

Chemical and Physical Evaluation of Native Chicken Nuggets that using Several Types and the Proportion of Corn Flour

Wahidah Maruf^{1*}, DjalalRosyidi², LilikEkaRadiati² and Purwadi²

¹Faculty of Animal Husbandry, University of Sam Ratulangi, Indonesia
and Postgraduate student of Animal Husbandry Faculty, University of Brawijaya,
Indonesia

²Faculty of Animal Husbandry, University of Brawijaya, Indonesia

Abstract : This study has analyzed chemically and physically the type and proportion of corn flour used in making native chicken nuggets. The main materials used in the study were native chicken meat and various types of corn flour (yellow corn, purple corn, pulen corn, provit A1 corn and provit A2 corn). While the supporting materials used are bread flour, skim milk powder, ice cubes, cooking oil, corn oil, and spices included: salt, garlic, and pepper. Research has been carried out using the proximate analysis and a completely randomized design (CRD), where in this research consisting of 2 factors, the first factor is the type of corn flour and the second factor is the percentage of corn flour to the weight of local chicken meat that is used. The first factor is the type of corn starch that consists of 5 levels and the second factor is the percentage of corn flour to the weight of meat consisting of 4 levels. From these two factors, 20 treatment combinations were obtained, in which each treatment combination was repeated 3 times. The data collected were analyzed using analysis of variance (ANOVA). The results showed that the interaction between the type and the level of corn flour, influenced the physical-chemical condition, and the quality characteristics of native or local chicken nugget. The use of provit A1 corn flour 40 g gives the best characteristic of native chicken nugget quality, because with maximum moisture content 60,147%, protein 15,92%, starch level 11,28% which fulfill Indonesian national standard, with β - sufficient carotene with water holding capacity of 53.69% and cooking shrinkage of 1.48%. The treatment that gives the nuggets almost as good as the use of provit A2 corn for 40 g.

Keywords : *Native Chicken, Corn Flour, Nuggets.*

Introduction

Chicken meat and its products are best available sources of quality protein in human diet and offers eating satisfaction to consumers due to their desirable flavor and texture. Among the meat based comminuted products, chicken nuggets are more acceptable world wide and occupy a predominated place due to its characteristic flavour and pronounced chewy texture. Chicken nugget is a cooked and fried product suitable as a snack food as well as an adjunct to the routine meals. It is a ready to eat food with reasonably good shelf life under refrigerated and frozen storage conditions^[1].

Commercial, ready-to-fry and frozen chicken nuggets were purchased from a major local manufacturer. For chicken nuggets, surface appearance and texture are the most significant factors for acceptability, and for fried chicken nuggets, surface appearance and texture are the most significant factors for acceptability^[2].

In the now era, the model of food consuming is changing in the world; tendency to fast foods has been increased. Regarding to this fact that nuggets having suitable properties which improves consumers taste^[3]. And application of suitable fast foods are increasing due to their unique flavor^[4].

Now, nuggets are usually made from different meats (poultry, pork, fish), and cuts such as whole muscle, ground meat, chunks of white and dark meat, as well as ground meat with and without the inclusion of mechanically deboned meat and skin^[5]. Sani et al was tested to evaluate the influences of two different maize starches (native, modified with sonication) replacement in batter coating on rheological properties of batter, water absorption and solubility index of maize starch and quality parameters (color, pick up, texture, cooking yield, porosity and sensory properties) of chicken nugget during frying^[6].

Native or local chicken is a source of tasty and healthy chicken meat, where native chickens have existed in Indonesia, mainly live in rural areas in natural environments^[7]. And for this research, nuggets made from native or local chicken meat, for analyzed chemical and physical based on the types and proportion of corn flour used in making native or local chicken nugget.

Materials and Methods

Materials and tools.

