PHYSICAL-CHEMICAL PROPERTIES OF REJECTED DUCK NUGGETS GIVEN PROVIT A1 COMMEAL AS A FILLER

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Abstract

This study aims to determine the physical and chemical properties of rejected duck meat nuggets given provit A1 corn flour as a filler. This study used a completely randomized design (CRD) with 4 treatments and 5 replications (addition of provit A1 corn flour consisting of: 10% (J10), 20% (J20), 30% (J30) and 40% (J40). The results of the analysis of variances showed that the addition of provit A1 corn flour to the level of 40% had a very significant difference in the physical and chemical properties of rejected duck nuggets. The water content values ranged from 61.18 - 66.39%, protein 14, 38 - 16, 39%, starch 11.28 – 12.18%, water holding capacity 49.72 – 55.32 %, cooking shrinkage 1.26 – 4.73%.

The conclusion of this study is that the addition of provit A1 corn flour to a level of 40% has an effect on the quality of physical and chemical properties of rejected duck meat nuggets.

Key words*: nuggets, duck rejected, Provit A1, cornmeal*

INTRODUCTION

The rejected duck meat has the advantage of high protein content and low calorie content. However, it has weaknesses such as a fishy smell, tough and higher fat content. According to Oteku et al. (2006) obstacles faced in the development of duck meat, namely clay texture, has a higher fat content than broiler, unsaturated fatty acid (ALT) content of about 60% of the total fatty acid (AL), and red meat fibres because it contains heminic pigments (haemoglobin and myoglobin) are high enough to cause oxidation of meat which affects the composition of fatty acids, prooxidants, and oxygen in meat and food processing.

Corn is one type of food ingredient that contains a carbohydrate source that can be used to replace (substitute) rice, because corn has almost the same calories as the calories contained in rice. The protein and carbohydrate content is almost close to the protein and carbohydrate content in rice. According to Suarni and Widowati (2005), the main component of corn is starch, which is about 70% of the grain weight. Other carbohydrate components are simple sugars, namely glucose, sucrose, and fructose, 1-3% of the seed weight. Starch consists of two types of glucose polymers, namely amylose and amylopectin. The composition of amylose and amylopectin in corn kernels is genetically controlled.

Processing of livestock commodities produces various added values. Some of these added values include making them durable, more attractive to consumers because of their innovative appearance, easier to present and higher economic value (Ginting, 2006). According to Usmiati et al., 2012 (in Setyaningrum and Sukesi, 2013), one of the most popular processed meats is nuggets. Nuggets are processed meat products that use meat restructuring technology which requires fillers and binders as well as spices to make them.

One of the fillers that can be used is corn flour. Corn flakes do not contain gluten so they are suitable for processed products that do not require development (Richana, Budiyanto and Mulyawati, 2010). According to Suarni (2009), corn contains higher dietary fibre than wheat (dietary fibre) which is good for health. Corn starch granule size which is

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quite large and not homogeneous makes corn more resistant to heat and water treatment. Corn flour also has the advantage that it contains beta-carotene which is good for health. Yellow corn is rich in beta-carotene (pro-vitamin A), essential fatty acids, purple corn contains anthocyanin and isoflavones, while red corn is rich in iron which wheat does not have (Agroinovasi, 2012).

Without realizing it, the wrong diet and lifestyle, pollution and exposure to ultraviolet rays have increased the number of free radicals in the body. Increased free radicals are harmful to the body because they can cause cancer and tumours (Hongmin, Xiaoding and Daifu, 1996), so the body needs antioxidants to reduce free radicals. One of the antioxidants that can reduce free radicals is beta-carotene. Beta-carotene compounds in addition to having vitamin A activity, can also slow down aging, increase immunity, anticipate cancer, heart disease, stroke, cataracts, sunburn and muscle disorders (Mayne, 1996).

Making nuggets requires several cooking processes such as steaming and frying. Steaming will cause the release of liquid meat, especially in meat that contains little fat. In the cooking process must pay attention to the right temperature and processing time. Adverse effects of excessive processing temperature and time are related to denaturation of soluble proteins decreased emulsion viscosity and melting of fat particles (Ginting, 2006). The manufacture of nuggets requires a filler that is able to bind water but has a small effect on emulsification (Gumilar et al., 2011). The research that has been carried out shows that the interaction between the type and level of use of corn flour affects the nature and water holding capacity as well as the organoleptic quality characteristics of native chicken nuggets (Ma'ruf et al., 2018). Furthermore, research has been carried out using provit A1 corn flour at a level of 40 grams which provides the best quality characteristics of free-range chicken nuggets and gives a satisfying sensation in organoleptic tests (Ma'ruf et al., 2019).

