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SUBSTITUTION OF WHEAT FLOUR WITH SOYBEAN FLOUR TO INCREASE NUTRITIONAL VALUE, PHYSICAL AND ORGANOLEPTIC QUALITY OF CHICKEN NUGGETS

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ABSTRACT

This research was conducted to investigate the effect of substitution of wheat flour with soybean flour to increase nutritional value, physical and organoleptic quality of chicken nuggets. Chicken nuggets cooked for five different treatments and each treatment consisted of four replications. Proportions of wheat flour and soybean flour used in this research were 100 : 0 (P_0); 75 : 25 (P_1); 50 : 50 (P_2); 25 : 75 (P_3); and 0 : 100 (P_4), respectively. Chicken nuggets formulations consist of 84% of mixed meat and filler, 1% of salt, 3.6% of garlic, 0,4% of pepper and 11% of water. The variables tested included water, protein, fat, and ash content, physical quality (pH and textur) and organoleptic of chicken nuggets. The data were analyzed by using *Completely Randomized Design* (CRD) with MINITAB program. The result showed that wheat flour substitution with soybean flour has a significant effect on water (50.822 to 56.062%), protein (22.118 to 26.165%), fat (7.891 to 14.646%) and ash content (1.851 to 2.575%) of the nuggets. P4 resulted the lowest water content (50.822), and the highest protein (26.165%), fat (14.646%), and ash content (2.575%). There were significant differences on tenderness ($P<0.05$) and pH ($P<0.01$). Tenderness of P3 (74.111 N) and P4 (93.382 N) was not different compared to control (79.432 N). Color, tenderness, flavor, and appearance of chicken nugget indicated no significant differences ($P<0.01$). However, juiciness increased ($P<0.05$) by increasing level of soybean flour. Consumer acceptance on color, tenderness, flavor, juiciness, and appearance were not different between control and treatments. It can be concluded that substitution of wheat flour with soybean flour increases nutritine value, physical and organoleptic quality of chicken nuggets. The optimum proportion of wheat and soybean flour as filler to be accepted by consumer and resulting in good nutritional value, physical and organoleptic quality is 25:75 (25% of wheat flour and 75% of soybean flour).

Key Words : Nutritional Value, Physical And Organoleptic Quality, Chicken Nuggets, Wheat Flour, Soybean Flour.

INTRODUCTION

Broiler meat contents high nutritional value and its price is relatively cheap. Nutritional values of broiler meat including protein, fat, saturated fatty acid, unsaturated fatty acid, ash, and water content are 22.5%, 1.30%, 30.27%, 69.47%, and 74.85%, respectively (Kartikasari, 2002).

Even though broiler meat has high potential as nutritional source, most consumers are less likely to consume it because of the high level of fat. The food containing high level of fat tends to content high saturated fatty acid and cholesterol, hence there is worry in regard to health disease, such as arteriosclerosis (Jeffrey *et al.*,

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1996).Through carcass and broiler meat processing, broiler meat fat can be omitted, so broiler meat products can be more received by consumers. Meat products and meat processing technology are steadily developing in Indonesia and produce varieties of food products. Meat processing will improve nutritional values, make more interesting shape and appearance, and give economical benefit. One of meat products which is easy to do and nowadays is likely to be consumed is nuggets.

Chicken nuggets are meat products produced from chicken meat which has been chopped, mixed with ingredients, added with filler, and cooked with bread crumbs. The use of filler in nugget formulations can increase nutritional values, physical quality, and organoleptic products (Prinyawiwatkul *et al.*, 1997a).
Filler also can be role as binder which can increase water-holding capacity (WHC), thus product can be more juiciness.

Soybean contents high nutritional values, especially protein content (37-38%), and low fat and cholesterol (Anonim, 1995), thus representing source of nutrients and becoming a potential functional ingredient in wide range of food products. Soy products such as soy protein isolates and concentrates are commonly used in meat- based products for their functional properties. Soy protein has been utilized in the food industries as a partial or complete replacement of animal protein. The protein value of soy protein is comparable to that of meat protein (Lin *et al.*, 2000). Protein content of soybean flours is about 50% (Kumar *et al.*, 2003). One important physical characteristic of soy protein is its water solubility, and roles as a good extender, filler and binder (Prinyawiwatkul *et al.*, 1997a). This property is significantly contributes to superior functional properties of soy products (Ramezani *et al.*, 2003).

Substitution of wheat flour with soybean flour as filler in chicken nuggets processing is expressed to produce meat products hearing high nutritional value, good physical and organoleptic quality, hence they are more likely to be liked by consumers.