This study has analyzed chemically and physically the type and proportion of corn flour used in making native chicken nugget. The analysis has been done in Agricultural Technology Laboratory, Faculty of Animal Husbandry, Bogor Agricultural University (IPB) Bogor, and Laboratory of Research Institute of Spices and Medicinal Plants, Bogor Agricultural University (IPB) Bogor.

The main materials used in the study were native chicken meat and various types of corn flour (yellow corn, purple corn, pulen corn, provit A₁ corn and provit A₂ corn). While the supporting materials used are bread flour, skim milk powder, ice cubes, cooking oil, corn oil, and spices included: salt, garlic, and pepper.

The tools used for the proximate analysis include concentrated H₂SO₄ solution, 1.25% H₂SO₄, 1.25% NaOH, 0.02 N HCl, water (H₂O), boric acid (H₃BO₃), NaOH 50%, red metal 0.2% in alcohol, 0.2% blue metal in alcohol, chloroform and ethanol (1: 2).

The equipment used for the manufacture of nuggets consists of a grinding device (food processor), scales, freezers, stoves, fryers, bowls, baking pan, wrapping plastic and other cookware. While the tools for chemical analysis consists of porcelain cup, metal plate, metal, oven, desiccator, fat extraction unit, Kjeldahl flask, erlenmeyer, measuring cup, filter paper, Soxhlet extract, pipette, electric furnace, burette and test tube.

Methods.

Research has been carried out using a completely randomized design (CRD), where in a CRD the treatments can be either crossed or nested^[8]. In this research consisting of 2 factors, the first factor is the type of corn flour and the second factor is the percentage of corn flour to the weight of local chicken meat that is used.

The first factor is the type of corn starch that consists of 5 levels:

J₁ = yellow corn J₄ = provit A₁ corn
 J₂ = pulen corn J₅ = provit A₂ corn
 J₃ = purple corn

The second factor is the percentage of corn flour to the weight of meat consisting of 4 levels

T₁ = 10% T₃ = 20%
 T₂ = 15% T₄ = 25%

From these two factors, 20 treatment combinations were obtained, in which each treatment combination was repeated 3 times.

Implementation of research

(1) Making corn flour

The five types of corn that will be used in research, first used as corn flour. The method used in the manufacture of cornmeal is the dry grinding method. The corn flour used in the study is a flour that passes a 100 mesh sieve.

(2) Nugget creation process

The nugget-making method uses the application of Tanoto^[9], using corn flour on local chicken nugget. The local chicken meat of 300 g was ground, then added flakes of ice, salt and STPP, then added sugar, pepper, garlic, skim milk, corn oil. The type of corn flour and the percentage of corn flour on the nuggets used in accordance with each treatment. All the ingredients are stirred into a homogeneous dough. The dough nuggets are formed in an aluminum baking dish and plated with plastic, then steamed. The steaming is carried out until the internal temperature of the dough reaches 60 to 70°C for about 30 minutes, after it has been steamed, the cooled nuggets dough at room temperature is then put into the refrigerator for 30 minutes. Solid dough is then cut into pieces of approximately 4 x 4 cm with a thickness of one centimeter, then dough covered with flour (batter) adhesives made from a mixture of 80 g of cornstarch and 100 ml of water, then smeared with bread and flour with eggs and smeared back with bread flour. Then the initial frying using oil submerged for 30 seconds at 170°C temperature. Nugget packed in plastic and stored in the freezer and then performed the final fryer that is fried nugget for 4 minutes at 170°C.

(3) Statistic analysis

The data collected were analyzed using analysis of variance (ANOVA). If from the analysis of variance there is a significant difference between the treatments examined, then tested further with the test of the least significant difference (LSD) at the level of 5% and 1%^[10].

Results and Discussion

The aim of this research is to get the type and proportion of corn flour on nugget that can produce local chicken nugget with good physical, chemical and organoleptic properties. The results of chemical composition analysis of various types of corn flour used in making chicken nugget, including moisture content, ash content, carbohydrate, fat content, fiber, β -carotene, P and Ca minerals, and pH, are presented in Table 1.