Corn flour provit A1 in this study was used as a filler in the manufacture of rejected duck nuggets to see the physicochemical characteristics at the level of 10%, 20%, 30% and 40%.

RESEARCH METHODOLOGY

1. Method

The method used was a completely randomized design (CRD) with four treatments and five replications. The treatments in this study were corn levels of Provit A1: 10%, 20%, 30% and 40%. The research design used was a completely randomized design (CRD) with 4 treatments and 5 replications. The measurement variables are: Physical Properties (water binding capacity and cooking loss) and Chemical (moisture, p rotein and starch content).

2. Research procedure

The method used in the manufacture of corn flour is the dry milling method. The provit A1 corn flour used in this study was flour that passed a 100 mesh sieve.

The method of making nuggets uses the application of Tanoto (1994), using corn flour on rejected duck meat nuggets. 400 grams of rejected duck meat was ground, then crushed ice and salt were added, then sugar, pepper, garlic, and skim milk were added. Corn flour provit A1 in the nuggets used according to each treatment. All ingredients are stirred so that it becomes a homogeneous mixture. The nugget dough is moulded in an aluminium pan and covered with plastic, then steamed. Steaming is carried out until the internal temperature of the dough reaches 60 to 70˚C for approximately 30 minutes. After steaming, the nugget dough that has been cooled at room temperature is then put in the refrigerator for 30 minutes. The solid dough is then cut into pieces with a size of approximately 4 x 4 cm with a thickness of one cm, then the dough is coated with a flour adhesive (batter) made from a mixture of 80 g of corn-starch and 100 ml of water, then covered with breadcrumbs and smeared with egg and dusted again with breadcrumbs. Initial frying was carried out using oil submerged for 30 seconds at 170˚C. The nuggets are packed in plastic and stored in the freezer and then the final frying is done, namely the nuggets are fried for 4 minutes at a temperature of 170˚C.

RESULTS AND DISCUSSIONS

1. Water holding capacity of rejected duck nuggets

The data and research results in Table 1. Show that provit A1 J30 maize flour has the lowest water holding capacity of 50.75% while provit A1 J40 maize flour has the highest binding capacity of 53.23%.

Water holding capacity is the ability of meat to retain water when a force (heat, pressure) is applied.

Water is the main component (about 75%) of muscle tissue. Most of it exists in layers around polar molecules and between layers of cellular material. The majority reside in the intermolecular spaces between the salt-soluble proteins (actin, myosin) of muscle tissue, both within myofibrils, between myofibrils and between myofibrils and the cell membrane (sarcolemma), as well as between muscle cells and between muscle bundles (groups of muscle cells). After muscle is harvested the amount of water and the location of water in the meat can change depending on various factors related to the tissue itself and how the product is processed (Honicel, 2004; Brewer, 2010).

Based on the BNJ test (Table 1), it showed that the water holding capacity of provit A1 (J40) corn was significantly different ($P<0.05$) higher than that of provit A1 J10, J20 and J30 corn flour. Provit A1 J10 corn flour was not significantly different ($P>0.05$) from provit A1 J20 and J30 corn flour. Maliluan et al. (2013) reported that in making chicken nuggets using filler substitution between wheat flour and flour as much as 10%, the percentage of water holding capacity was in the range of 30.59-38.89%. The results of this study were lower than the results of this study, where from the use of provit A1 corn flour in the proportions of 10%, 20%, 30% and 40%, the water holding capacity was between 50.75–53.23%. This condition is made possible by the presence of water-soluble fibre components in corn flour, especially -glucan which has an effect on higher water holding capacity. The higher the -glucan content in flour, the higher the water holding capacity of the flour (Berggren, 2017).

Table 1. Average value of physical and chemical properties of rejected duck nuggets given corn flour Provit A1

Observation Variable (%)	Treatments			
	J10 (10 %)	J20 (20 %)	J30 (30 %)	J40 (40 %)
Water Holding Capacity	51.23[a]	52.27[a]	50.75[a]	53.23[b]
Cooking Loss	1.30[a]	1.43[b]	4.26[c]	3.03[b]
Water Content	66.38[a]	65.40[a]	65.39[b]	61.18[c]
Protein	14.38[a]	15.44[b]	15.72[c]	16.93[a]
Pati	12.51[b]	12.40[b]	11.67[a]	11.65[a]

Note: Different notations show significant differences ($P<0.01$) on each treatment

In this study, water binding took place through the gelatinization process of corn starch granules, where in the presence of water and heating the process of breaking down the intermolecular bonds of starch molecules, allowing hydrogen (H), hydroxyl (OH) and oxygen (O) bonding sites to involve more water. The process that occurs in starch granules: swelling of the granules, crystal or double helix structure melts, and amylose leaches occur (Erickson, 2006). At a certain temperature range the crystalline region does not allow water to enter. The heat causes the area to diffuse, the amylose chain dissolves, decomposes into amorphous form and the number and size of the crystalline regions decreases, so that the water penetration increases randomly in the starch granules, and causes swelling, finally the solution of the amylose molecular structure seeps into the surrounding water and structure.