The aims are to investigate the effect of substitution of wheat flour with soybean flour to nutritional values, physical, and organoleptic quality of chicken nuggets.

MATERIALS AND METHODS

Meat was trimmed of external fat and visible connective tissue and then coarsely ground in a chopper. Chicken nuggets formulation consists of 84% of mixed meat and filler, 1% of salt, 3,6% of garlic, 0,4% of black pepper, and 11% of water. Meat and ingredients were weight and mixed with the water. Furthermore, all of the materials were mixed by mixer and operated at a low speed (#1) for two minutes, and added by filler which had been weighed. Proportion of wheat flour and soybean flour was 100:0 (P0), 75:25 (P1), 50:50 (P2), 25:75 (P3), and 0:100 (P4). The total flour used was 10%. The mixture from each formulation was shaped about 1-1.5 cm thick, and fried for 2 minutes. Fried nuggets were drained on absorbent paper, cooled to room temperature, and used immediately for texture and pH analyses. Additional nuggets from each treatment were stored in freezer bag at 4^0 C for subsequent water, fat, protein, and ash analyses (AOAC, 1975). Freshly prepared nuggets were used for consumer acceptance test (Prinyawiwatkul *et al.*, 1997b). The data taken were analyzed by one way Completely Randomized Design (CRD) by MINITAB program.

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RESULT AND DISCUSSION

A. Chemical Composition

Table 1 shows that wheat flour substitution with soybean flour has a significant effect on water content of the nuggets (50.822 to 56.062%). P4 yielded the lowest water content (50.822%). The result is likely to be caused by increasing of fat content according to increasing of soybean flour used in the chicken nuggets .

The substitution had a significant effect on protein content. The protein content increased ($P<0.01$) along with increasing of soybean flour in the nuggets. P0 contained the lowest protein (22.118%), on the contrary, P4 had the highest protein content. It was because soybean had high protein content so the increase in using soybean flour in the formulation would increase protein content in the nuggets. Protein content in fatless soybean is 48% (Wu *et al.*, 2000).

The treatment resulted significant differences ($P<0.01$) on fat content. Fat contents in P0, P1, P2, P3, and P4 were 7.891; 8.190; 8.723; 9.201; and 16.646%, respectively. It increased along with increasing of soybean flour use in the nuggets. The highest fat was obtained from P4. It was different ($P<0.01$) with that of P0, P1, P2, and P3. A result of research conducted by Kartikasari (2004) indicated that the use of soybean flour up to 20% in chicken nuggets would increase its fat content.

Table 1. Chemical composition

Parameter (%)	Treatments				
	P0	P1	P2	P3	P4
Water content	54.657^{A}	53.842^{A}	56.062^{B}	55.867^{B}	50.822^{C}
Protein content	22.118^{A}	23.496^{A}	23.055^{AB}	25.701^{C}	26.165^{C}
Fat content	7.891^{A}	8.190^{A}	8.723^{A}	9.201^{A}	14.646^{B}
Ash content	1.851^{A}	2.467^{B}	1.462^{C}	2.529^{B}	2.575^{B}

^{A,B,C} with different superscript in each row indicate significant differences ($P<0.01$)

The substitution has a significant effect on ash content as well. The ash contents in P0, P1, P2, P3, and P4 were 2.851; 2.467; 1.462; 2.529 and 2.575, respectively. The low ash in P2 was caused by the treatment has the highest content of water.

B. Physical Quality

The treatments have significant effects ($P<0.01$) on pH. However, pH value in P0 (6.183) was lower than that of P1 (6.378); P2 (6.383); P3 (6.498); and P4 (6.258). pH value tends to increase according to increasing of soybean flour. It could be caused by the increasing of protein and fat content in the treatments. The increase of protein content would improve water-holding capacity, so the water content should be increased and influencing pH values. One of the important roles of soybean is increasing the ability to hold water in the meat (Wolf and Cowan, 1975). Intramuscularly fat content would fill meat's microstructure tissue and finally it would increase water content as well.

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Table 2. pH value and tenderness

Parameter	Treatments				
	P0	P1	P2	P3	P4
pH	6.183^{A}	6.378^{B}	6.385^{B}	6.498^{B}	6.258^{AB}
Tenderness (N)	79.432^{ab}	100.576^{a}	71.077^{b}	74.111^{ab}	93.382^{ab}

^{A,B,} with different superscript in each row indicate significant differences (P<0.01)
^{a,b} with different superscript in each row indicate differences (P<0.05)

Amount of power needed to measure tenderness of the chicken nuggets (table 3) indicated significant differences (P<0.05). The amount of power was 71.077 (P2) to 100.576 (P1). Values of tenderness, P2 (74.111) and P4 (93.382), were not different from P0 (79.432). P2 has the highest tenderness value (71.077). It was supported by analyses results of water, protein, and fat content, in which P2 yielded highest water, high protein, and high- fat content. Tenderness value related to juiciness, besides fat and protein content. Fat is able to improve the tenderness of meat products. The ability of additive protein to hold water (Wolf and Cowan, 1975) and fat could influence texture, juicy, and characteristic holding tissue.