Table 1. Types and Chemical Composition of Corn Flour

Sample Type	Test Type	Test Result *				
		Yellow corn	Pulen corn	Purple corn	Provit A ₁ corn	Provit A ₂ corn
----- % -----						
Corn flour	Water content	14.84	15.72	15.87	10.70	10.70
	Ash :	2.40	1.37	1.78	1.98	1.42
	- Starch	51.99	55.88	56.84	58.32	54.83
	- Protein	11.88	10.13	9.95	11.87	8.48
	- Fat	6.68	4.74	3.58	6.15	5.80
	- Fiber	3.70	3.24	4.08	4.15	4.46
	- β -Karoten	0.22	0.19	0.22	0.29	0.26
	- P	0.42	0.30	0.35	0.35	0.28
	- Ca	0.03	0.023	0.03	0.02	0.01
	- pH	5.30	5.28	5.10	6.24	6.13

*) Analysis result from Laboratory of Research Institute of Spices and Medicinal Plants, IPB, Bogor (Feb-Mar 2015)

Corn is the main source of carbohydrate food, but also has a fairly important protein content. The main nutrient content of maize is starch (72-73%), with amylose and amylopectin ratio 25-30%: 70-75%, but on waxy maize 0-7%: 93-100%. Simple sugar content of maize (glucose, fructose, and sucrose) ranges from 1-3%. Corn protein (8-11%) consists of five fractions, namely: albumin, globulin, prolamin, glutelin, and nonprotein nitrogen^[11].

Data on the effect of treatment interaction on moisture content, protein content, starch content, β -carotene content, water holding capacity and shrinkage of local chicken nugget were presented in Table 2. Analysis of variance in a row showed an interaction between type and corn flour ($P < 0.01$) to water content, protein content, β -carotene level, water holding capacity and shrinkage of local chicken nugget. While other results showed no significant effect ($P > 0,05$) from treatment interaction to starch content, but separately the treatment of corn type and corn level had a very real effect ($P < 0,01$) on local chicken nugget starch content.

Table 2a. Effect of treatment interaction on water content, protein, starch, β -carotene, local chicken nugget

Interaction	Water content (%)	Protein (%)	β -Caroten (%)			
	Mean	LSD Test	Mean	LSD Test	Mean	LSD Test
1	2	3	4	5	6	7
J ₁ T1	62,60	cde	13.96	g	0.118	i
J ₁ T2	64,48	abc	13.82	g	0.127	i
J ₁ T3	61,58	efg	13.64	g	0.170	f
J ₁ T4	61,62	efg	13.50	g	0.200	d
J ₂ T1	62,81	cd	15.53	b	0.118	i
J ₂ T2	62,05	def	14.86	ef	0.143	hi
J ₂ T3	62,24	cde	14.41	f	0.177	ef
J ₂ T4	64,91	ab	13.58	g	0.203	d
J ₃ T1	66,11	a	13.80	g	0.125	i
J ₃ T2	64,09	bc	13.54	g	0.167	fg
J ₃ T3	62,11	def	13.29	g	0.192	de
J ₃ T4	65,10	ab	12.80	g	0.233	ab
J ₄ T1	60,17	g	15.92	a	0.155	gh
J ₄ T2	60,14	g	15.21	cde	0.207	cd
J ₄ T3	60,35	g	14.62	f	0.237	a
J ₄ T4	60,77	efg	14.32	f	0.250	a
J ₅ T1	61,32	efg	15.77	ab	0.142	abcdefghi
J ₅ T2	61,19	efg	14.97	de	0.197	d
J ₅ T3	61,41	defg	14.60	f	0.217	bc
J ₅ T4	61,34	defg	14.55	f	0.247	a

Table 2b. Effect of type and level of corn on local chicken nugget starch content

Type of corn treatment	Mean	LSD Test		Level of corn treatment	Mean	LSD Test
J1	12.18	a		T4	12.43	a
J2	12.03	a		T3	11.97	b
J3	11.30	b		T2	11.22	c
J5	11.29	b		T1	10.84	d
J4	11.28	b				

