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Nuggets from *Canavalia Ensiformis L.* Koro Beans Flour and Bamboo Shoots as a Prevention for *Wasting* in Children 5–12 Years

Nugget Berbahan Dasar Tepung Kacang Koro Canavalia Ensiformis L. dan Rebung sebagai Upaya Pencegahan Wasting pada Anak Usia 5–12 Tahun

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ABSTRACT

Background: Wasting in children can hinder their growth and development, cognitive ability and productivity.
Objectives: To create innovative nugget products from *Canavalia Ensiformis L.* flour and bamboo shoots for wasting prevention for children aged 5–12 years, to determine the acceptability of *Canavalia Ensiformis L.* flour and bamboo shoots nugget, to measure the nutritional value the product.
Methods: The ratios of the ingredients, i.e., *Canavalia Ensiformis L.* flour and bamboo shoots, are 100:25, 75:50, and 50:75. The proximate test parameters include water, ash, protein, fat, and carbohydrates. Each test was repeated 3 times. The acquired proximate data was processed using one-way ANOVA test; the results indicate significant differences; Duncan test will be conducted. The hedonic test assessing the color, aroma, taste, texture and the overall parameters of the product was carried out on untrained panelist. The obtained hedonic data was processed using the Kruskal-Wallis test.
Results: The ratio of the ingredients significantly affects the water, ash, protein, fat, and carbohydrate content of the nuggets. The higher proportion of the *Canavalia Ensiformis L.* flour, the lower water, ash, and fat content of the nuggets, but the higher their protein and carbohydrate content. However, ratio of the ingredients does significantly influence the acceptability of the nuggets.
Conclusions: Formula A, which has the ratio of 100:25, is recommended due to its excellent nutritional values of 27.98% water, 1.98% ash, 18.85% protein, 20.4% fat, and 30.79% carbohydrates. It provides a good sensory acceptance and can be used to prevent wasting in children.

INTRODUCTION

Wasting can hinder children's growth and development, especially their cognitive and productive ability. Improving cognitive development and catching up with children's growth are the stages and consequences when the children are 5 to 12 years old[1]. These stages mean that nutritional interventions must be made to prevent growth delays. At the national level, wasting in Indonesia has caused IDR 1.042 to IDR 4.687 billion of economic losses to the country's GDP[2]. The Netherlands has incurred additional 80 million medical costs for children suffering from wasting[3].

Strong memory intensity and high interest in learning make children aged 5-12 years require optimal nutritional intake. Suboptimal nutritional intake in children of those ages can lead to wasting[4]. This type of malnutrition is characterized by the Body Mass Index by Age (BMI/A) indicator with the z-score value of ≥-3 standard deviations[5]. According to the World Health Organization (WHO) data, 45 million children suffered from wasting in 2020, and it accounted for 45% of the causes of death in children[6]. The prevalence of wasting in 2018 among children aged 5-12 years in Indonesia reached 9.2%[7]. Wasting in children can lead to decreases in intelligence, productivity, mental and physical health, reproductive performance in adulthood, and increases in morbidity[8]. Fast food, especially nugget products, consumed as an alternative to processed ground meat as side dishes, is in high demand by all age groups. Nugget contains high fat content because it is made from animal protein[9].

Legumes, such as *Canavalia Ensiformis L.*, are plant-based food sources that are high in protein but low in fat. *Canavalia Ensiformis L.* beans have the potential to be processed into nuggets as they have high contents of carbohydrates (60.1%), protein (30.36%), and fiber (8.3%)[10]. Therefore, they are expected to be able to replace food ingredients that contain high fat such as meat. The flour form of these beans is also expected to become nuggets with the addition of a small amount of

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wheat flour. Vegetables also have an important role in increasing the nutritional value of nuggets. Bamboo shoots have a dietary fiber content of 2.56%, higher than other types of vegetables. This fiber can improve the physiological function of the intestine to prevent gastrointestinal diseases in children[11] Research related to nugget innovation using bamboo shoots includes bamboo shoot-based nuggets with soy flour, producing nuggets with a nutritional value of 17.19% protein and 6.97% fiber[12]. In addition, there are jackfruit seed fish nuggets added with bamboo shoot flour, producing nuggets with protein levels of 10.50% and fiber levels of 20.43%[13]. However, there is no research that combines *Canavalia Ensiformis L.* beans with bamboo shoots to be processed into food products with high nutritional value to prevent wasting.