According to Fennema (1996), the gelatinization temperature is the temperature at which the birefringence properties and X-ray diffraction patterns of starch granules begin to disappear. The gelatinization temperature begins with the irreversible swelling of the starch granules in hot water and ends just as the starch granules have lost their crystalline properties. Winarno (2004)

stated that the temperature at which the birefringence of starch granules begins to disappear is calculated as the initial temperature of gelatinization. The gelatinization temperature of corn starch is in the range of 61 -72°C (Fennema, 1996).

2. Cooking loss of rejected duck nuggets

The data and research results in Table 1. Show that the provision of Provit A1 (J10) corn flour had the lowest cooking loss proportion of 1.30% while Provit A1 (J30) corn flour had the highest cooking loss proportion of 1.43%. High cooking losses will cause the nutritional content contained in the nuggets to decrease so that with higher cooking losses, the quality of the nuggets will decrease. Soeparno (2005) meat with lower cooking loss has relatively better quality than meat with higher cooking loss because there will be less loss of nutrients during cooking. The treatment using corn flour as a filler for rejected duck nuggets, was found to have an effect on lower cooking losses, and had a positive effect on the water holding capacity of the product. Cooking shrinkage is identical to emulsion stability. This is an important parameter for assessing the quality of meat products.

3. Water content of rejected duck nugget

The data and research results in Table 1 show that provit A1 maize has the lowest water content range at J40, 61.18%, while the highest moisture content is in provit A1 maize (J10) 66.38%. Tests on the water content of rejected duck nuggets given provit A1 corn flour as a test material gave significantly different results. Further tests with BNJ gave significantly different results, J10 was higher than J20, J30 and J40. Provit A1 corn flour given 20% (J20) was significantly higher than J30 and J40. Provision of 30% provit A1 corn flour (J30) was higher than J40.

The higher the level of addition of provit A1 corn flour, the lower the value of the water content of the nugget.

The results of the analysis of variance showed that there was a very significant effect ($P \leq 0.01$) on the provit A1 corn flour treatment on the water content of rejected duck nuggets. The difference in water content was due to the difference in the amount of Provit A1 corn flour given to the nugget dough. The water content in the nuggets correlated with the protein content. Meat protein plays a role in the binding of meat water. High protein content causes an increase in the water holding capacity of meat, thereby reducing the free water content and vice versa (Kartikasari, 2009). Likewise, the amount of water content in flour is related to the durability of flour during storage. If the water content is too high, the flour cannot be stored for a long time, is easily damaged and undergoes hydroxic acid so that the quality decreases (Masudi, 2009). This difference is continued with the Honest Significant Difference Test (BNJ) which can be seen from different notations.

Based on the results of the BNJ test showed that the water content in J10 (66.38%) was significantly different ($P<0.05$) higher than that of provit A1 J30 and J40 (65.40 and 61.19%) and not significantly different ($P>0.05$) from corn provit A2 J20.

According to the research data in Table 1, the moisture content of provit A1 corn flour is between 61.19–66.38%, this indicates that the rejected duck nuggets product using provit A1 corn is almost the same as the study by Suratkar et al., (2013) which used lean broiler meat with an average moisture content, 59.34. However, it is lower than the research reported by Sharma et al., (2018), that in making nuggets using lean chicken meat, it turns out to produce chicken nuggets with an average water content of 63.80%. According to Welyanila and Aisman (2013) corn flour is very good for emulsion products because it is able to withstand the water binding power of the product during cooking. The lower the water content, the more durable the food will be.

4. Protein nugget levels of rejected duck

The data and research results in Table 1. Show that Provit A1 (J10) corn flour has the lowest protein content of 14.38%, while Provit A1 (J40) corn flour has the highest protein content of 16.39%. The protein content in the dough will affect the ability to absorb water, so the resulting nuggets are not

hard. The more flour that is added to the dough, the less protein proportion will be so that the tenderness will decrease. Increasing the amount of flour added will increase the amylose content, high amylose content will cause the nugget tenderness to decrease (Richana and Chandra, 2004).

The results of the BNJ test showed that the protein content of provit A1 corn flour was significantly different ($P<0.05$), the provision of provit A1 corn flour (J10) was significantly different from J20 and J40 but not significantly different from J30. Corn flour Provit A1 J20 is different from J30 and J40. Corn flour Provit A1 J30 is different from J40.

The range of protein content in rejected duck nuggets from all treatments resulted from this study, was almost the same as the results of research by Lukman et al., (2009) who reported their research on 5 types of commercial chicken nuggets, which ranged from 12.52 to 15.18%.

