

Physical and chemical characteristics of Chitofudregs nugget in comparison to commercial nugget

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ABSTRACT

The study aims to compare the physical characteristics (water holding capacity and cooking loss) and chemical characteristics (moisture, protein, fat, ash, carbohydrate content, and total calories) of Chitofudregs nugget with commercial nuggets. Four categories of nuggets which are Fiesta, So Good, Nugget Curah, and Chitofudregs nugget (FT, SG, NC, and Chitofudregs) were determined as treatments in this study with 5 repetitions for each category. The experimental method of this research was a randomized design complete (RDC). Physically, Chitofudregs had the highest water-holding capacity and the lowest cooking loss among all commercial nuggets ($p < 0.05$) so there were not many nutrient losses during the processing. Chemically, Chitofudregs contained higher water content than one of the commercial-NC nuggets while the protein and ash content was lower than the two types of commercial nuggets (FT and SG) with carbohydrate content which was also lower than the NC commercial nuggets ($p < 0.05$). The fat content and total calories of chitofudreg were the lowest among all commercial nuggets ($p < 0.05$). Chitofudregs are combination nuggets whose physical quality is as good as commercial nuggets with specific chemical characteristics and has potency as a diet product because it is low in fat and calories.

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1. INTRODUCTION

Nugget is a favorite food of many people today because of its delicious taste and relatively easy processing. The busyness of the community in their activities often makes them not have time to make various processed foods, so they prefer food products that do not take long to process, one of which is nuggets. Based on data from the Livestock and Animal Health Statistics, in 2015 the consumption of nuggets increased by 0.261 kg and in 2017 to 0.521 kg [1]. Chicken nuggets are generally a source of highly nutritious protein with a fairly balanced macronutrient composition. One variation of the nugget is a nugget from free-range or non-race chicken meat. When compared to a nugget in general, free-range chicken nugget is lower in fat but still high in protein [2]. When viewed in terms of taste and texture, free-range chicken nuggets are more savory and denser. However, from an economic point of view, free-range chicken nugget is more expensive due to the high price of free-range chicken carcasses on the market. Efforts to substitute free-range chicken meat with other ingredients to reduce the production cost of nuggets without reducing its nutritional status are feasible, one of which is tofu dregs. Substitution of broiler chicken meat with tofu dregs

of as much as 30% in the process of making nuggets can produce a product with fairly good quality in terms of sensory aspects [3].

Tofu dregs are a by-product of tofu processing in the form of fine grains and have a low shelf life due to protein degradation [4]. Processing of tofu dregs in Indonesia is still very limited because so far it has only been used as animal feed and processed into tempe gembus. Tofu pulp is high in carbohydrates, protein, and low in fat. The nutritional value of tofu pulp was found to be 8.66% protein, 3.79% fat, 51.63% water, and 1.21% ash [5]. One kg of soybeans produces 2 kg to 2.2 kg of tofu waste, which also produces a global warming impact with a value of 0.978 kg CO₂-eq [6]. A tofu processing factory can produce 100 kg of soybeans per day, so there are 200 kg of tofu waste per day [7]. Based on the literature in the previous study, utilizing tofu waste will be beneficial for many sectors and help in reducing the global warming impact caused by tofu waste.

In this study, tofu dregs were used as a substitute for native chicken meat which was processed into nugget products. Based on preliminary research by [8], the proportion of tofu dregs: free-range chicken meat (1:1) can produce a nugget that is liked (score 3.6 out of 4 which means like) by the panelists based on the hedonic test. The nugget with the main components of free-range chicken meat and tofu dregs was then given the name Chitofudregs which stands for the combination of the words chicken (chicken) with tofu dregs (tofu pulp). Quality studies on Chitofudreg need to be carried out considering that the nugget is a food innovation resulting from the use of tofu dregs. This qualitative study is expected to strengthen its potential as a commercial product in the future. Apart from the preferred aspect, product quality can also be viewed from the physical and chemical aspects. This study aims to compare the physical characteristics (water holding capacity and cooking loss) and chemical characteristics (moisture content, protein, fat, ash, carbohydrates, and calories) of Chitofudregs and commercial eggs, namely, Fiesta (FT), So Good (SG), Nugget Curah (NC). Information from this study is expected to increase the use value of tofu dregs as a nutritious and economical food commodity through its processing as a nugget.

