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Characteristic of Wheat Flour Nuggets : Study of Cooking Process and Proportion of Red Beans

Marina Revitriani[1], Diana Puspitasari[1*], Fungki Sri Rejeki[1]

[1]Department of Agricultural Industrial Technology, Engineering Faculty,
Universitas Wijaya Kusuma Surabaya, East Java, Indonesia
Jl. Dukuh Kupang XXV/54 Surabaya 60225, Indonesia
Corres Author Email: diana.puspitasari@uwks.ac.id

ABSTRACT

Making nuggets by replacing meat with red beans can be used as a variant of nuggets for vegetarian consumption. Red beans have hard skin, so it is necessary to know the most appropriate cooking method to produce quality nuggets. The use of whole wheat flour as a binder aims to increase the fiber and protein content of the product. The purpose of this study was to determine the proportion of red beans and whole wheat flour as well as to show how to cook red beans for the quality of the nugget produced. This study used a factorial randomized block design (RAK) the first factor was the proportion of red beans and wheat flour (K), namely K1 (60%:40%), K2 (50%:50%), K3 (40%:60%). The second factor was the red beans cooking process (P), namely P1 (boiling) and P2 (steaming). The results showed that there was no interaction in all treatments. The treatment of the proportion of red beans and whole wheat flour had no significant effect on all parameters, while the treatment of red bean cooking affected the parameters of water content, ash, and carbohydrates. The results of the organoleptic test had a significant effect on taste, aroma, texture, and color. K3P2 treatment (proportion of red beans: 40%: 60% whole wheat flour and steaming) became the selected treatment with parameters water content 49.09%, ash content 1.85%, protein content 10.62 %, fat content 2.90%, carbohydrate content 35.53% and total preference for taste 63.3%, aroma 53.3%, texture 43.3% and color 63.4%.

Keywords: *Nuggets; Red Beans; Whole Wheat Flour*

INTRODUCTION

Nuggets are a form of a processed meat product made from ground beef which is molded in the form of rectangular pieces and coated with seasoned flour (Pusra et al., 2010), and fried food that is very popular with the community (Setyaji and Jambi, 2014). Nuggets are made from ground beef that is seasoned, mixed with a binder, then molded into a certain shape, steamed, cut, coated with a flour adhesive (batter), and covered with bread flour (breading). Nuggets are a form of ready-to-eat frozen food products, namely products that have been heated to half-cooked (pre-cooked), then frozen (Setyaji and Jambi, 2014). This frozen ready-to-eat product requires frying time for 1 minute at a temperature of 150º C.. In Nuggets Production there are basic ingredients which beef or chicken meat are commonly used whereas tapioca flour commonly used as filling ingredients. Beef as basic ingredients can be substituted with plant-based ingredients which contains high content of protein, one of which is red beans.

Red beans are vegetable ingredients that have high nutritional content, especially fiber and protein content (Wisaniyasa and Suter, 2016). Replacing meat with red beans is expected to meet the protein needs of the vegetarian group. Red beans contain substances that are efficacious to prevent various diseases, which are reducing blood vessel cancer, blood sugar concentration, reducing colon cancer, and breast cancer, protecting the body from cancer and heart attacks (Campos-Vega et al., 2013). Furthermore, consumption of red beans can prevent the risk of diabetes because the content of complex carbohydrates has a low glycemic index and includes slow digestion (Asih et al., 2019). Red Beans have a hard shell therefore need to be processed in advance using the right immersion or cooking

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method. According to Sundari et al.(2015) Cooking process is introduction of heat with the temperature of 100^{o}C with the purpose of gaining better, flavor and aroma, tender texture, and kills bacteria furthermore enzyme inactivation can be done by immersion or steaming.

The texture of the nugget depends on the material of origin (Sharima-Abdullah et al., 2018) so if the filler is added, it will increase the nutritional content of protein and carbohydrates. In addition to raw materials, there are also fillers which are generally in the form of flour (Sharima-Abdullah et al., 2018). Filler aims to substitute some of the meat, therefore overall costs can be reduced (Akesowan, 2016). The addition of fillers can help increase the volume of the product. The use of whole wheat flour as a binder of nuggets aims to restore nutrients, especially fiber, protein, and vitamins. The nutritional content of whole wheat flour is 1.68% ash, 10.60% protein, 9.90% dry gluten, 2.24% crude fiber, and 54.50% starch (Ramakrishna et al., 2006).

Whole wheat flour is flour that is produced by grinding the whole wheat grain along with bran, endosperm, and germ. Bread made with 100% whole wheat flour is heavier than bread made with 100% wheat flour because it contains higher gluten protein than wheat flour. Bread dough with 100% whole wheat flour is usually preferred by the community because of its strong taste and healthier content (Wahyuningtias et al., 2014). Besides being high in fiber, one of the advantages of whole wheat is that its amylose content is higher than wheat flour (Ramakrishna et al., 2006).

