Characteristics of chicken nuggets with breadfruit substitution

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Abstract. This study was designed for to produce cheaper chicken nugget with high quality. Also it arranged base on randomized complete with 9 treatments, there are P1 as control 100% tapioca flour, P2 substituted 15% breadfruit flour and 85% tapioca flour, P3 substituted 25% breadfruit flour and 75% tapioca flour, P4 substituted 35% breadfruit flour and tapioca 65%, P5 substituting 50% breadfruit flour and 50% tapioca, P6 substituting 65% breadfruit and 35% tapioca, P7 substituting 75% breadfruit flour and 25% tapioca, P8 substituting 85% breadfruit flour and 15% tapioca and P9 substituting 100% breadfruit flour and 0% tapioca. The result showed significantly nugget with breadfruit 35% (p4) to 100% (p9) has pH lower than without breadfruit flour (p1). cooking loos in nugget with breadfruit flour didn’t same from all treatments. Nugget yield with breadfruit flour as substitution 50% (p5) to 100% (p9) significantly different (p˂ 0.05) with nugget without breadfruit flour (p1). Nugget yield which reached in this study ranged between 119,2-125. So that, the optimal composition was nugget with substitution 50% breadfruit flour and 50% tapioca with pH 6,05, cooking loos 5% and yield 120%.

1. Introduction

One of the by-products of chicken slaughtering is the intestine. Chicken intestine is a waste product that has almost no economic value, has the potential to be a source of environmental pollution but contains high nutritional value. Chicken intestine contains about 22. 93% protein [1]. The chicken intestine is used mainly for catfish feed and as a raw material for chips satay intestine or bowel that was commonly found in Java, Indonesia. In Southeast Sulawesi, the use of the chicken intestine as a raw material for food was still very limited.

Nugget is one of food produce from animal. Nuggets is a product with form of spiced ground beef, and covered by batter, breading, half-cooked and then frozen to maintain quality. The main materials of nugget production such as chicken, beef, mutton, and marine animals. Other materials are filler and spices like garlic, nutmeg, pepper, salt, and sugar [2]. Filler ingredients can be used with variety of flour. It added to give compact and solid texture. This is caused by starch gelatinization process that occurs.
during the production process [3]. Besides that, adding fillers has function to increase the weight and substitute most of the meat which results in cost reduction [4].

In the production of nuggets tapioca flour is used. It contains 86.9% carbohydrates, 0.5% protein, 0.3 fat and 11.54% water [5]. It can be replaced with others flour which has high starch level. Several studies have reported positive effects on substituting tapioca flour with various flour [3]. By using 10% suweng flour as filler for chicken nuggets give the same physical and chemical properties with tapioca flour [6].

Breadfruit (*Artocarpus communis*) is a local plant that is widely found in southeast Sulawesi. Breadfruit is having high carbohydrate level, high phosphorus and others nutrients [7]. It fleshes can be used as flour with level of starch up to 75%, 31% sugar, 5% protein, and about 2% fat. It allows this breadfruit flour to be used as an alternative filler. The function of starch is to increasing the water holding capacity. Starch consists of two fractions, the dissolved fraction (amylose) and the insoluble fraction (amylopectin). The greater level of amylopectin or the smaller level of amylose giving stickier characteristic to the product [3]. Breadfruit flour contains amylopectin of 77.48% and amylose 22.52% [8]. Meanwhile tapioca flour contains 83% amylopectin and 17% amylose.

This research is the first stage of the study which produces the best nugget products using raw materials of chicken meat substituted with chicken intestines by 50% [9-11]. The best nugget product obtained in the first stage uses tapioca flour as a filler. In the next stage, substitution of tapioca flour with breadfruit flour was used to utilize the abundant potential of breadfruit in Southeast Sulawesi, diversification of raw materials and to reduce the price of nuggets. This study aims to examine the physical characteristics of nuggets using flour substituted with breadfruit flour substitutes with different percentages.

2. Method
This research was conducted at the Animal Husbandry and Production Technology Laboratory of the Faculty of Animal Husbandry, Halu Oleo University. While the sample testing was carried out at the Halu Oleo University FMIPA Forensic Chemistry Laboratory, in March 2018 until October 2018.

The sample used in this study was chicken nuggets with the main ingredients of broiler chicken meat and intestine obtained from traders in the Anduonohu market in Kendari city. Additional ingredients in the form of tapioca flour, breadfruit flour and spices (garlic, ground pepper, salt, flavoring powder nutmeg, skim milk, pan flour, and eggs).