Note : J : Corn type (J₁=Yellow corn; J₂=Pulen corn; J₃=Purple corn; J₄= pro-A₁ corn; J₅= pro-A₂ corn);
T :Corn level (T₁=40 g; T₂=60 g; T₃=80 g; T₄=100 g)

Different superscripts in the same column show a significant difference (P<0,01; P<0,05)

The results showed that the water content of local chicken nugget was in the range of 60.14 - 66.11%, where the lowest moisture content was found in the J₄T₂ combination treatment (ieprovit A1 maize of 60 g), while the highest water content on the combination treatment of J₃T₁ (purple maize using 40 g).

Based on the smallest significant difference test, there were 10 treatment combinations containing moisture content, between 60.14 - 61.62%, ie: J₄T₂, J₄T₁, J₄T₃, J₄T₄, J₅T₂, J₅T₁, J₅T₄, J₅T₃, J₁T₃, and J₁T₄, where the water content was significantly different (P <0.01) lower than that of the combination of treatments J₃T₁, J₃T₄, J₂T₄ and J₁T₂, was also different (P <0.05) lower than the treatment of J₃T₂, the treatment did not show any significant difference (P > 0.05). Meanwhile, there are 4 (four) treatments having water content between 64.48 - 66.11 which in addition are very significantly different (P <0.01) higher than the above ten treatments, are also significantly different from the combination of treatments J₂T₂, J₃T₃, J₂T₃, J₁T₁, J₂T₁ and J₃T₂, but the four treatments were not significantly different (P > 0.05) from each other.

One of the important properties of the meat protein is its ability to bind water and fat. These functional properties, such as water binding capacity and emulsification (oil binding capacity), are essential in producing a wide range of meat-based products. Whole meat proteins, or soaked meat, or in extracted and purified forms, can form complex and stable structures. This condition allows, both from extracted extricate myofibril proteins, which can be used to form protein-based gels, as well as to partially extracted surface proteins that can be used to bind pieces together^[12].

The results showed that the protein content of chicken nugget was in the range of 12.80% - 15.92%, where the J₃T₄ treatment (purple corn with the level of 100gr usage) had the lowest protein percentage, while the highest was J₄T₁ (corn provit A1 level of use 40 g).

Based on the LSD test, there were 9 (nine) treatment combinations: J₃T₄, J₃T₃, J₁T₄, J₃T₂, J₂T₄, J₁T₃, J₃T₁, J₁T₂, and J₁T₁, respectively, with protein content ranging from 12.80 to 13.96 , where the results were significantly different (P > 0.01) lower than the other 10 treatment combinations, but the tenth interactions of the treatment were not significantly different (P > 0.05) from each other. The experimental results also showed that there were 2 (two) treatment combinations with protein content of 15.92 and 15.77, respectively: J₄T₁ and J₅T₁, where these results were significantly different (P <0.01) higher than 18 combination of other treatments, but between these two treatments are not different from each other (P > 0.05). Referring to the National Standard of chicken nuggets 6683^[13], protein content of at least 12%, while the results showed the protein content in the range of 12.80% - 15.92%. This means that the chicken nugget resulted from all treatments (20 treatment combinations) in this study met the recommendation of the Indonesian National Standard Agency (INSA-BSNI), where from all treatments, the treatment using provit maize A1 (J4) and provit A2 (J5) at the 40 g usage level provides the highest and best protein yield, which can be a protein source of processed chicken meat using maize.

Starch flour is included in the category of non-meat ingredients (non-meat ingredient), but is an important component needed as a filler in making chicken nuggets. Starch in starch, in addition to its functional capacity as a filler, its use is also in chicken nugget because it has the properties and ability to absorb water in large quantities^[14]. In fact, starch can bind water and fat by means of physical traps and is usually also considered a binder.