The general objective of this research is to make innovative nugget products based on the white bean flour and bamboo shoots as an effort to prevent wasting in children aged 5-12 years. The specific objective of this research is to determine the nutritional value and the acceptability of the produced nugget. The results of this research are expected to be taken into consideration in making policies related to the handling of wasting with the development of food innovation. They can also be used as a source of information and new literature for students conducting similar research as they can provide views, learning, and knowledge in the field of Food Nutrition, especially regarding food innovation in the form of nuggets for wasting prevention.

METHODS

This research was conducted at the Culinary and Biochemistry Laboratory, Faculty of Medicine and Health Sciences, Satya Wacana Christian University. It took place from January to June 2022. This experimental research used a questionnaire in organoleptic and hedonic data collection. The panelists indicated the level of preference for each sample by selecting the appropriate categories, called as hedonic scales, of (1) strongly dislike, (2) dislike, (3) somewhat like, (4) like, and (5) strongly like[14].

Here Statistical Product and Service Solution (SPSS) was incorporated to test the difference between the treatments of the sample. Should differences were found, a further test would be carried out using the Duncan test with a 95% confidence interval to determine the real difference between the treatments. This analysis was used for research data on proximate tests. After the data was acquired using the organoleptic and hedonic instruments or questionnaires, the Kruskal-Wallis test was conducted to examine the differences between the treatments in the sample. Upon the discovery of differences, a further test would be carried out via the Mann-Whitney test with a 95% confidence interval to determine the real difference between the treatments. The results of the data analysis were analyzed descriptively to draw the conclusions. Here the nutritional content of the products was also measured by using NutriSurvey.

This study creates innovative food products that can be consumed to prevent wasting in children aged 5-12 years. In addition to proximate tests, organoleptic and hedonic tests, the nutritional content of the products was also measured and adjusted to the age of the panelists of the organoleptic and hedonic tests, who were children of 7-12 years of age. The independent variables of this study are *Canavalia Ensiformis L.* flour and bamboo shoots in the product manufacturing, while the dependent variable is the produced nuggets because they depend on the flour and the shoots, and the control variables are the use of the ingredients and the weight of the ingredients. This research was conducted with 3 formulations. The proportions of bamboo shoots and *Canavalia Ensiformis L.* flour formulations are as follows: Formulation A (FA) = 25 g of bamboo shoots : 100 g of *Canavalia Ensiformis L.* flour; Formulation B (FB) = 50 g of bamboo shoots : 75 g of *Canavalia Ensiformis L.* flour; and Formulation C (FC) = 75 g of bamboo shoots : 50 g of *Canavalia Ensiformis L.* flour[12].

Tools and Materials

The tools used for the nugget production are flour machine, scales, bowls, measuring spoons, plates, baking sheets, steamers, fryers, and gas stoves. The tools used for the proximate test are oven, porcelain cup, desiccator, digital scale, analytical balance, furnace, Kjeldahl flask, pipette, Erlenmeyer, beaker glass, measuring cup, distillation tool, titration tool, Soxhlet tool, and rotary machine. The ingredients are *Canavalia Ensiformis L.* flour acquired from Rumah Koro Indonesia, which can be found from the company's Instagram account, and bamboo shoots from Bambusa vulgaris S., which are commonly sold in the market and consumed by people. The complementary ingredients include chicken meat, corn flour, eggs, breadcrumbs, garlic, salt, pepper, sugar, and flavoring. The manufacturing stage starts from making the flour and preparing the bamboo shoots, then making the nuggets.

Preparation of *Canavalia Ensiformis L.* Flour

The beans were peeled and boiled for 7-8 minutes in a 3% NaOH solution, then rinsed while squeezing with running water until the skin is peeled off and the pH is neutral. Steam blanching was then performed for 30 minutes, then the beans were thinly sliced and dried for approximately 24 hours at 55-60°C using an oven. The last step was grinding the dried beans and sifting them with an 80 mesh sieve. The sifted flour was then kept in an airtight and tightly closed containers[15].

Pzrocedure for Bamboo Shoot Preparation

The bamboo shoots were cleaned and washed, and the center and ends of the bamboo shoots were thinly sliced, while the base were discarded. The slices were then soaked for 12 hours in clean water in a ratio of 2:1 (2 liters of water for 1 kg of bamboo shoots). Next, the bamboo shoots were boiled at 90-100°C for 30 minutes using a 3% salt solution, soaked again using 3% salt solution for 5 hours, and then mashed until they were pureed[16].

