Chicken nugget nutrition composition with an additional variation of breadfruit flour

H Hafid1*, Nuraini1, D Agustina1, Fitrianingsih1, Inderawati4, S H Ananda2, D. U. Anggraini3, FNurhidayati4

1Animal Science Departement, Faculty of Animal Science,Halu Oleo University Jl. HEA MokodompitKampusBumiTridarmaAnduonohuKendari, Indonesia
2Nutrition Departement, STIKES KaryaKesehatan, KampusAnduonohu, Kendari Southeast Sulawesi, Indonesia
3Management Department, STIE RahmaniyahSekayu, South Sumatera, Indonesia
4AccountingDepartement, Faculty Economy, UniversitasMaarif Hasyim Latif, Sidoarjo, East Java, Indonesia

*E-mail: harapinhafid14@gmail.com

Abstract. The study aims to evaluate nuggets substituted with chicken intestine and breadfruit flour. The treatment consisted of 100% topica flour (P1), and substitution with breadfruit flour each of 15% (P2), 25% (P3), 35% (P4), 50% (P5), 65% (P6), 75% (P7), 85% (P8), 100% (P9).

The study showed that the water content of P4 nugget to 100% (P9) was significantly lower than the control (P1). 100% ash content substitution nugget (P9) breadfruit flour was significantly higher than the control. The substitution of breadfruit flour does not affect protein and fat. It was concluded that the substitution of breadfruit flour with tapioca in the manufacture of the nugget was significantly different in water content and ash, but protein and fat content of the resulting nugget were relatively the same. The composition of 50% substitution nugget tapioca flour and breadfruit 50% (P5) contains 61.5% water, 1.65% ash, 17.55% protein, and 17.72% fat.

1. Introduction

Although only chicken slaughter waste, the chicken intestine can still be processed into processed food because it has adequate nutrition. The amount of protein in the chicken intestine is around 93%[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 the results of meat processing. Nugget is a food made from seasoned meat, and wrapped in a mixture, fried half-cooked and then temporarily 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. Filler ingredients can be used with a variety of flour. It added to give compact and solid texture. This is caused by the starch gelatinization process that occurs during the production process [2]. Besides that, adding fillers has a function to increase the weight and substitute most of the meat, which results in cost reduction [3].

In the production of nuggets, tapioca flour is used. It contains 86.9% carbohydrates, 0.5% protein, 0.3 fat and 11.54% water [4]. It can be replaced with other flour, which has a high starch level. Several
studies have reported positive effects on substituting tapioca flour with various flour [2]. By using 10%, suweg flour as filler for chicken nuggets give the same physical and chemical properties with tapioca flour [5].

Breadfruit (Artocarpus communis) is a local plant that is widely found in southeast Sulawesi. Breadfruit is having high carbohydrate level, high phosphorus, and other nutrients [6]. Its flesh can be used as flour with the 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 increase 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 more sticky characteristic to the product [2]. Breadfruit flour contains amylopectin of 77.48% and amylose 22.52% [7]. 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% [8][9][10]. The best nugget product obtained in the first stage uses tapioca flour as a filler. In the next stage, the 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. The research was directed to evaluate the physical properties of nuggets with tapioca flour substituted with different percentage of breadfruit flour.

2. Methods
This research was conducted at the Livestock Technology Laboratory of the Faculty of Animal Sciences, Halu Oleo University, in March 2018 to October 2018. The research material consisted of chicken meat, chicken intestine, tapioca flour, breadfruit flour, eggs and spices in the form of pepper, salt, garlic, nutmeg powder, panir flour, and skim milk).

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. Making nuggets based on predetermined formulations Table 1 [11].

| Ingredients (%) | Treatment |
|-----------------|-----------|
|                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Chicken Meat    | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Chicken Intestine| 50 | 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 |
| Garlic          | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Ground Pepper   | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Nutmeg Powder   | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 |
| Salt            | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 | 2,5 |
| Skimmed milk powder | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Sugar           | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Taste Sealing   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
The process of making nuggets follows the following procedure. First, 300 g of chicken meat and intestine are ground, then added ice cubes and salt, then given sugar, pepper, garlic, skim milk, tapioca flour, and breadfruit flour [12]. After that, all the ingredients have been stirred into a homogeneous mixture. The nugget mixture is put into an aluminum pan coated with plastic and then steamed. Steaming is carried out with the internal temperature of the dough reaching 60 to 70 °C for 30 minutes. After steaming, this half-cooked nugget is cooled at room temperature and then put in the refrigerator for 30 minutes. The half-cooked nuggets are then cut to a size of about 4 x 4 cm with a thickness of one cm, all pieces of nuggets are dipped in egg beaters then smeared with bread flour. The initial frying is done in a cooking oil soaking for 30 seconds at 200 °C. After cooling the nuggets are packed in plastic and stored in the freezer before cooking. The last nugget frying was carried out at 200 °C for 4 minutes.