**Table 1.** Formulation ingredients nugget chicken with fillers (*filler*) tapioca flour breadfruit flour was substituted.

| Ingredients (%) | Treatment |
|-----------------|-----------|
|                 | 1 2 3 4 5 6 7 8 9 |
| Chicken meat    | 50 50 50 50 50 50 50 50 |
| Chicken intestine | 50 50 50 50 50 50 50 50 |
| Tapioca flour   | 100 85 75 65 50 35 25 15 0 |
| Breadfruit flour | 0 15 25 35 50 65 75 85 100 |
| pepper powder   | 2 2 2 2 2 2 2 2 2 |
| Garlic          | 3 3 3 3 3 3 3 3 3 |
| Salt            | 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 |
| Nutmeg          | 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25 |
| Flavouring      | 1 1 1 1 1 1 1 1 1 |
| Sugar           | 1 1 1 1 1 1 1 1 1 |
| Skimmed milk powder | 5 5 5 5 5 5 5 5 5 |

2.1. Nugget formulation
Breadfruit Making. Breadfruit flour production with the following stages: 1) Sorting breadfruit (select the one that is nearing maturity; 2) Stripping; 3) washing; 4) Cleavage / Cutting; 5) Soaking fruit in clean water for approximately 30-60 minutes; 6) fruit that has been soaked is thinly sliced using a sharp
knife; 7) Drying, and 8) Milling and sifting [12]. Nuggets production based formulations have been determined in table 1.

Making modified nuggets with a combination of 50% chicken meat and 50% chicken intestine weighed as much as 300 g and then milled, during the grinding added ice and salt. Then added ingredients such as sugar, pepper, garlic, skim milk, starch and breadfruit flour. All ingredients are stirred evenly to get a dense and homogeneous mixture. The resulting nugget mixture is then printed on an aluminum pan with plastic coated and steamed. The mixture is steamed until the internal temperature of the dough reaches 60 to 70 ° C for 30 minutes. After cooking the nugget mixture is then cooled at room temperature and then put in the refrigerator for about 30 minutes. After that the mixture is removed and cut into pieces measuring approximately 4 x 4 cm with a thickness of 1 cm. The nugget pieces are then smeared with eggs and sprinkle with bread flour. The initial frying is done soaking in cooking oil for 30 seconds at 200 ° C. After the nuggets are then removed and drained. After cold put the nuggets in plastic and stored in the freezer. Frying to be served as cooked nuggets for four minutes at 200 ° C until a yellowish-colored nugget is obtained.

2.2. Research design
This study set based on Completely Randomized Design (CRD). Treatment factor is the substitution of starch with breadfruit flour consists of five levels i.e.; A0 (0% + 100% breadfruit flour tapioca starch), A1 (10% + 90% breadfruit flour tapioca starch), A2 (25% breadfruit flour + 75% starch), A3 (35% breadfruit flour + 65% starch), A4 (50% breadfruit flour + 50% starch), A5 (60% breadfruit flour + 40% starch), A6 (75% + 25% breadfruit flour tapioca starch), A7 (85% + 15% breadfruit flour tapioca starch), A8 (100% + 0% breadfruit flour tapioca flour). Each treatment was repeated 5 times

Data analysis was performed variance according to instructions [13]. Data analysis will be performed using SPSS software. If the treatment shows the real effect, then continued by honestly significant difference (HSD).

2.3. The observed parameters
The observation parameters of physical parameters consisting i.e. pH. cooking loss and yield nugget (%).

2.3.1. pH. pH testing nugget performed by this method [14]. First of all, weighed 10 g samples were pulverized, then insert it into the bottle, shake and add 50 ml of deionized water. After that shake machine for 30 minutes, then the sample was measured with a pH meter.

2.3.2. Cooking Loss. Determination of shrinkage cook using this method to see the weight lost during cooking. Cooking shrinkage value (Cooking Loss) meatballs are calculated with the following formula:

\[
\text{Cooking loss (\%) = } \frac{\text{sample weight (start) - sample weight (end)}}{\text{sample weight (end)}} \times 100\%
\]

2.3.3. The yield. Tests performed following the method [15]. The yield is calculated as a percentage of the initial weight of the raw material by weight of the resulting product. The yield is calculated by the following formula:

\[
\text{Nugget Yield (\%) = } \frac{\text{weight of nugget}}{\text{weight of chicken meat}} \times 100\%
\]

3. Results and discussion
In this study treated physical qualities observed in this study were pH, cooking shrinkage and yield. Based on this research, the physical quality nugget chicken substitution of starch and flour (table 2).
The replacement of most flour with breadfruit flour significantly affects the yield of nuggets, particularly when using 50% (P4) to 100% (P8) breadfruit flour. The yield nugget with 0% (P0) breadfruit flour was significantly different (P < 0.05) from those with 10% (P1), 20% (P2), and 30% (P3) breadfruit flour, but not from those with 15% (P1), 25% (P2), and 35% (P3) breadfruit flour. Meanwhile, the use of breadfruit flour as much as 35% (P3) to 100% (P8) significantly lower than nugget with 0% breadfruit flour (P0). Based on this, it can be said that the use of at least 35% of breadfruit flour can affect the result of the pH of nuggets.