2. RESEARCH METHOD

2.1. Research design

Samples were prepared in a completely randomized design which was carried out in stages including i) preparation of Chitofudreg nugget (village chicken substituted with tofu dregs 50%), ii) comparative analysis of physical parameters of Chitofudreg nugget and commercial nugget, iii) comparative analysis of chemical parameters of Chitofudreg nugget and commercial nugget. The treatments observed were Chitofudregs and commercial nuggets (Fiesta (FT), So Good (SG), and Nugget Curah (NC)).

This research was carried out at the Food Chemistry and Nutrition Laboratory, Faculty of Animal Husbandry and Agriculture, Universitas Diponegoro in Juli-Agustus 2020. The main ingredients in this study were boneless chicken meat commercial (125 g) ordered from a chicken slaughterhouse and tofu dregs (125 g) obtained from tofu Enterprises, Small and Medium (UKM) Sumber Makmur Sumurrejo, Gunung Pati, Semarang.

2.2. Research procedure

2.2.1. Production of Chitofudregs nugget

The making of nugget begins with refining 125 g of free-range chicken meat by chopping and blending, then weighing other ingredients such as 125 g of tofu dregs, 15 g of tapioca flour, 15 g of skim milk, 5 g of mashed garlic, 3.75 g of salt, 2.5 g sugar, 0.8 g pepper, and 1 g flavoring. The main ingredients are free-range chicken meat and tofu dregs (1:1) mixed evenly with tapioca flour, skim milk, garlic, salt, sugar, pepper, and flavoring. The nugget dough that has been mixed well is poured into a baking sheet that has been previously greased with oil and then steamed for 15 minutes. The cooked nugget is removed from the pan and then cut into rectangles (4x2 cm). The cut nugget is dipped in batter (a mixture of water, flour, and egg yolk) after which it is sprinkled with breadcrumbs. Chitofudreg nugget samples were stored in the freezer for 2 to 4 days for further evaluation.

2.2.2. Analysis of physical parameters of Chitofudregs nugget and commercial nugget

Testing the physical characteristics of the Chitofudreg nugget and the three types of commercial chicken nuggets included water holding capacity and cooking loss using [9]. Testing of water holding capacity is done by pressing method. The cooking loss test was measured by weighing the weight of raw chicken and cooked chicken after being drained at room temperature for 15 minutes.

2.2.3. Analysis of chemical parameters of Chitofudregs nugget and commercial nuggets

The chemical characteristics of the nugget were tested proximately. The water content test was carried out by weighing the nugget before and after the oven process [10]. Testing of protein content refers to [11] using the Kjeldahl method. Testing of fat content using the Soxhlet method. The ash content test was carried out by following the AOAC method [12]. Carbohydrate levels were tested referring to [13] with the by difference method. Calorie calculation using the Atwater method refers to [14] which converts energy values based on fat, protein, and carbohydrate content.

2.3. Data analysis

The experimental method of this research was a randomized design complete (CRD) with a single factor of four treatments and five replications. The data were analyzed using the parametric analysis of variance (ANOVA) test. If there is a significant effect of the treatment, it is continued with Duncan's Multiple Region Test to find out if there is a significant difference. Parametric testing was carried out using SPSS 23.0 with a 95% significance level.

3. RESULTS AND DISCUSSION

3.1. Nugget's physical characteristics

The physical properties of a nugget are required to establish its quality, and they can impact its water-holding capacity and cooking loss, both of which are critical aspects of a nugget. Physical characteristics of Chitofudregs Nugget were water holding capacity and cooking loss as described in Table 1.

Table 1. Comparison of physical characteristics of chitofudreg nugget with commercial nugget

Physical Parameters	Category of Nugget			
	Chitofudreg	FT	SG	NC
Water holding capacity (%)	22.14±3.04 ^a	16.87±2.23 ^b	12.37±1.75 ^c	7.32±0.84 ^d
Cooking loss (%)	1.37±0.19 ^c	2.04±0.29 ^b	2.13±0.31 ^b	3.38±0.34 ^a

Data were expressed as mean ± SD. Different letter superscripts indicate significant differences between nugget categories (p<0.05).

This study tries to use tofu dregs to substitute free-range chicken meat into nugget products, hereinafter referred to as Chitofudregs, shown in Figure 1, an abbreviation of chicken tofu dreg which means tofu dregs chicken nugget. Agani stated that Chitofudregs were quite accepted and favored by panelists with a fairly affordable selling price of around Rp. 17,000.00 per pack of 250 g, while other commercial nuggets are in the range of Rp. 20,000.00 to Rp. 25,000.00 for the same packaging weight [8]. Evaluation of the physical characteristics of Chitofudregs (water holding capacity and cooking shrinkage) are then carried out in this study to find out more about the quality.