2.2 Research design
This study uses a completely randomized design (CRD). The substitution of tapioca flour with breadfruit flour with different levels is treated. This study consisted of nine treatments; A1 (0% breadfruit flour + 100% tapioca flour), A2 (10% breadfruit flour + 90% tapioca flour), A3 (25% breadfruit flour + 75% tapioca flour), A4 (35% breadfruit flour + 65% tapioca flour), A5 (50% breadfruit flour + 50% tapioca flour), A6 (60% breadfruit flour + 40% tapioca flour), A7 (75% breadfruit flour + 25% tapioca flour), A8 (85% breadfruit flour + 15% tapioca flour), A9 (100% breadfruit flour + 0% tapioca flour). Each treatment was repeated 5 times. Data analysis was carried out by analyze of variance according to the instructions [13].

2.3 The Observed Parameters
Parameters that will be observed in this study are chemical parameters consisting of water content, protein content, fat content, and ash content.

2.3.1 Water Content (KA) [14]
The empty glass was dried in an oven at 105 °C for 15 minutes then cooled in a desiccator and weighed. Material samples of 10 g were put into a weighed glass then dried in an oven at 105 °C for 12 hours. The glass containing the dry sample is then transferred to the desiccator, cooled, and then weighed. Drying is carried out until a constant weight is obtained. The percentage of moisture content is calculated as follows:

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

2.3.2. Ash Content [14]
The material sample used to test the moisture content was weighed as much as 10 g then put in a porcelain glass. Then put in an electric furnace at a temperature of 400-600 °C. After the sample is whitish, the sample is then removed and then cooled in a desiccator and then weighed. Ash content can be calculated by the formula:

\[ \text{Ash (\%)} = \frac{\text{ash weight}}{\text{weight before furnaced (g)}} \times 100\% \]

2.3.3. Protein Content [14]
Measurement of material protein content was carried out using the kjeldahl method by working as follows, 10 g of the sample was put into a 100 ml Kjeldahl flask, then 2 g of K2SO4 was added, 20 ml of concentrated H2SO4 and boiling stone. After that, for 30 minutes, it is reconstructed until light green liquid is obtained. Distillation results were added with 10 ml of distilled water, then shake until homogeneous, after that 20 ml of solution was added with 20 ml of concentrated NaOH and pp indicator 3 drops then distilled with a 20 ml Erlenmeyer flask containing 20 ml 3% H3BO3, and metal
and red metal indicators 2 drops of blue each. After distillation with 0.1 N HCl, until the color turns into a waiting color, it's easy. Empty solutions are carried out in the same way but without using samples. The measurement of protein content was carried out using the keldel method where nitrogen levels were calculated by the formula:

\[
\text{Nitrogen (\%) = \frac{(HCL - blanko) \times NHCL \times 14.007}{mg \text{ sample}} \times 100%}
\]

2.3.4. Fat Content [14]
The method for calculating fat content is the Soxlet method. The sample was weighed as much as 1 g and then weighed in dry fat-free paper and put in the oven at 150 °C for one night. The dried samples were then weighed in a still warm condition, then put into the Soxhlet extraction device. The collecting flask is filled with chlorophrom and methanol in a ratio of 2: 1 as much as half the contents of the collecting flask. The Soxhlet extraction tool is also filled with the same solution up to half the volume. After that it was extracted for approximately 8 hours, then the samples were taken and dried in the oven for 24 hours. After drying, the sample is weighed in hot conditions. The percentage of fat content is calculated as follows:

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

3. Results and Discussions
Chemical quality shows that treatment does not have a significant difference in each treatment. This can be seen in Table 2.

| Parameters | Water (%) | Ash (%) | Protein (%) | Fat (%) |
|------------|-----------|---------|-------------|---------|
| P0         | 63.70±0.37d | 1.58±0.09a | 17.86±0.38a | 17.86±0.97a |
| P1         | 62.94±0.22cd | 1.51±0.23a | 17.72±0.39a | 17.62±0.13a |
| P2         | 62.60±0.32cd | 1.64±0.08ab | 16.69±0.89a | 17.70±0.29a |
| P3         | 62.26±1.19cd | 1.64±0.10ab | 16.99±0.51a | 17.74±0.24a |
| P4         | 61.50±0.23bc | 1.65±0.14ab | 17.55±0.75a | 17.72±0.23a |
| P5         | 58.92±0.70a  | 1.63±0.10ab | 16.84±0.19a | 17.86±0.16a |
| P6         | 59.12±0.87a  | 1.70±0.24ab | 17.23±0.15a | 17.81±0.06a |
| P7         | 60.01±0.90ab | 1.61±0.15a  | 16.95±0.34a | 17.65±0.36a |
| P8         | 61.49±1.23bc | 1.99±0.21b  | 17.92±0.74a | 17.79±0.56a |

Information: Values with different letter marks indicate a real difference (P<0.05).