The purpose of this research was to determine the effect of the proportion of red beans and wheat flour and the cooking process of red beans on the characteristics of nuggets.

METHODS

Material

The ingredients used in this study were whole wheat flour, red beans, salt, tapioca flour, egg and garlic. Chemicals used for analysis include petroleum ether (Merck, GR), H2SO4 (Merck, GR), NaOH (Merck, GR), boric acid (Merck, GR), methylene (Merck, GR), and HCl (Merck, GR)

Tool

The tools used in the processing of nugget were scales, blenders, stove molds, pans. The tools used for analysis include analytical scales (Ohaus), drying oven (Binder), muffle furnace (Wisd), water bath (Memerth), glassware (phyrex).

Research Design

This study used a Randomized Block Design (RAK) which consisted of two factors. The first factor is the proportion of red beans and wheat flour (K) which consists of 3 levels, namely K1 (60%:40%), K2 (50%:50%), K3 (40%:60%). The second factor was the red bean cooking process (P) which consists of two levels, namely P1 (Boiling) and P2 (Steaming). Each treatment was repeated 3 times.

Determination Of The Chemical Characteristics Of Red Beans Nugget

This stage of research was conducted to determine the characteristics of red beans nugget by knowing the physical and chemical properties of red beans nugget selected in the previous stage. Parameter testing was carried out on red beans nugget, which included: water content test using the gravimetric method (Sudarmadji, et al., 1984), test for ash

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content using the ashing method (Sudarmadji et al., 1984), protein content test using the micro Kjehldal method (AOAC., 1990), test for fat content with Soxhlet, and carbohydrate content test using by difference (Winarno, 1986).

Sensory Evaluation

The consumer acceptance test for red beans nugget was conducted by 30 semi-trained panelists using a hedonic five scales. Sensory tests performed on the parameters of texture, aroma, taste, and color.

Data Analysis

The data obtained was presented quantitatively based on observations and statistical tests using the ANOVA method which show the effect of significant differences was further tested using Duncan's test and for data from organoleptic tests analyzed using the Friedman Test method.

Alternative Selection

Alternative selection aims to determine the selected alternative treatment. The basis for selecting alternatives is the quality parameter for each product. The parameters used were water content, fat content, protein, carbohydrates, taste, texture, and aroma. Determining the weight of importance for each parameter used the Analytical Hierarchy Process (AHP) method (Saaty, 2008), while the selected options used the expected value method. According to (Haudi and Wijoyo, 2021), the expected value was the average consideration of all possible outcomes where the weighting was the expected value with each outcome.

RESULT AND DISCUSSIONS

Sensory Evaluation

Sensory evaluation was carried out to determine the level of consumer preference for the taste, aroma, texture, and color of the red beans nugget product which was produced by treating the proportions of red beans nugget and brown rice flour (P) and the cooking method of red beans. The test was conducted using the scoring method, with a total of 30 panelists. The results of the organoleptic test can be seen in Figure 1.

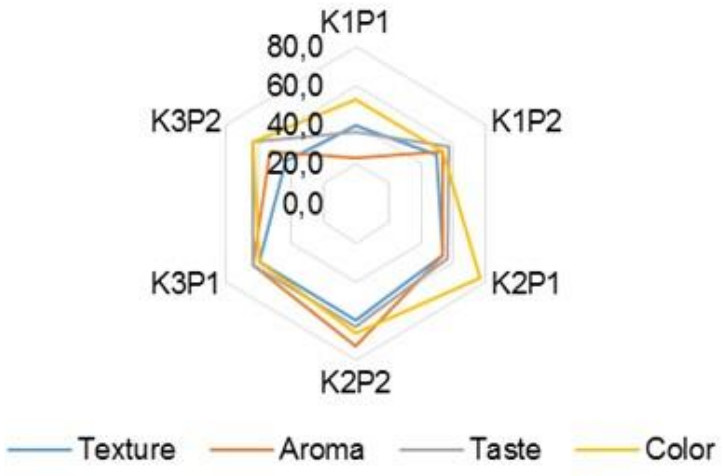

Figure 1. Graph of nugget sensory evaluation data

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Friedman test results on the taste parameters of nuggets showed a significant difference (sig count value 0.010 < 0.05). Taste is an important parameter. The taste of nuggets is influenced by the addition of red beans, that the higher the proportion of red beans more preferred the nuggets by the panelists. This is because more red beans are added to the nuggets, the more taste of red beans will be felt. According to Zahara et al., (2015) The more red bean flour was substituted for cookies, the more real the taste was. Cooking by steaming was preferred by panelists, this is because by steaming not many components were lost compared to boiling which causes a lot of protein to be lost because it dissolves in water. The protein contained in red beans can act as a taste maker. Protein can react with reducing sugar, fat, and oxidized product therefore able to cause darker colour and formation of flavor. This is in line with research conducted by (Rahmawati and Irawan, 2021) that the less the addition of red bean flour, the lower the panelists' preference level.