The physical characteristics of a food product are an indicator of intrinsic quality. These qualities cannot be replaced or manipulated without experiments aimed at changing their physical properties. The physical quality of the nugget in this study, especially for water holding capacity and cooking loss, was significantly affected by the nugget category shown in Table 1. This shows that the physical quality of the nugget is largely determined by the producer related to the composition or type of raw material used to make the nugget product. The highest water-binding with the lowest cooking loss was shown by the Chitofudregs nugget (p<0.05). Chitofudreg nugget uses free-range chicken and tofu dregs, while both are not used in FT, NC, or SG nuggets. The three-nugget use broiler chicken and spices according to their respective company recipes. Tofu pulp, which is abundant in fiber, interacts with macromolecules (proteins) in the production of gels to assist bind water, resulting in the high water retention ability of chitofu dreg nuggets [15]. Water that has been tightly bound to food fiber will be difficult to evaporate again even with the drying process [3]. The high-water holding capacity, apart from tofu dregs, is also caused by other ingredients, namely the use of tapioca flour as a binding agent and filler in Chitofudreg nuggets. Tapioca flour can produce products with high binding capacity because it has a high crude fiber content [16]. Meanwhile, the low water holding capacity is caused by the process of denaturation, depolymerization, and an increase in protein solubility due to several things such as pressure and steaming time [17]. The water-holding capacity of the nugget is related to the cooking loss value. The more water that is bound by the material, the less the mass loss of the material during the heating process will be.



Figure 1. Combination nugget made from chicken and tofu dregs namely Chitofudregs

3.2. Nugget's chemical characteristics

The nugget category had a significant effect on its chemical characteristics, see Table 2. Each category of nugget according to the manufacturer has a different composition of ingredients so they also have different chemical characteristics. Chitofudregs contained higher moisture content than one of the commercial NC nuggets and lower protein and ash content than the two types of commercial nugget (FT and SG) while the carbohydrate content was also lower than the NC commercial nugget ($p < 0.05$). The fat and calorie content of chitofudreg was the lowest among all commercial nuggets ($p < 0.05$).

The high water content in Chitofudreg is caused by the raw material used, namely tofu dregs with a fairly high water content of 84%. The water content of chitofudreg has met the standard of quality requirements for the water content of combination nuggets which should not be more than 60% (National Standardization Agency (BSN) 2014). Tofu dregs are a by-product of tofu products obtained by grinding soybeans mixed with hot water, then filtering the soybean pulp and draining the dregs. Milling with hot water makes the water content in the tofu dregs increase. The water content in the nugget will affect the shelf life of the product. The higher the water content of the material, the easier it is for microorganisms to grow, causing changes in color, aroma, texture, and taste [18]. Chitofudreg has the softest texture among the other three nuggets due to its relationship with the highest water content.

The protein content of Chitofudregs was lower than commercial nuggets namely SG and FT, but it was higher than NC nuggets. Manufacturers claim that NC which is a bulk nugget contains 100% chicken meat. However, based on facts in the field, NC is a combination nugget where the proportion of chicken meat is only 51% so the protein content is not so high [19]. The low protein content of Chitofudreg compared to SG and FT nuggets is caused by the composition of Chitofudreg which is a combination of free-range chicken meat with tofu dregs. Tofu dregs is a type of vegetable protein whose protein quantity (17.4%) is not as high as chicken meat which is animal protein. In terms of quantity, animal food is a better source of protein than vegetables [19]. Although low (11.02%), the protein content of Chitofudreg has met the quality standard as a combination nugget, namely the protein content should not be less than 9% [10].

On the other hand, the low-fat content of Chitofudreg (3.11%) is related to the lower fat content of native chicken meat than native chicken meat as the main raw material for FT, SG, and NS nuggets. Fat content in broiler chicken ranges from 10 to 15% of the total carcass weight while native chicken meat is only 0.81% [20]. Nugget Chitofudreg also contains tofu pulp which has a very low-fat content, which is 5.9 g/100 g of ingredients [21]. As a low-fat nugget, the nutritional value of Chitofudregs nuggets can still be said to be feasible because the standard fat content for the combined nugget category is not more than 20% [10]. Low-fat nugget is very good for people who are on a diet and have high cholesterol. High cholesterol comes from high-fat foods, too often eating high-fat foods will cause hypercholesterolemia which increases the risk of heart disease, pancreatitis, and others.