The results showed the water content of intestinal nugget, which was substituted 15% (P1) and 25% (P2) of breadfruit flour, was not different from the control nugget (P0). Meanwhile nuggets with 35% (P3), 50% (P4), 65% (P5), 75% (P6), 85% (P7) and 100% (P8) breadfruit flour showed significant differences (P <0.05) lower than the control nugget (P0). This means that the use of breadfruit flour affects the water content of nuggets. In line with the research that the types of flour/filler with different concentrations affect the water content of nuggets[15][16].

Fillers for nuggets usually use flour with starch and high carbohydrate content. Starch correlates with water holding capacity. Starch itself consists of two fractions, namely amylose and amylopectin. The amylose fraction influences the ability to bind water by starch. The higher the amylose content,
the more closely the product produced. It can be said that the higher the amylose content, the lower the water content. Breadfruit flour contains amyllopectin 77.48% and amylose 22.52%, and tapioca flour contains amyllopectin 83% and amylose 17% [8]. This is the background that the greater the use of breadfruit flour, the nugget water content tends to decrease.

The results of the study (Table 3.) showed that the ash content of nugget using breadfruit flour to 85% did not show a significant difference with breadfruit nugget (P0). Whereas the use of 100% breadfruit flour was significantly different (P <0.05) higher than the control nugget (P0). Although statistically, the use of breadfruit flour to 85% was not significantly different; it can be seen in Table 3. that the greater the percentage of breadfruit flour use in nuggets, the ash content tends to increase. The ash content value in the food form is determined by the raw material as well as by additional ingredients such as fillers and spices. Breadfruit ash content was 1.9% [15], while tapioca flour was 0.3% [17].

The value of ash content correlates with the mineral content in food. Breadfruit flour contains quite complete minerals (490 mg of potassium and 17 mg of calcium). Meanwhile, tapioca flour contains 84 mg of calcium, 125 mg of phosphorus, and 1 mg of iron. Apart from flour, salt, and spices also contribute to the ash content of nuggets[18].

Table 3 shows the protein content of breadfruit flour substituted nuggets not significantly different (P <0.05) with controls. This shows that the substitution of tapioca flour with breadfruit flour does not affect the protein content of nuggets. The protein content of a product is more influenced by the amount of food source of protein used as the main raw material in the manufacture of products. In this study the main raw materials used are chicken meat and intestine, where both of these ingredients belong to protein source food with 23% protein content [1][19] The amount of chicken meat and chicken intestines from each treatment is the same so it does not bring influence to the levels of protein nuggets.

It can be said that the amount and type of meat used as raw material and additives are used to influence the protein content of the product. Fillers are included in the category of additional ingredients in making nuggets. Breadfruit flour and tapioca flour are foods that contain high carbohydrates with a protein content of only 3.6% and 1.1%, so as not to affect the resulting nugget products [20].

The results of the study (Table 3) showed that the fat content of nuggets using breadfruit flour as filler was not significantly different (p<0.05) with controls. It can be interpreted that the use of tapioca flour substituted with breadfruit flour does not give a difference in the fat content of the nuggets produced. The maximum fat content of the nugget is 20% [21].

Like other chemical quality indicators, fat nugget levels are also influenced by the value of fat content from raw materials and additional ingredients. Breadfruit flour is included in the category of additional ingredients. Breadfruit flour contains 0.4% fat, while tapioca contains 0.5% fat [22]. The filling material that is often used for nuggets is a food ingredient with carbohydrate content as a dominating chemical. While the levels of other chemicals such as fat are usually present in small quantities. So the substitution of tapioca flour with breadfruit flour with different levels does not affect the fat content of chicken nuggets produced. It should be noted that the raw material of meat used in this study is chicken meat and chicken intestine, with a fat content of each amount 11% and 5.60% [1][19]. Therefore the percentage of meat and intestine used in this study is the same so that the fat content in nuggets is also relatively different.

4. Conclusion
Based on the results of the research and discussion that have been discussed previously, it can be concluded that the substitution of tapioca flour with breadfruit flour showed a significant difference (p <0.05) to moisture and ash content but relatively similar to the levels of crude protein and fat nuggets produced. Nugget with 50% substitution of breadfruit flour and 50% tapioca flour (P4) has a moisture content of 61.5%, 1.65% ash, 17.55% protein and 17.72% fat.
5. Acknowledgment

We thank the Director of the Directorate General of Research and Development, the Ministry of Research, Technology and Higher Education for the assistance of research funding with No.056/SP2H/LT/DPRM/2018 dated January 30, 2018, the Institute of Research and Community Service Halu Oleo University who has proposed this research and the parties who have helped this research, especially S1 and S2 students who participate related to their final project.