Materials used in the manufacture of nuggets including meat and flour have the potential to influence the pH value. In this research, the pH values obtained in this study range from 6.00 ± 0.00 to 6.08 ± 0.00. The pH value of chicken meat, chicken intestines breadfruit flour and tapioca starch respectively are 7.00, 6.43, 6.08, and 6.02. The pH value will change depending on the treatment process. The pH value of the base material of nuggets affects the final it, this occurs because changes in the balance of hydrogen at nugget. Mixing the ingredients creates a new point of equilibrium hydrogen on nugget [4].

Heating factor in the process of steaming or frying nugget is also suspected as one of the factors that affect the pH of nuggets, where in the process, using high-temperature heating. The temperature and duration of cooking played a role in influencing the final pH value [16].

Cooking loss using breadfruit flour did not differ between each treatment. Using 0% (P0) to 100% (P8) breadfruit flour did not affect cooking shrinkage of nuggets research results. It is also disclosed that when using flour, corn-starch, jackfruit seed flour and tapioca flour in beef nuggets does not affect the value of cooking shrinkage [17]. The use of flour suwag (1.94%) as chicken nugget fillers also did not affect the cooking shrinkage [18]. Besides, the addition of tomato paste (15%) produces a pH value, the value of breaking power and cooking losses of chicken nuggets are lower than the levels of 5% and 10% [18].

On the other hand, the different results shown [19], the replacement of most flour with corn-starch (10, 20, and 30%) in nugget effect on shrinkage cook chicken nuggets, the average of yield nugget obtained in this study is in the range between 119.2 - 125. The results showed no significant differences between nugget which use 15% (P1), 25% (P2), and 35% (P3) with a breadfruit flour nugget without using breadfruit flour (P0). Meanwhile, using 50% (P4) to 100% (P8) breadfruit flour significantly different (P < 0.05) with nugget without breadfruit flour (P0).

The yield is slowly declines with the magnitude of using breadfruit flour in nugget, the results of this study indicate that there are having correlation between the magnitude in using breadfruit flour to yield nugget, it was alleged that the different water levels between breadfruit flour and cassava flour would influence the yield. The water content of breadfruit flour is 15% which the higher compared to the water content of starch is 9% [19]. The higher water content of breadfruit allows with the greater loss of water during the cooking process. Filler in nugget determining the yield nugget, the filler in food products intended to improve water binding, reduce shrinkage during cooking, fixing properties of slices and reduce production costs [14].

Excipients (filler) is a source of starch which added in restructuring product to add weight to the product with substituting most of the meat so that the cost can be reduced [14]. The filler is used to reduce shrinkage during cooking and can increase the water holding capacity of meat products [9].

**Table 2. Quality nuggets chicken substitution flour tapioca and flour breadfruit.**

| Treatment | Variables | The Yield |
|-----------|-----------|-----------|
|           | pH        | Cooking Loss |          |
| P1        | 6.08 ± 0.00c | 5 ± 10a     | 125.0 ± 0.89d |
| P2        | 6.05 ± 0.02bc | 15 ± 12.2a  | 124.4 ± 080cd |
| P3        | 6.06 ± 0.01bc | 5 ± 10a     | 123.6 ± 2.33bcd |
| P4        | 6.03 ± 0.03ab | 25 ± 0a     | 122.0 ± 2.28abcd |
| P5        | 6.05 ± 0.00bc | 5 ± 10a     | 122.2 ± 2.23ab |
| P6        | 6.02 ± 0.02ab | 15 ± 12.2a  | 120.6 ± 2.65abcd |
| P7        | 6.03 ± 0.01ab | 25 ± 0a     | 120.2 ± 1.47ab |
| P8        | 6.03 ± 0.03ab | 20 ± 10a    | 119.6 ± 1.02a  |
| P9        | 6.00 ± 0.00a  | 15 ± 12.2a  | 119.2 ± 0.75a  |

Description: Values with a different letters indicate significant differences (P <0.05).
As recommendation for other research, researcher suggest to produce nuggets chicken substitution results with breadfruit flour tapioca flour with the basic ingredients of meat and chicken intestines respectively 50%, with good physical properties it better to use composition 50% breadfruit flour 50% and 50% tapioca flour. This study needs to be proposed to acquire patents and applied in the form of community service activity and industrial cooperation.

4. Conclusion
The result of this study that has been discussed previously, showed that substitution of starch by showing shrinkage ripe breadfruit flour products nugget relatively at the same quality in all treatment combinations were tested. While the pH and yield of the product nugget there are significant differences on some combination of treatments being tested. Nugget product with a maximum of 50 substitutions composition% 50% breadfruit flour and tapioca flour (P4) having a pH of 6:05, cooking shrinkage of 5% and a yield of 120%.

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