Chitofudreg's ash content is lower than that of nugget FT and NC caused by the use of free-range chicken meat and tapioca flour in the dough while other nugget uses broiler chicken and flour. Broiler chicken meat has an ash content of 1.45% while native chicken meat has an ash content of 1.05% [22]. The ash content of tofu dregs is quite high (3.61%), its contribution to the ash content of Chitofudregs nugget is not comparable to the contribution of wheat ash content to the nugget. FT and NC in which tapioca contains only 0.3% ash while flour contains 0.5% ash [5]. Ash content reflects the mineral content contained in food products. The minerals contained in tofu dregs include calcium 19 mg, phosphorus 29 mg, and iron 4 mg [15].

Another nutritional fact explains that Chitofudreg nuggets contain the highest carbohydrates among other nuggets. The proportion of tofu dregs and tapioca flour in the dough contributes to the high carbohydrate content of Chitofudregs nugget. Tofu pulp contains 26.92% carbohydrates while tapioca 86.9% [23]. Other nugget contains flour as a mixture, while the carbohydrate content is only 77.3%. Tofu dregs

have a carbohydrate content of as much as Chicken nuggets. Usually use wheat flour as a mixture in the dough but Chitofudreg nuggets use tapioca flour which has a higher carbohydrate content than wheat flour. This is by the opinion which states that the carbohydrate content of cornstarch is 85.0%, tapioca flour by 86.9%, and wheat flour by 77.3%. Although the carbohydrate content of Chitofudregs was the highest (23.69%) in this study, the nugget still met the permitted nutritional standards because the carbohydrate content of the combined nugget product should not exceed 25% [10].

The total calories of Chitofudregs are the lowest even though they are the highest in carbohydrates. The low calorie is influenced by the low-fat content in the product. Fat is one of the largest contributors of calories in food products. The presence of fiber in tofu pulp also allows low calories in Chitofudregs. In a previous study conducted by [22] regarding the processing of tofu waste in nuggets, it was found that the superior nutritional value of nuggets with tofu dregs substitution was high in fiber and low in fat, thus making this nugget have low calories when compared to a nugget on the market. Low in fiber and high in fat. Soybean as a raw material for the tofu industry is a source of fiber from the tofu waste produced. Dietary fiber consists of complex carbohydrates that make up plant cell walls. These complex carbohydrates such as hemicellulose, cellulose, pectin, lignin, and intracellular polysaccharides (gum and mucilage) are not hydrolyzed by human digestion so they are not soluble and can ultimately reduce calorie content. Nugget Chitofudregs is a low-calorie food so it has the potential as a special diet to lose weight, especially for obese people who are at risk of heart [23]. Therefore, the processing of Chitofudregs nuggets has the potential to be developed because it is good for consumption by patients with low-fat and high-fiber diets.

Table 2. Comparison of the chemical characteristics of chitofudreg nugget with commercial nugget

Chemical Parameter	Chitofudreg	Category of Nugget		
		FT	SG	NC
Water content (%)	60.00±3.53 ^a	56.00±4.18 ^a	55.00±7.07 ^a	32.15±4.60 ^b
Proteins (%)	11.02±1.09 ^b	14.77±1.30 ^a	14.41±2.02 ^a	10.51±0.69 ^b
Fat (%)	3.11±0.38 ^c	12.19±1.27 ^a	13.18±1.64 ^a	4.86±0.58 ^b
Ash (%)	2.16±0.21 ^b	2.61±0.25 ^a	2.83±0.25 ^a	1.91±0.24 ^b
Carbohydrates (%)	23.69±3.23 ^b	14.06±1.85 ^b	10.59±1.51 ^b	49.63±5.27 ^a
Calories (cal)	166.81±18.71 ^d	225.03±10.56 ^a	218.62±10.56 ^c	284.30±23.31 ^b

Data were expressed as mean±SD. Different letters superscripts indicate significant differences between nugget categories (p<0.05)

4. CONCLUSION

Compared to FT, SG, and NC nuggets, Nugget-Chitofudreg has the highest binding capacity and water content, as well as the lowest cooking loss, fat, and calories. As a result, Chitofudregs is a combination of nuggets with the physical quality of a commercial nugget and specific chemical characteristics, and it has the potential to be a diet product due to its low fat and calorie content.

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