6. Reference

[1] Baihaki, M. Ramadhan, Resta, NK Sari, IM Areopagus. 2010. Chicken Guts utilization as Bird Flu Recovery Efforts, Department of Animal Husbandry, Polytechnic Lampung. Lampung.

[2] Winarno, FG 1984. Nutrition and Food Chemistry. PT. Gramedia Pustaka Utama, Jakarta

[3] Astriani, R. P., Kusrahayudan S. Mulyani. 2013. The effect of various filler on the characteristic of beef nugget. nimal Agriculture Journal. 2(1) : 247–252.

[4] Helmi H. 2001. Kemungkinan penggunaan edible film dari pati tapioka untuk pengemas lempuk. Jurnal Ilmu-ilmu Pertanian Indonesia Volume 3. Fakultas Pertanian Universitas Bengkulu. Bengkulu.

[5] Anneke, D. Rosyidi , I. Thohari. 2014. Breadfruit (Artocarpus communis) flour as a substitution of tapioca flour on water content, water holding capacity, elasticity, and shear force of beef meatball.

[6] Widowati, S., 2009. Prosek suken (artocarpus communis) sebagai pangan sumber karbohidrat dalam mendukung diversifikasi konsumsi pangan. Pangan. 56(18) : 67-75.

[7] Agustin, S. 2011. Effects of hydrocolloids and CaCl2 Assessment Against Profile Gelatinization Raw Materials and Its Application in Breadfruit vermicelli. Graduate School. Bogor Agricultural Institute. Bogor.

[8] Hafid, H.,Nuraini, D.Agustina, Fitrianingsih, and Inderawati. 2017. Karakteristik organoleptik nugget yang disubstitusi usus ayam. Prosiding Seminar Nasional Industri Peternakan I. Hal 72-77.

[9] Hafid,H.,Nuraini, D.Agustina, Fitrianingsih, Inderawati, and Hasnudi. 2018a. pH, cooking loss, and yield of chicken nuggets with intestine substitution. International Journal of Agronomy and Tropical Plants. 1(1) : 9-13.

[10] Hafid,H.,Nuraini, D.Agustina, Fitrianingsih, and Inderawati. 2018b. Effect of chicken intestine substitution to chemical quality of nugget International Journal of Animal Production. 19(3) : 207-213.

[11] Fatmawati, W.T. 2012. Pemanfaatan tepung sukun dalam pembuatan produk cookies. Proyek Akhir. Program Studi Teknik Boga. Fakultas Teknik. Universitas Negeri Yogyakarta, Yogyakarta.

[12] Tanoto, E. 1994. Pembuatan fish nugget dari ikan tenggiri. Skripsi. Jurusan Teknologi Pangan dan Gizi. Fakultas Teknologi Pertanian. Institut Pertanian Bogor, Bogor.

[13] Steel, C.J. dan J.H. Torrie.1995. Prinsip dan Prosedur Statistika : Suatu Pendekatan Biometrik. Terjemahan B. Sumantri. PT. Gramedia: Jakarta.

[14] AOAC, 2005. Official Methods of Analysis. Association of Official Analytical Chemists. Benjamin Franklin Station, Washington.

[15] Gumilar, J., Rachmawan, O., and Nurdyanti, W. 2011. Physicochemical quality of chicken nugget using suweg (Amorphopallus campanulatus B1) Flour as Filler. Journal of Animal Science, 11 (1): 1-5.

[16] Yuanita. I. dan L. Silitonga. 2014. Sifat kimia dan palatabilitas nugget ayam menggunakan jenis dan konsentrasit bahan pengisi yang berbeda. Jurnal Ilmu Hewani Tropika Vol. 3. No. 1 Juni.

[17] Direktorat Gizi Depkes RI, 1995. Daftar Komposisi Bahan Makanan. Bharata karya Aksara: Jakarta.

[18] Suyanti, S., Widowati and Suismono. 2003. Teknologi pengolahan tepung sukun dan pemanfaatannya untuk berbagai produk makanan olahan. Jurnal Warta Penelitian
Pengembangan Pertanian, 25(2): 12-13.
[19] United States Department of Agriculture. 2011. Chicken & Turkey Nutrition Fact. Food Safety and Inspection Service.
[20] Abubakar, Suryati, dan A. Aziz. 2011. Pengaruh penambahan karagenan terhadap sifat fisik, kimia dan palatabilitas nugget daging itik lokal (Anas platyrynchos). Seminar Nasional Teknologi Peternakan dan Veteriner.
[21] BSN. 2002. Naget Ayam (Chicken Nugget). SNI 01-6683. Badan Standarisasi Nasional, Jakarta.
[22] Soemarno. 2007. Rancangan Teknologi Proses Pengolahan Tapioka dan Produk-produknya. Kanisius: Jakarta.