Nugget Making

The production of the nuggets began by mixing the ingredients, i.e., *Canavalia Ensiformis L.* flour and pureed bamboo shoots, in a bowl. Then, 15 g of tapioca

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flour, 1 egg (45 g), and ground spices (garlic, salt, pepper, and flavoring) were added. The dough was then stirred for homogeneity and consistency, poured to a pan, and steamed for 30 minutes at approximately 100°C. The dough was then taken out of the oven after being set, cooled at a room temperature for 10 minutes, and cut into 3 x 3 cm sizes. Next, the cut nuggets were dipped into the batter, coated with breadcrumbs, and stored in the freezer for 30 minutes at 3°C. Finally, the nuggets were fried using the deep frying technique until golden brown.

Proximate Test

Moisture Content Analysis

The moisture content measurement of the nugget follows the 2005 guideline of the Association of Official Analytical Chemist (AOAC), which starts with the drying stage using an oven for 16 hours[17]. Then, the porcelain cups were heated in the oven for 30 minutes at 105°C, put them into a desiccator, and weighted while empty. The cup was then filled with 5 g of sample, weighted again with the sample in it, placed into the oven for 16 hours at 105°C, and weighted again after cooling in a desiccator. The constant weight was acquired by drying the sample again using an oven after 1-hour gap[18].

Ash Content Analysis

The ash content measurement of the nugget follows the 2005 guideline of the Association of Official Analytical Chemist (AOAC) by using the Dry Ashing method[18]. The method started by heating a porcelain cup at 105°C using an oven for 30 minutes, placing it in a desiccator to cool quickly, and weighing it. The cup was then filled with 5 g of sample, placed it into the furnace for 6 hours at 550 °C until the sample turns white or becomes ash, cooled using a desiccator, and weighted again to obtain the final weight[18].

Protein Content Analysis

The protein content measurement of the nugget follows the 2005 guideline of the Association of Official Analytical Chemist (AOAC) by using the Kjeldahl method, which consists of destruction, distillation, and titration[18] stages. The destruction began by placing 1 g of sample into a Kjeldahl flask and adding 12 ml of sulfuric acid (H_2SO_4) and 2 Kjeldahl reaction tablets. The flask was then heated at 420°C for 60 minutes or until the solution become clear green. The destruction results was then put into a distillation device and added with 50 ml of 30% sodium hydroxide solution (NaOH 30%) and 100 ml of distilled water. The distillation process was carried out for 5 minutes. The liquid that boils and turns into vapor from the distillation process flew through the condenser to the Erlenmeyer. The Erlenmeyer was then filled with 30 ml of 4% H_3BO_3 and 10 drops of Tashiro indicator. The distillate was then titrated to the end point, marked by a change in green color to purple, using 0.2 N HCl solution[18].

Fat Content Analysis

The fat content measurement of the nugget follows the 2005 guideline of the Association of Official Analytical Chemist (AOAC) by using the Soxhlet method[18]. The method started by putting the flask into an oven and cooling it in a desiccator. The empty flask was then weighted, filled with 5 g of sample, and put into the Soxhlet extraction tube for 4 hours with enough hexane solvent. Then, the flask of fat extract was taken out, put in a rotary machine, put in the oven for 1 hour at 105°C, and put into a desiccator to cool. Finally, the flask containing the oil was weighted[18].

Carbohydrate Content Analysis

Carbohydrate content is influenced by other nutritional factors. The analysis of the carbohydrate content of the nugget in this study was carried out using the by-different method created by Winarno (1997) in Soputan (2016). This method measures the content of carbohydrate by subtracting 100% with the fat, water, ash, and protein content using the equation below[19]:

$$\text{Carbohydrate Content (\%)} = 100\% - (\text{Moisturizer Content} + \text{Ash Content} + \text{Protein Content} + \text{Fat Content})$$

Hedonic Test

The sensory test of the nugget product was carried out through the hedonic test using the acceptance scales from (1) strongly dislike, (2) dislike, (3) somewhat like, (4) like, to (5) strongly like. The parameters measured in the organoleptic testing are aroma, color, shape, taste, texture, and overall impression about the product[20]. The number of the untrained panelists in the organoleptic testing ranges from 25 to 100 people, taken from a group of people who have expertise in areas that do not require formal training, that is communicating and distinguishing reactions from the organoleptic assessment being tested[21].