Friedman test results showed that there was a significant effect on the aroma parameter (sig value 0.040 <0.05). Aroma is one of the components of food taste and can be a determinant of food delicacy. The use of red beans affected the aroma of nuggets. Red beans contain lipoxygenase that produce a beany flavor or unpleasant odor (Putri and Niken, 2018) which was not liked by most of the panelists.

Friedman test results showed that there was a significant effect on the texture parameters. This is based on the calculated sig value of 0.003 < 0.005. The use of red beans can affect the texture. Red beans contain 62.68 % of carbohydrate (James et al., 2020) which is according to (Rahmawati and Irawan, 2021) the addition of taro starch caused an increase in the hardness of chicken nuggets. It is stated that the increase in hardness was caused by the retrogradation of taro starch when the nugget dough was cooled where the amylose formed a rigid and hard character.

Friedman test results show that there is no significant effect on color parameters. This is based on the calculated sig value of 0.234 > 0.005. The greater the proportion of red beans, the darker the nuggets. Protein is a reactive component in foodstuffs that can react with reducing sugars causing a darker color (Rahmawati and Irawan, 2021). According to (Rosa and Kasih, 2019), the color of a product is influenced by the materials used, as well as the heating process that gives color pigments

Chemical Characteristics

The chemical test results of red beans nuggets can be seen in Table 1.

Table 1. Chemical composition of red bean nugget

Treatment	Water Content (%)	Ash Content (%)	Protein Content (%)	Fat Content (%)	Carbohydrat Content (%)
K1P1	46.89	2.09	9.90	2.52	38.60
K2P1	46.02	2.17	9.93	2.18	39.70
K3P1	46.30	2.14	9.86	3.17	38.53
K1P2	50.67	2.04	9.20	3.38	34.71
K2P2	48.62	2.06	10.18	2.56	36.58
K3P2	49.09	1.85	10.62	2.90	35.53

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Water Content

The results of the analysis of variance showed that there was no significant interaction between treatments (sig. 0.951 > 0.005). The proportion factor of wheat flour and red beans had no significant effect on water content (sig. 0.583 > 0.005), while the cooking factor had a significant effect (sig. 0.036 < 0.005). The treatment of red bean cooking with boiling was significantly different from steaming. Duncan test result of water content parameter can be seen on Table 2.

Table 2. Duncan test results moisture content parameter

Treatment	Moisture Content	Notation
P1	46.4%	B
P2	49.46%	A

Note: Different notation in the same column, shows a real difference

In Table 2 it can be seen that treatment P1 (boiling red beans) produced red beans nuggets with a lower water content than treatment P2 (steaming red beans). This is because the cooking process using high temperatures can cause the protein content in red beans to denature. Cooking by steaming causes less protein damage than boiling because when boiling the red beans are submerged in water so that the protein is dissolved in the boiling water. The higher the protein content, the higher the water content. (Afrilla and Santoso, 2011) suggested that higher protein content can provide greater Water Holding Capacity (WHC). A larger WHC will reduce the water lost in food processing using high temperatures.

Ash

The results of the analysis of variance showed that there was no significant interaction between treatments (sig. 0.721 > 0.005). The proportion factor of wheat flour and red beans had no significant effect on the ash content (sig. 0.723 > 0.005), while the cooking factor had a significant effect (sig. 0.014 < 0.005). The treatment of red beans cooking with boiling was significantly different from steaming. Duncan test result of ash content parameter can be seen on Table 3.

Table 3. Duncan test results ash content parameters

Treatment	Ash Content	Notation
P1	2.13 %	A
P2	1.98 %	B

Note: Different notation in the same column, shows a real difference

Table 3 showed that treatment P1 (boiled red beans) produced nuggets with greater ash content than P2 (steamed red beans). This was thought to be due to the water content of the nugget which was more lost during boiling so that the ash content increases. Ash content shows the amount of minerals contained in a product. Red beans contain 4.72% Ash (James et al., 2020)

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Protein

The results of the analysis of variance showed that there was no significant interaction between treatments (sig. 0.063 > 0.005). The proportion factor of wheat flour and kidney beans had no significant effect on protein content (sig. 0.344 > 0.005). The red bean ripening factor also had no significant effect (sig. 0.244 > 0.005). Red beans contain 14.36% protein, 6.5% fat and 2.5% fiber (James et al., 2020). Reddy et al. (1999) stated that during the boiling process the meat was submerged in water so that some water-soluble nutrients such as protein were dissolved in the boiling water. According to (Sundari et al., 2015), cooking was a processing process that reduces the water content, boiling can cause the meat to shrink so that a lot of water comes out.