Referring to the national standard of chicken nuggets 6683 (BSNI, 2014), the protein content is at least 12%, while the results of the study show that the protein content is in the range of 14.38-16.39%. This means that the duck nuggets rejected from all treatments in this study fully met the recommendations of the Indonesian National Standards Agency, from all treatments. The treatment using provit A1 (J40) corn gave the highest and best protein content, which can be a source of protein nutrition from processed duck meat using corn.

One of the important properties of meat protein is its ability to bind water and fat. These functional properties, such as water binding capacity and emulsification are very important in producing a wide variety of meat-based products. Whole meat proteins, or marinated meats, or in extracted and purified forms, can form complex and stable structures.

These bias conditions allow, both from extreme extracted myofibril proteins, which can be used to form protein-based gels, and to partially extracted surface proteins that can be used to bond pieces of meat together (Fletcher, 2004).

Tamberg (2005) in his research explained that the protein content of oyster mushroom chicken nuggets ranged from 9.56-11.916% and chicken nuggets as a control had a protein content of 14.101%. The results of the nuggets contain protein in accordance with SNI, both chicken nuggets and oyster mushroom chicken nuggets.

Differences in protein levels in nuggets can be influenced by several factors, including various chemical raw materials, additional materials used during processing, processing processes that affect process stability, length of time and temperature used for frying foodstuffs.

5. Starch content of rejected duck nuggets

The data and research results in Table 1 show that the provit corn type A1 J (40) has the lowest starch content of 11.65% while J (10) has the highest starch content of 12.51%.

Treatment of corn species showed a significantly different effect ($P<0.05$) on starch content in native chicken nuggets. Corn flour starch is included in the category of non-meat ingredients. However, it is an important component needed as a filler in making chicken nuggets. Heinz and Hautzinger (2007) stated that starch in flour, in addition to its functional capacity as a filler, is also used in large quantities. Even starch can bind water and fat by means of physical traps and can also be considered a binder.

Corn starch content of provit A1 ranged from 11.65%-12.51%. According to Sumarni (2005), the lower the amylose content, the weaker the gel structure formed. Meanwhile, the higher the amylopectin content, the softer, fluffier texture and the better the taste of corn. Based on the National Standard, the maximum carbohydrate content of chicken nuggets is 20% (BSNI, 2014). If we refer to the starch content in corn carbohydrates on average 72% (Suarni and Yasin, 2011), meaning that the starch content of native chicken nuggets refers to the national standard of carbohydrates, the average starch content is 14.4%. This means that the starch content of all experiments using the type and proportion of corn meets the minimum

standard according to the BSNI recommendation (2014). Polizer et al., (2015) reported that the carbohydrate content of chicken nuggets in their research ranged from 19.16 to 21.84%, this figure when converted by multiplying 72% (Suarni and Yasin, 2011) obtained starch content of between 13 ,80-15.72%. This means that the starch content obtained in the study is quite sufficient.

Under natural conditions, the starch component consists of small granules called granules. The molecules in starch granules have a linear structure or straight bonds, such as amylose, and branched bonds, such as amylopectin, which form thin ring-shaped layers or lamellae, where the lamellae are arranged centrally around a starting point called the hilum or hilum. Starch granules from the *Ginae* plant group, such as rice, corn, and wheat have a hilum located in the middle, while starch granules in potato and sago tubers have a hilum located at the edge. Normal corn starch and waxy corn starch (waxy/glutinous corn) have diameters ranging from 2–30 m (Hoseney, 1998). Corn starch, is stable in dry storage, even for an indefinite period. Although starch granules are physically durable, in fact they can be easily damaged.

If starch granules in suspension of water are heated gradually, they begin to absorb water. The granules hydrate, increase in size and eventually lose their structural integrity. This condition, causes loss of the characteristics of birefringence and opacity (level of transparency), increased viscosity, and finally the formation of a paste or gel. This process is referred to as flour paste or gelatinization (Corn Refiners Association, 2006).

Gelatinization is an endothermic physical transition process that destroys the molecular order of the granules and involves swelling of the granules, melting of crystals, loss of birefringence and dissolution of starch (Shamekh, 2002). Jenkins and Donald (1998) suggested that, during the heating process, water is first absorbed in the amorphous region which is the bonding area of the strong double helical structure of amylopectin.

Starch granules in raw corn, steamed nuggets and fried nuggets were distributed unevenly, with varying granule sizes. Raw corn has an irregular starch granule shape with several sides (polyhedral) with relatively sharp edges (Jane, 1994).

CONCLUSIONS

The conclusion of this study is that the addition of provit A1 corn flour to a level of 40% has an effect on the quality of physical and chemical properties of rejected duck meat nuggets.

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