The panelists were selected using a technique for dealing with a heterogeneous population, so strata based on certain categories need to be determined. From each stratum a sub-sample was selected again randomly, commonly referred to as stratified random sampling technique[22]. The inclusion criteria are school children with aged between 5 and 12 years, having no allergies to the ingredients as stated in the informed consent, and willing to become panelists or research respondents. The exclusion criteria are not willing to become panelists or research respondents, having allergies to the ingredients of the nuggets. The organoleptic testing was conducted on 50 untrained panelists taken from a population of school children from grade 1 to grade 6. The number of the respondents was acquired by calculating the number of children from each class multiplied by the number of required panelists and divided by the population[22]. The implementation of the organoleptic test of the bean and bamboo shoot nugget formula for elementary school children was based on the Certificate of Ethical Feasibility

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of Research published on April 7, 2022 No. 038/KOMISIETIK/EC/4/2022, which has been declared ethically feasible according to 7 (seven) WHO Standards of 2011 which refer to the 2016 CIOMS Guidelines, namely social value, scientific value, equal distribution of burdens and benefits, risk, exploitation, confidentiality, and consent after explanation. The institution that conducted the ethical feasibility test of this research was the Ethics Commission of Satya Wacana Christian University.

RESULTS AND DISCUSSIONS

Proximate Test

Proximate test is a chemical analysis to determine the nutrient content of a product. The results of the proximate test performed in this study show that the more the *Canavalia Ensiformis L.* flour, the higher the protein content. The detailed results about the water, ash, protein, fat, and the carbohydrate content of the bean flour and bamboo shoot nuggets are presented in Table 1.

Table 1. The results of One way-ANOVA test analysis followed by Duncan's test on moisture, ash, protein, fat, and carbohydrate content in white bean flour nuggets and bamboo shoots.

Parameters	Mean±SD (n=3)			p-value	SNI
	FA (100:25)	FB (75:50)	FC (50:75)		
Water Content	27.98±1.79[a]	34.91±1.84[b]	33.64±0.93[b]	0.004	Max 60%
Ash Content	1.98±0.01[a]	2.04±0.11[a]	2.91±0.93[a]	0.139	-
Protein Content	18.85±0.56[a]	17.18±1.21[b]	16.06±0.24[b]	0.014	Min 9%
Fat Content	20.40±0.35[a]	40.20±0.20[b]	40.27±0.64[b]	<0.001	Max 20%
Carbohydrate Content	30.79±1.61[a]	5.67±2.43[b]	7.12±0.31[b]	<0.001	Max 25%

Proportion of Canavalia ensiformis flour: bamboo shoots; FA: Formula A, FB: Formula B, FC: Formula C; similar superscricpt letters (a,b) in the same row indicate no significant difference at the Duncan test level (p-value≥0.05).

Table 1 shows that the nuggets produced using Formula A is significantly different from those made using Formula B and C in terms of the value of the water content (p-value=0.004), meaning that in the treatment of Formula A, Formula B, and Formula C there is a real difference as marked by the superscript letters in Formula A, which are then different from those in the treatments of Formula B and Formula C, whose superscript letters are the same. Formula A has the moisture content of 27.98%, lower than those of Formula B and Formula C. The low moisture content in Formula A is influenced by the higher proportion of *Canavalia Ensiformis L.* flour than the bamboo shoots. Bamboo shoots have a high ability to absorb water because they contain high amounts of fiber. The less the bamboo shoots, the lower the water content due to the low amount of fiber contained in the product[23].

According to the Indonesian National Standard (SNI) number 01-6683-2004, the maximum amount of water content in nuggets containing mixed ingredients is 60% b/w[24]. Therefore, all nugget samples in this study meet the moisture content standard in products with mixed ingredients because they have the moisture content of <60%. Moisture content in nuggets is very important because it affects their quality. The freshness and shelf life of food products are influenced by moisture content as it affects bacterial development and food decay[25].

Based on the table above, the ash content of the nuggets produced using Formula A, Formula B, and Formula C has no significant difference (p-value≥0.05) as evidenced by the p value of 0.139, which is marked with the same superscript letter in the same treatment. Formula C had the ash content of 2.91%, higher than Formula B and Formula A. In this research the ash content tends to increase along the increased addition of bamboo shoots. The high ash content in Formula C was caused by the higher proportion of bamboo shoots compared to its content in Formula A and Formula B. Bamboo shoots contain high minerals that can be utilized by the body; every 100 g of bamboo shoots contain 533 mg of potassium (K), 28 mg of calcium (Ca), and 50 mg of phosphorus (P)[23].