C. Organoleptic Quality

1. Color

There were no significant differences between the control (P0) and The treatments (P1, P2, P3, P4). Mean of the color scores was 1.7 to 4.0. The color scores made were 1 = Pale brown; 2 = Light brown; 3 = Golden brown; 4 = Brown; and 5 = Dark brown. Golden brown nuggets were the most preferred color. P4 had the highest score (golden brown).

2. Tenderness

Table 4 shows that, according to panellists, there were no significant differences on tenderness level. The tenderness level was 1.5 to 3.0. It indicated that nuggets yielded were tender. Tenderness levels made were 1 = Very tender; 2 = Tender; 3 = Less tender; 4 = tough; 5 = Very tough. The results were supported by juicy analyses indicating significant differences between the control and the treatments, and also there were differences on fat content between the control and the treatments. Prinyawiwatkul *et al.*, (1997) reported that softness and tenderness texture of chicken nuggets containing *Fermented Partially Defatted Peanuts Flours* (FPDPF) were influenced by the amount of fat in the nuggets and the ability of protein to hold the fat.

3. Flavor

There were no significant differences on flavor between the control and the treatments. The flavor score was 1.5 to 3.0. The flavor scores made were 1 = Very flavor; 2 = Flavor; 3 = Less flavor; 4 = No Flavor; 5 = Extremely less flavor. There was a correlation between the increase of flavor and that of the use of soybean flour. It seems caused by the increase of flavor from the soybean flour.

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4. Juiciness

There were significant differences on juiciness between the control and the treatments ($P<0.05$). The score was 1.6 (P0) to 2.4 (P4). The juiciness level significantly increased along with increasing of soybean flour usage. The juiciness scores made were 1 = Very juicy; 2 = Juicy; 3 = Less juicy; 4 = No juicy; 5 = Extremely no juicy. The yielded scores were P0 (1.6); P1 (1.7); P2 (2.0); P3 (2.3); and P4 (24). Protein performed to hold water in meat products. The increase of juicy level in processed meat products with addition materials was more influenced by water retention than fat holding.

5. Appearance

There were no significant differences between the control and the treatments i.e. 1.6 to 2.2. The appearance scores made were 1 = Very interesting; P2 = Interesting; 3 = Less interesting; 4 = Not interesting; 5 = Extremely not interesting. All of the chicken nuggets, according to panelists, were interesting. The results were supported by color analyses indicating that no significant differences among the nuggets. The Golden brown nuggets were the most interesting. Appearance, according to Cardello (1983), is comprises of both sensory properties such as color, and form, and more complicated properties such as surface texture and consistent composition.

D. Consumer Acceptance

The results showed that there were no significant difference on consumer acceptance on color, tenderness, flavor, juicy, appearance, and overall between the control and the treatments. The scores of consumer acceptance were 1.9 to 2.3. The consumer acceptance scores made were 1 = Very preferred; P2 = Preferred; 3 = Less preferred; 4 = Not preferred; 5 = Extremely not preferred.

The consumers preferred both the control and the treatments. The obtained results were supported by analyses on color, tenderness, flavor, juiciness, and appearance, which indicated no differences between the control and the treatments.

Table 3. Consumer acceptance

Parameter (%)	Treatments				
	P0	P1	P2	P3	P4
Color	1.9	2.3	2.0	2.3	2.0
Tenderness	1.8	2.0	2.1	1.8	2.7
Flavor	1.8	2.1	2.0	2.3	2.5
Juiciness	2.2	2.3	2.4	2.2	2.9
Appearance	2.2	2.6	2.1	2.1	2.2
Overall	2.0	2.3	2.0	2.2	2.3

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CONCLUSION

From the research, it was concluded that:

1. The substitution has increased protein content and fat content of the chicken nuggets.
2. The substitution has improved physical quality of the chicken nuggets covering pH and tenderness.
3. The substitution has yielded equal organoleptic qualities between the control and the treatments of the nuggets covering color, tenderness, flavor, and appearance.
4. Consumer acceptance on color, tenderness, flavor, juiciness, appearance, and overall was not different.
5. The optimum proportion of the substitution to obtain both consumer preference and good quality was 25:75.

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