹. The carbohydrate nutrient content in Canavalia biscuits, both T₀, T₁, and T₂, has met the standards for fulfilling carbohydrate nutrition for pregnant women according to the 2016 Republic of Indonesia Minister of Health Regulation, where the carbohydrate content in 1 Canavalia biscuit is 75.54 g/100 g Canavalia Biscuits up to 76.66 g/100 g Canavalia Biscuits. The calcium nutrient content in Canavalia Biscuits, whether treated with T₀, T₁ or T₂, does not meet the standards for fulfilling calcium nutrients for additional food for pregnant women, where the calcium content is still below 200 g, namely 119.7 mg/100 g respectively. Canavalia Biscuits, 139.7/100 g Canavalia Biscuits and 159.7 mg/100 g Canavalia Biscuits, while the standard according to the Republic of Indonesia Minister of Health Regulation is a minimum of 250 mg/100 g¹¹.

Energy Nutrient Content in Canavalia Biscuits

The main source for the body is energy, which is used to support various physiological processes, including circulation and protein synthesis. High sugar intake during pregnancy is associated with Low Birth Weight (LBW), thereby increasing the potential for pregnancy to impact the body's metabolism and cause increased calorie needs. Second and third trimester pregnant women who experience limited energy will be able to give birth to children with low birth weight²⁴. Pregnant women require more energy to support the growth of the fetus, placenta and maternal tissue and to compensate for the ± 15% increase in metabolic activity required to have a healthy pregnancy²⁴.

Energy analysis of Canavalia Biscuit samples showed that the highest energy content was in the T₂ sample with 50 substitutions of sword bean flour g where the energy content is 479 kcal. The quality requirements of the Indonesian National Standard (SNI) 2973:2011 state that the energy content of biscuits is a minimum of 450 kcal per 100 g and is based on the Republic of Indonesia Minister of Health Regulation Number 5 of 2016, where the standard for fulfilling PMT calories for pregnant women is 450 kcal¹¹. This shows that the addition of sword bean flour to Canavalia Biscuits can increase the level of nutritional value contained in Canavalia Biscuits so that they can meet the energy value standards for additional food for pregnant women.

Protein Nutrient Content in Canavalia Biscuits

Through the activation of protein synthesis, protein is a macronutrient that is very important for the formation of enzymes, hormones, structural elements and the immune system. Recent research shows that the biological processes in lipid production and bone lengthening depend on amino acid-containing proteins. The insulin-like growth factor (IGF), which regulates protein consumption, is important for controlling growth. For fetal development and embryogenesis, which are necessary for a healthy birth, pregnant women should consume a lot of protein. Overnutrition can also be achieved because too much protein and energy

consumption can increase fetal death²⁵. Insufficient protein intake during pregnancy can disrupt fetal growth in the womb, resulting in LBW, and vice versa^{8,26}.

Protein analysis of Canavalia Biscuit samples showed that the highest protein content was in sample T₂ with the addition of sword bean flour 50 g where the protein content is 26 grams/100 g Canavalia Biscuits. This protein level is the target in making Canavalia Biscuits made from sword beans. It has a fairly high protein content and can be used to make Canavalia Biscuits as an additional food for pregnant women with high protein content, where the more sword bean flour you add, the higher the protein content in Canavalia Biscuits. Based on the quality requirements of SNI biscuits 2973:2011, the minimum protein content is 9%. The protein content results from the three treatments have met the SNI requirements for biscuits and have also met the standards of the Republic of Indonesia Minister of Health Regulation Number 5 of 2016, where the standard for meeting PMT protein for pregnant women is 10 g/100 g. Based on TKPI, 2017, it is known that the protein nutritional content in 100 g of sword koro beans is 20.5 g. After being processed into Canavalia Biscuits to 26 g, it can be interpreted that the addition of jack bean flour can help increase the nutritional value of protein in Canavalia Biscuits¹¹.

Calcium Nutrient Content on Canavalia Biscuits

One of the most abundant minerals in the human body is calcium, which makes up more than 99% of the bones in the body. Formation of bone structure, maintenance of cell membrane potential, signal transduction between hormone receptors, neuromuscular stimulation, cell membrane integrity, and body calcium reserves are just some of the physiological processes in which calcium plays an important role²⁴. Calcium is essential for biological processes in the body, such as hormone and enzyme activity in bone formation and muscle contraction. This can affect both mother and baby and result in osteopenia, tremors, paresthesia, muscle cramps, tetanus, delayed fetal development, low birth weight, and poor fetal mineralization if pregnant women consume more than the recommended amount of calcium. The fetus stores up to 28.2 g of calcium during pregnancy, and 80 % of this amount is obtained in the third trimester, which is when the fetus needs calcium most for growth^{24,25,26}. Calcium analysis of Canavalia Biscuit samples showed that the highest calcium content was in the T₂ sample substituted for sword bean flour 50 g, where the calcium content is 159.7 mg/100 g. Based on the standards from the Minister of Health the Republic of Indonesia Number 5 of 2016, calcium compliance standards PMT for pregnant women is 250 to 450 mg/100 g and based on TKPI, 2017 it is known that the calcium nutrient content in 100 g of sword beans is 150 mg, but after being processed into Canavalia Biscuits to 159.7 mg/100 g¹¹.

CONCLUSIONS

The addition of sword bean flour in the process of making Canavalia Biscuits has an effect on the organoleptic properties of Canavalia Biscuits, including the best color, aroma, texture and taste in the T₂

treatment of adding 50 g of sword bean flour. The addition of sword bean flour has a significant effect on increasing the nutritional content of Canavalia Biscuits, where the best nutritional content is found in the treatment of adding 50 g of sword bean flour (T₂), including Energy 479 kcal, Protein 26 g, Fat 21.82 g Carbohydrates 76.66 g and Calcium 159.7 mg. It is recommended that pregnant women with KEK consume 1 ½ Canavalia Biscuits each morning or afternoon so as to meet the nutritional requirements of pregnant women and hopefully prevent nutritional problems, especially stunting in babies and toddlers.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

BDSS: conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, validation, visualization, roles/writing-original draft, writing-review & editing; LDSA: investigation, writing-review & editing.

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