The SNI number 01-6683-2004 about chicken nuggets with mixed ingredients does not mention the standard content of ash, so the presence of this substance in all samples is an added value of these products. Macronutrients such as zinc (Zn), magnesium (Mg), and potassium (K) can improve the growth and the development of children suffering from wasting because the minerals are needed in bodily biochemical processes[26]. According to a study conducted in Malawi and South Africa, lipid-based nutrient supplements (LNS) treatments for 12 weeks resulted in higher weight gain and WAZ in children suffering from wasting with the Weight for Age Score of <-2 SD aged 6-15 months[27]. The high ash content in food products indicates that the meal has a high mineral content, which is good for children to consume to prevent wasting.

The table above shows that the nuggets produced using Formula A is significantly different from those of Formula B and Formula C on in terms of protein content (p=0.014), meaning that in the treatment of Formula A, Formula B, and Formula C there is a real difference as marked by superscript letters in Formula A, which are then different from those in the treatments of Formula B and Formula C, whose superscript letters are the same. Formula A has the protein content of 18.85%, higher than Formula B and Formula C. The high protein content in Formula A is influenced by the higher proportion of *Canavalia Ensiformis L.* The addition of *Canavalia Ensiformis L.* flour can increase the protein content of the food products because *Canavalia Ensiformis L.* contains high protein, which is 24-28.6%[15].

According to SNI number 01-6683-2004, the minimum protein content in nuggets with mixed ingredients is 9% b/w[24]. Therefore, all products meet the standards because they have the protein levels of >9%.

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Protein provides energy, maintains body cells and tissues, builds substances, and helps metabolize the immune system[28]. High protein content in nugget products can boost the process of body tissues development in children, thus preventing wasting. Low protein consumption can increase the risk of wasting in children by 3.1 times[29].

That the nuggets produced using Formula A is significantly different from those of Formula B and Formula C on in terms of fat content (p-value<0.001). The products manufactured following Formula B and Formula C have the fat contents 40.20% and 40.27% respectively, higher than Formula A. The high fat content in nuggets from Formula B and Formula C is influenced by the higher proportion of bamboo shoots than that of *Canavalia Ensiformis L.* flour. The more the used bamboo shoots, the higher the fiber content, so the greater the oil absorption level. Bamboo shoots contain 15.77% crude fiber, which consists of lignin, hemicellulose, and cellulose[30]. Hemicellulose has an irregular structure that causes binding between stably charged molecular groups so that it has non-polar properties and the ability to absorb oil[31].

According to SNI number 01-6683-2004, the maximum fat content in nuggets with mixed ingredients is 40% w/b[24]. Nuggets made using Formula A samples have the fat content of <40%, while those processed using Formula B and Formula C have the fat content of >40%, which means that the nuggets manufactured through Formula A meet the standard, but not with those made using Formula B and Formula C. Each gram of fat produces 9 kcal, functioning as the body's largest energy reserve[28]. Chunming (2000) in Manuhutu (2017) stated that low fat intake can lead to wasting in children due to reduced energy availability, resulting in protein catabolism causing weight loss[32]. The sufficient fat content in the nuggets produced in this study can help increase the amount of energy, and this affects the children's nutritional status.

The table above shows that the nuggets produced using Formula A is significantly different from those of Formula B and Formula C on in terms of carbohydrate content (p-value<0.001). The nuggets produced using Formula A has the carbohydrate level of 30.79%, higher than those of Formula B and Formula C. The high carbohydrate content is driven by the higher proportion of *Canavalia Ensiformis L.* flour, which can increase the carbohydrate content of the food products since the flour contain high carbohydrates, namely 60.1%[33].

According SNI number 01-6683-2004, the maximum carbohydrate content in nuggets with mixed ingredients is 25% b/b[24]. The samples made using Formula A have the carbohydrate content of >25%, while those of Formula B and Formula C have the carbohydrate content of <25%, which means that Formula B and Formula C can produce nuggets that meet the standard, while Formula A cannot. Carbohydrate is the main producer of glucose, the main source of energy for the body[34]. Carbohydrate consumption affects the nutritional status of children. Low carbohydrate intake in children can increase the prevalence of wasting. The high carbohydrate content in the nuggets produced in this study can be used to create energy, so the product is suitable for snacks, complementary foods or side dishes for children to prevent wasting.