As mentioned above, based on the analysis of diversity, the combination of type and maize treatment showed no significant treatment interaction ($P > 0,05$) to the starch content in local chicken nugget. However, separately, both the treatment of corn types, and the level of use of maize showed a very real influence ($P < 0,01$) on the starch content in local chicken nugget.

In the treatment of corn type (J) the starch content was in the range of 11.28 - 12.18%, where the J_4 treatment (corn provit A1) had the lowest starch content, and the highest in the J_1 treatment (yellow corn). Meanwhile, from corn treatment (T), starch content was in the range of 10.84 - 12.43%, where the T_1 treatment (the 40 g usage level) had the lowest percentage of starch, while the highest was in T_4 treatment (100 g).

Based on the LSD test, the treatment of corn type J_1 (yellow corn) and J_2 (corn pulen) contained starch content of 12.18 and 12.03%, which was significantly different than J_3 (purple corn), J_4 (corn pro A1) and J_5 (corn pro A2), which only have starch content of 11.30, 11.29, and 11.28%, respectively. Between treatments J_1 and J_2 were not significantly different ($P > 0,05$), thus the treatment of J_3 , J_4 and J_5 was also not significantly different ($P > 0,05$) from each other. Meanwhile, in the treatment of corn, the LSD test showed that all treatment levels differed significantly ($P < 0,01$) from each other, where the T_4 treatment (100 g) had the highest levels of 12.43%, followed by T_3 (80 g) starch content 11.97%, T_2 (60 g) starch content 11.22%, and T_1 (40 g) starch content 10.84%. National standard carbohydrate content of chicken nugget maximum 20%^[13]. If it refers to the content of starch in corn carbohydrate an average of 72%^[15], means the content of chicken nugget starch refers to the national standard carbohydrate then the average starch content is 14.4%. This means that the starch content of all experiments using the type and the level of maize meets the minimum standards as recommended by BSN^[13].

The β -carotene is a safe source of vitamin A and that the provitaminA function of β -carotene contributes to the intake of vitamin A. Essential to human needs. Vitamin A is essential for many functions in the human body; in particular, essential for normal growth and development, immune function, and vision^[16].

The β -carotene content of chicken nugget in this study was in the range of 0.118% - 0.250%, where the J_1T_1 treatment (yellow maize on 40 g) had the lowest percentage of β -carotene, while the highest was in J_4T_4 treatment (provit maize A1 level of use 100 g).

Based on the LSD test, there are 6 (six) treatment combinations that produce nugget with β -carotene content between 0.118 - 0.143%, namely: J_1T_1 , J_2T_1 , J_3T_1 , J_1T_2 , J_5T_1 and J_2T_2 , where the β -carotene levels are very significant ($P > 0,01$) was lower than the other 14 treatment combinations, but the interaction between the treatments was not significantly different ($P > 0,05$) from each other. In contrast, there are 4 (four) treatment combinations: J_4T_4 , J_5T_4 , J_4T_3 and J_3T_4 , which have β -carotene levels ranging from 0.233 to 0.250%, where these results differ significantly ($P < 0,01$) higher than 16 combinations. Other treatments, between these four treatments are not different from one another ($P > 0,05$). Meanwhile, there were 10 treatment interactions with β -carotene levels ranging from 0.155 to 0.217%, ie: J_4T_1 , J_3T_2 , J_1T_3 , J_2T_3 , J_3T_3 , J_5T_2 , J_1T_4 , J_2T_4 , J_4T_2 , and J_5T_3 . The ten treatments, significantly different ($P < 0,01$) were lower than the four treatment combinations with the highest results (J_4T_4 , J_5T_4 , J_4T_3 and J_3T_4), but still significantly higher ($P < 0,01$) than the six treatment combinations with the lowest results (J_1T_1 , J_2T_1 , J_3T_1 , J_1T_2 , J_5T_1 and J_2T_2).