Fat

The results of the analysis of variance showed that there was no significant interaction between treatments (sig. 0.115 > 0.005). And each factor also had no significant effect on fat content. The proportion factor of wheat flour and red beans had no significant effect on fat content (sig. 0.207 > 0.005). And the cooking factor had no significant effect (sig. 0.309 > 0.005).According to James et al., (2020), Red beans contain 6.5 % fat.

Carbohydrate

The results of the analysis of variance showed that there was no significant interaction between treatments (sig. 0.943 > 0.005). The proportion factor of wheat flour and red beans had no significant effect on carbohydrate content (sig. 0.758 > 0.005), while the cooking factor had a significant effect (sig. 0.032 < 0.005). The treatment of red beans cooking with boiling was significantly different from steaming. Duncan test results carbohydrate content parameter can be seen on Table 4.

Table 4. Duncan test results carbohydrate content parameters

Treatment	Carbohydrate Content	Notation
P1	38. 94 %	B
P2	35. 61 %	A

Note: Different notation in the same column, shows a real difference

Carbohydrate content is obtained from the carbohydrate by difference method, where the calculation results are influenced by the results of other chemical contents such as water content, ash content, protein content, and fat content. Treatment P1 (boiled red beans) produced higher carbohydrates than treatment P2 (steamed red beans). This was because the P1 treatment (boiling red beans) produced less water, protein and fat content, so that the carbohydrate content increased.

Alternative Selection

Alternative selection is carried out with the aim of choosing the best treatment from several existing treatments (Haudi and Wijoyo, 2021). Decision making is a process of selecting the best treatment systematically. Determination of the weight of the importance of each parameter is carried out using the AHP test. As for the determination of the selection of the best treatment based on the Expected Value method.

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AHP (Analityc Hierarchy Process)

AHP is a decision-making algorithm for multi-criteria problems. The weight of importance of nugget parameters from each parameter can be seen in Figure 2.

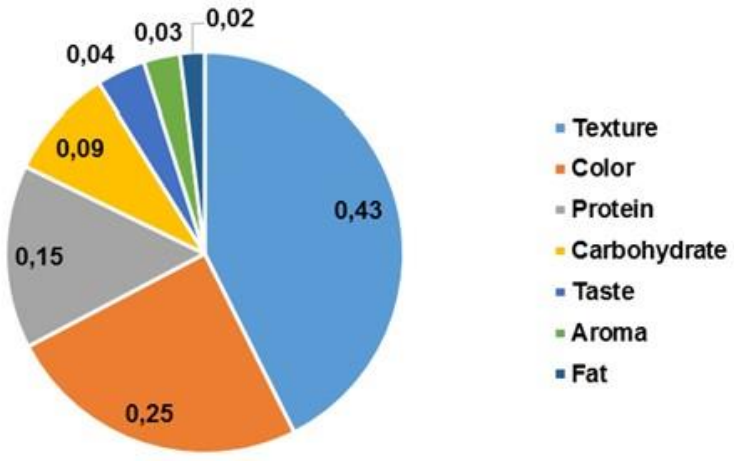

Figure 2. Pie diagram of nugget's total interest

Expected Value

Expected value is the sum of the values that are expected to occur for a probability. The basis of calculation for the selection of the best treatment is the result of product quality for each parameter and the weight of importance of each of these parameters. In decision making, it should always be endeavored to choose the treatment with the maximum expected value. The results of calculating the expected score for each treatment are shown in Table 5.

Table 5. Expected value score

Treatment	Total Expected Value
K1P1	4.55
K2P1	4.55
K3P1	1.07
K1P2	6.31
K2P2	7.05
K3P2	8.97

It can be seen from Table 5 that the highest total is in the K3P2 treatment, namely the proportion of the ratio of wheat flour and red beans (40:60) and cooking red beans by steaming.

CONCLUSION

The results showed that there was no interaction in all treatments. The treatment of the proportion of red beans and whole wheat flour had no significant effect on all parameters, while the treatment of red beans cooking had an effect on the parameters of water content, ash and carbohydrates. The results of the organoleptic test had a significant effect on taste, aroma, texture and color. K3P2 treatment (proportion of red beans: 40%: 60% whole wheat flour and steaming) became the selected treatment.

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