Organoleptic Test

The organoleptic test for the products made of *Canavalia Ensiformis L.* flour and bamboo shoots was carried out through a hedonic test with the acceptance scales of 1 to 5; they are (1) strongly dislike, (2) dislike, (3) somewhat like, (4) like, and (5) strongly like . The parameters measured in this test are the aroma, color, shape, taste, texture, and the overall impression about the product[20]. The results of the organoleptic test on Canavalia ensiformis flour and bamboo shoots nuggets are presented in Table 2.

Table 2. Kruskall-Wallis test analysis results on organoleptic tests and hedonic tests of untrained panelists on the level of color, aroma, taste, texture, and overall liking of Canavalia enformis flour and bamboo shoots nuggets.

Parameter	Mean±SD (n=50)			p-value
	FA (100:25)	FB (75:50)	FC (50:75)	
Colour	3.78±0.62[a]	3.72±0.82[a]	3.98±0.77[a]	0.227
Aroma	3.78±0.89[a]	3.92±0.85[a]	3.96±0.88[a]	0.131
Taste	3.90±0.86[a]	3.82±1.02[a]	3.80±0.95[a]	0.483
Texture	3.18±0.90[a]	3.12±0.94[a]	3.42±0.93[a]	0.899
Overall	3.86±0.78[a]	3.86±0.97[a]	3.80±0.95[a]	0.980

Proportion of Canavalia enformis flour : bamboo shoot; FA: Formula A, FB: Formula B, FC: Formula C; similar superscricpt letters (a,b) in the same row indicate no significant difference at the Kruskall-Wallis test level (p-value≤0.05).

Table 2 shows the results of the organoleptic test and hedonic test conducted on untrained panelists on the color, aroma, taste, texture, and the overall impression about the nugget products. The Mann-Whitney test was not performed because the Kruskal- Wallis test resulted in no significant difference between the treatments in all parameters. The results of the organoleptic test and hedonic test on Table 2 show that the panelists' impression about the color of the nuggets produced from the three formulas is not significantly different (p-value≤0.05) as evidenced by the p value for the color parameter of 0.227, which is marked with the same superscript letter in the same treatment. This is because the samples of the three formulas have a similar golden brown color. The samples were coated with yellow-orange breadcrumbs so that during the frying process with the optimal temperature and time, the nugget samples turned, similarly, golden brown. The color of the nuggets became dark due to the frying process in which the reaction between reducing sugars and free amino groups from proteins, commonly called the Maillard reaction, took place[35]. The color of the food greatly

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affects a person's eating preferences because appetite is strongly influenced by the visual appeal of the food, in this case natural and attractive color.

Regarding the aroma, Table 2 shows that the panelists perceived that the three sample nuggets are not significantly different (p-value≤0.05) as evidenced by the p value of 0.131, which is marked with the same superscript letter in the same treatments. Nuggets of Formula A has the lowest score in aroma, i.e., 3.78. The three sample products had a normal nugget aroma with mild nutty smell. The distinctive aroma in the three samples was caused by the use *of Canavalia Ensiformis L.* flour, which resulted in a strong aroma. Too much *Canavalia Ensiformis L.* flour resulted in a strong aroma, where the strong aroma of nuts is often referred to as beany flavor[15]. Aroma is an important parameter in organoleptic testing and hedonic testing because it affects a person's likeness to enjoy food. Natural aroma from served food products can stimulate a person's appetite.

In terms of taste, Table 2 shows that the panelists perceived that the three sample nuggets samples did not differ significantly (p-value≤0.05) as evidenced by the p value of 0.483, which is marked by the same superscript letter in the same treatments. Nuggets of Formula A has the highest level of taste preference with the average score of 3.90. This is because the proportion of *Canavalia Ensiformis L.* in the products affects the taste of the nuggets, which is savory and delicious. *Canavalia Ensiformis L.* flour contains a lot of glutamic acid, i.e., 5.47%[36]. This acid plays an important role in food processing because it can create a good taste in food by increasing the balance of processed food flavors[37]. In this study, taste is an important parameter. The produced food is good and does not leave the distinctive taste of *Canavalia Ensiformis L.* flour and bamboo shoots.

Regarding the texture, Table 2 shows that the panelists believed that the texture of the three samples is not significantly different (p-value≤0.05) as evidenced by the p value of 0.899, which is marked with the same superscript letter in the same treatments. Nuggets made using Formula C have the highest score in texture, i.e., of 3.42. The three samples had a crispy outer texture because the nuggets were coated with breadcrumbs. The inner texture of nuggets produced using Formula C is chewier and softer that those of Formula A and Formula B, which were dense and slightly hard. The difference in the inner texture is caused by the difference in the use of *Canavalia Ensiformis L.* flour.