The results showed that β -carotene content in chicken nugget increased with the increasing of corn usage level (from 40 g - 100 g). If judging from the factors of treatment of corn types, provit A1 (J_4) and provit A2 (J_5) gives the highest average yield on β -carotene level of chicken nugget. The results of this study also indicate that chicken nugget using corn type provitA and B are better than other corn type treatment in terms of β -carotene content, which is useful as precursor of vitamin A for consumer needs.

Conclusions

The results showed that the interaction between the type and the level of corn flour, influenced the physical-chemical condition, and the quality characteristics of local chicken nuggets. The use of provit A1 corn flour 40 g gives the best characteristic of local chicken nugget quality, because with maximum moisture content 60,147%, protein 15,92%, starch level 11,28% which fulfill national standard, with β - sufficient carotene with water holding capacity of 53.69% and cooking shrinkage of 1.48%. The treatment that gives the nuggets almost as good as the J_5T_1 is the use of provit A2 cornfor 40 g.

References

1. Reddy, V. B. G. Development Of Spent Chicken Meat Nuggets With Different Extenders. Thesis. Department Of Livestock Products Technology College Of Veterinary Science Sri Venkateswara Veterinary University, Tirupati.2008.
2. Yunsheng Li. Quality Changes In Chicken Nuggets Fried In Oils With Different Degrees Of Hydrogenation. Thesis.Department of Bioresource Engineering Macdonald Campus, McGill University Montreal, Quebec, Canada.2005.
3. Soreshjani, B. H., M. Hojjatoleslami, H. Molavi, S. H. Dastgerdi, M. A. Shariaty. Producing Low Fat Chicken Nugget Through Coating by Gellan Gum. International Journal of Farming and Allied Sciences,2017, 2(20), 785-789.
4. Pedreschi, F. and Moyano, P. Oil uptake and texture development in fried potato slices. J. Food Engineering,2005, 70(4), 557-563.
5. Barbut, S. Producing battered and breaded meat products. Meat Processing Technology Series.American Meat Association, Champain, IL.2012.
6. Sani, S. Y., S. A. Mortazavi, Z. Sheikholeslami, M. Karimi, and A. H. Elhamirad. A comparison of the effect of native and sonicated Maize starch on batter rheology and nugget quality. International Journal of Advanced Life Sciences, 2017,10(4), 448-459.
7. Yuwanta,T. and N. Fujihara. Indonesian native chickens: Production and reproduction potentials and future development. British Poultry Science, 2010,41:25, Issue sup001.
8. Casella, G. Statistical Design. Springer-Verlag New York.2008.
9. Tanoto, E. Making Fish Nugget from Mackerel Fish. Faculty of Agricultural Technology.University of Agricultural (IPB), Bogor.1994.
10. Snedecor, G. W. and Cochran, W. H. Statistical methods. 13th ed. Oxford and IBH Publishing Co.1980.
11. Suarni and S. Widowati. Structure, Composition, and Nutrition of Corn. In: Corn: Production and Development Technique. Cereals Plant Research Institute, Agricultural Research and Development, Bogor, Indonesia.2016.
12. Fletcher, D.L. Poultry meat quality. World's Poultry Science Journal, 2002, 58(2), 131-145.
13. Indonesian National Standard Agency (INSA-BSNI).NagetAyam (Chicken Nugget). BSNI, Jakarta.2014.
14. Heinz, G. and P. Hautzinger. Meat Processing Technology - For Small to Medium Scale Producers. Food And Agriculture Organization of The United Nations Regional Office For Asia And The Pacific, Bangkok. 2007.
15. Suarni and M. Yasin.Corn as a Functional Food Source. Food Crop Science, 2011, 6(1), 41-56.
16. Grune, T., Lietz, G., Palou, A., Catharine Ross, A., Stahl, W., Tang, G., Thurnham, D., Shi-an Yin and H.K. Biesalski. β -Carotene is an important vitamin A source for humans. J. Nutr.,2016, 140, 2268S–2285S.