The breading of the nuggets affects the roughness of the nuggets. The crispy and crunchy texture creates a sense of pleasure when chewing food due to the resisting sensation when the food is bitten[38]. The texture of the nuggets is also influenced by the starch content. *Canavalia Ensiformis L.* flour contains 37.94% of starch. The nuggets will be a little hard to bite if the flour is used in large quantities due to the gelatinization properties of the flour. This property causes the starch granules to enlarge, and the dough will become thick and hard[39]. The Indonesian National Standard (SNI) number 01-6682-2002 mentions the standard texture of nuggets; it consists of chewiness. Good nuggets are those with chewy texture, compact dough, and softness. The panelist prefer crunchy outer texture and the chewy inner texture to mushy outer texture and hard inner texture.

In terms of the overall impression about the products, Table 2 shows that the panelists' opinions about the three samples are not significantly different (p-value≤0.05) as evidenced by the p value of 0.980, which is marked with the same superscript letter in the same treatments. The products of Formula A and Formula B have the same average score of 3.86, while those of Formula C have the average score of 3.80. This means that the panelists in general somewhat like this nugget food innovation product because, according to the panelists, the shape of the nuggets is less varied for children, the texture of the nuggets is still not soft enough, and the doneness level of the nuggets is still poor.

Ghrelin hormone makes a person hungry just by looking at the shape and visual aspect of food. This hormone is responsible for the psychological mechanism of a person with his body when looking at beautifully shaped and arranged food, dish made of delicious ingredients, and meals that look tempting. The hormone is a peptide produced in large quantities in the stomach and has the effect of stimulating food intake[40]. The texture of food is strongly influenced its doneness. Inappropriate doneness makes the food too hard or too soft, while inappropriate texture can make children do not finish their meal[41]. Children get bored easily with food. Therefore, food processed into various shapes and properly cooked for correct texture can help increase children's eating appetite

Nutrition Fact Test Using NutriSurvey

The eating behavior of children aged 5-12 years varies. At this age range, children have high physical activity, so energy needs also increase. They have the habit of choosing food, and this affect their nutritional status. Parenting in food choice for children, especially regarding the quantity and quality of food, also affects their nutritional status. The nutritional content of *Canavalia Ensiformis L.* flour and bamboo shoot nuggets is presented in Table 3.

Table 3. Nutrition Fact of *Canavalia ensiformis* flour and raw bamboo shoot nuggets each piece (29 g) in formula A, formula B, and formula C

Formula	Weight (g)	Energy (kkal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fiber (g)
FA (100:25)	29	88.0	4,8	0.9	15.3	0.9
FB (75:50)	29	91.8	5.0	1.0	16.0	0.8
FC (50:75)	29	98.9	5.4	1.1	17.2	0.8

Proportion of Canavalia ensiformis flour : bamboo shoots; FA: Formula A, FB: Formula B, FC: Formula C.

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Table 3 shows the nutritional content of the raw nugget products produced using Formula A, Formula B, and Formula C. The nutritional content of the products is relatively the same. However, products made using Formula C is the best as they have higher energy, protein, and carbohydrate contents than those of Formula B and Formula C. In addition to their sufficient fat content, the products of Formula C also have added values acquired from the results of the organoleptic test and hedonic test. They are preferred by the panelists because they are softer and chewier than those of Formula A and Formula B. The high contents of energy, protein, and carbohydrates, as well as the low fat content, make the nuggets an alternative side dish and snacks for children. The serving size for this nugget is 2 pieces (58 g) each meal or 6 pieces (174 g) per day, and the nutritional content is presented in Table 4.

Table 4. Nutrition fact information each serving of Canavalia ensiformis and bamboo shoot nuggets in formula A, formula B, formula C

Nutrition Fact					
FA* (100:25)		**FB* (75:50)**		**FC* (50:75)**	
Serving size 2 pieces (58 g)					
Quantity serving					
Energy	221.7 kkal	Energy	262.9 kkal	Energy	263.9 kkal
Energy from fat	106,5 kkal	Energy from fat	209.8 kkal	Energy from fat	210.2 kkal
% AKG**		% AKG**		% AKG**	
Total fat 11,8 g	8.2%	Total fat 23.3 g	5.8%	Total fat 23.3 g	5.8%
Total carbohydrate 17,9 g	6%	Total carbohydrate 3.3 g	1.1%	Total carbohydrate 4.1 g	1.4%
Protein 18,9 g	21.8%	Protein 10 g	20%	Protein 9.3 g	18.6%
** Percent RDA based on 2000 kcal energy requirement. Your energy needs may be higher or lower					

Proportion of Canavalia ensiformis flour : bamboo shoots, FA: Formula A, FB: Formula B, FC: Formula C.

The The nutritional contents per serving size of the nuggets produced using Formula A, Formula B, and Formula C are relatively different. The products of Formula A contains higher protein and carbohydrate and lower fat than those of Formula B and Formula C. Eating 2 pieces of nuggets made using Formula A can contribute to the nutritional adequacy level of 21.8% of protein, 18.2% of fat, and 6% of carbohydrate, according to the Nutritional Adequacy Rate (RDA) for children aged 5-12 years[42]. Nutrient intake greatly affects the nutritional status of children. The lower the nutritional intake, the higher the risk of wasting. Low protein and energy consumption increases the risk of wasting. In addition, wasting leads to growth retardation and cognitive decline. Low fat consumption leads to impaired absorption of fat-soluble vitamins and decreased body mass. Macronutrient intake that is not suitable for the body's needs over a long period of time can lead to tissue alterations and changes in body mass, resulting in poor nutritional status[43].

More attention should be given to the nutritional content of children's food, especially protein. The nugget products in all three samples in this study contain quite high protein, where protein can help the process of growth, development of the body, tissues, and brain and intelligence[28]. The carbohydrate and fat content contained in the nuggets is also quite good. Therefore, consuming this product means fulfilling the energy needs. The nuggets produced in this study contain fiber from *Canavalia Ensiformis L.* flour and bamboo shoots; each of which contains 8.3%[10] and 2.56%[44] of fiber. Dietary fiber can improve the physiological function of the intestine[11] so as to maintain health and prevent digestive tract diseases for children. The nugget products also contain minerals in the form of potassium (K), calcium (Ca), phosphorus (P), and magnesium (Mg) derived from the *Canavalia Ensiformis L.* flour and bamboo shoots. The addition of these minerals in food can improve the growth and development of children suffering from wasting because these minerals play an important role for tissues regeneration and bodily biochemical processes[26]. The benefit of this study is that it produces food with excellent nutritional values of energy, carbohydrates, protein and fat so that it can be consumed to prevent wasting in children aged 5-12 years. The nugget products have a high content of fiber because they use bamboo shoots as one of the ingredients. The fiber can help the physiological function of the intestine in the digestive process. The nuggets were made of *Canavalia Ensiformis L.* flour and bamboo shoots, two ingredients not really favored by children.

Despite the advantages mentioned above, this study is still hindered by the fact that the hedonic test questionnaire has not been checked for validity and reliability. Then, the proximate test of crude fiber in the nugget products was not carried out, so, based on the proximate test, the nutritional content of crude fiber in this nugget product is not accurately known.

CONCLUSIONS

The nuggets made of *Canavalia Ensiformis L.* flour and bamboo shoots can be used to prevent wasting in children aged 5-12 years. The products of Formula A is recommended for consumption because they have good nutritional values and a good sensory acceptance score, not to mention that they can be used in campaigns preventing children aged 5-12 years from wasting . Based on the proximate test results, the products of Formula A have the moisture content of 27.98%, ash content of 1.98%, protein content of 18.85%, fat content of 20.40%, and carbohydrate content of 30.79%. Further research in this topic needs to be done so that nuggets produced using Formula A have a soft and chewy texture and still have optimal nutritional value. In addition, further

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research also needs to be done to determine the expiration date of the nugget products and to perform another proximate test for the crude fiber content of *Canavalia Ensiformis L.* flour and bamboo shoot in the nuggets.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

There is no conflict of interest between the three authors during the accomplishment of this study. This research was fully funded by private sources.

AUTHOR CONTRIBUTIONS

SP: conceptualized and designed the research, led the data collection, revised and wrote the methods chapter, assisted in the nugget recipe formulation, supervised and guided in data analysis and interpretation, provided critique, feedback and suggestions for manuscript writing, and revised the discussion chapter manuscript; BSR: supervised and guided in data analysis and interpretation, provided critique, feedback and suggestions for manuscript writing, and revised the discussion chapter manuscript; SWY: responsible for all scientific contents of the article, formulated the research problems, analyzed and interpreted the data, prepared the manuscript draft, and revised the manuscript.

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