Some Physico-Chemical Properties of Surimi-Like Material from Beef Meat as Affected by Sucrose Level

Suharyanto, O. Mega, I. Badarina, and E. Librayanti
Department of Animal Science, Faculty of Agriculture, University of Bengkulu, Bengkulu. Indonesia
email: suharyanto_wp@yahoo.com

ABSTRACT

Recently, study of surimi-like material appeal to be studied. Surimi is a Japanese term for intermediate product made from ground meat fish deboned mechanically and washed by using chiling water repeatedly. One of the procedures of surimi processing is supplementation of cryoprotectant such as sucrose, sorbitol and phosphate to prevent from protein denaturation during processing and frozen storage of surimi. This study was evaluated the effect of sucrose level on the physico-chemical properties of beef surimi. The muscle tissue of round meat of beef was separated from fat and connective tissue manually and then was cut into 3 cm size of meat for mincing by using meat mincer. Then, the minced meat was washed three times by using chilling water (5-10^{o}C). The final wash used chilling 0.5% NaCl solution. The ratio of water to minced meat in washing was 3:1. The final step was dewatering by pressing washed minced meat in the screen of linen mesh manually. Finally, raw surimi was stirred with sucrose 3% (P1), 4% (P2) and 5% (P3) and added sodium tripolyphosphate 0.2% for each treatment. Both pH and WHC were significantly decrease from P2 to P3 ($P<0.05$), whereas the gel strength was no different. The decline of WHC was followed by the decrease of water and crude protein content ($P<0.05$). However, sucrose could not affect ash and fat content as well as salt-soluble protein . Sucrose supplementation at 3% in beef surimi is better than other level added.

Key words: surimi, physico-chemical properties, sucrose

INTRODUCTION

Surimi is a Japanese term for intermediate product made from ground meat fish deboned mechanically and washed by using chilling water repeatedly. Washing procedure is to remove fat and undesirable matters, such as blood, pigments, and odorous substances, and to increase the concentration of myofibrillar, thereby improving gel strength and elasticity, essential properties for surimi-based products (Lee, 1984). This product is light in color, bland in odor, low in fat, high in myofibrillar protein, and extremely functional due to the unique gelling properties of the myofibrillar protein (Jin *et al*., 2008).

Frozen surimi is used as a starting material in the factory due to the advantages of it rather than whole fish (Suzuki, 1981). Unfortunately, frozen storage decreases the functional properties, mainly gel-forming ability of surimi (Lee, 1984). The loss of this property is due to the denaturation of protein. The freezing increases solute concentration and favors dehydration, both of which contribute to protein denaturation (McDonald and Lanier, 1991). To prevent protein from denaturation during frozen storage, utilization of cryoprotectant, such as sucrose, sorbitol and phosphate is applied (Nowsad et al., 2000). At first, cryoprotectant applied was sucrose 8%, but it caused the surimi taste too sweet and turned the finished product a brownish color. To reduce the sweetness of surimi, cryoprotectant used was sucrose 4% and sorbitol 4%. The effectiveness of this sugar effect was markedly enhanced by adding phosphate 0.2% (Lee, 1984). Even though the formulation of cryoprotectant could not protect the gel strength, deformation was slightly improved, and water retention properties, elasticity and cohesiveness of gel were protected (Nowsad et al., 2000). Moreover, sorbitol utilization cause the surimi-based product texture is harder than the one with sucrose (Suzuki, 1981).

The characteristics mentioned above are affected by meat protein, mainly myofibril. The ability of meat protein (myofibril) binds water is important to evaluate the characteristics of meat and meat product (Aberle *et al*., 2001). The damage of meat protein will decrease some physico-chemical properties of meat and meat product.

Due to the negative effect of sucrose 8% and sorbitol, this study investigated the effects of sucrose level under 8% as a single agent of cryioprotectant on the physico-chemical properties of surimi-like from beef meat.

MATERIALS AND METHODS

Surimi Preparation

The *round* meat of beef was obtained from traditional market in Bengkulu. The muscle tissue was separated from fat and connective tissue manually and then was cut into 3 cm size of meat for mincing by using meat mincer. Then, the minced meat was washed three times by using chilling water (5-10^{o}C) which the final washing used chilling 0.5% NaCl solution. The ratio of water to minced meat in washing was 3:1. The final step of surimi preparation was dewatering by pressing washed minced meat in the screen of linen mesh manually. Finally, raw surimi was stirred with sucrose 3% (P1), 4% (P2) and 5% (P3) and added sodium tripolyphosphate 0.2% for each treatment. Each treatment was replicated three times.

pH and Water Holding Capacity (WHC)

Surimi pH was measured by using pH-meter (TOA HM-11p). At first, the electrode of pH-meter was calibrated to pH 4 and 7. After calibrating, the electrode of pH-meter was inserted into sample and the pH indicator rose on the monitor of pH-meter. WHC was determined by using Hamm method (Soeparno, 2005). The steps of WHC determination are below:

a) A 0.3 g sample was placed on filter paper Whatman 41 and pressed at 3,000 psi for 3 minutes by using Carver Press.
b) Two distinct areas are produced: a meat area and a water area and measured by using plain mater. The area between water and meat area is wet area (mm^2). The weight of water (mg) is counted by using formula:

$$\frac{\text{wet area}}{0.0948} - 8$$

c) Converting weight of free water into percentage of sample: ratio of weight of free water to weight of sample (known as % free water).
d) To determine WHC, the percentage of free water in the moisture of sample is counted by using formula:

$$\frac{100}{\text{moisture}} \text{ X (\% free water)}$$

e) Finally, WHC (%) is counted by the formula: (100 – percent free water in the moisture).

Gel Strength

Gel strength was determined according to method described by Tan et al., (1988). Surimi was mixed with 3% smooth salt and 30% chilling water by using food processor until sticky surimi formed. Then, sticky surimi was cased and was heated with double step heating: 40°C in 20 minutes and 90°C in 20 minutes. This surimi's gel strength was measured by using anvil instron 1140 and expressed as gf/cm^2.

Chemical Composition

The procedures used to determine proximate composition was similar to that of Apriyantono *et al*. (1989). Moisture was determined through oven drying method at 110°C for 24 h; crude protein was determined by using Kjeldhal method; crude fat was evaluated by using the soxhlet method; and ash content was measured by ashing the sample in a muffle furnace at 600°C. Using a modified method used by Park *et al*. (1996), Salt-Soluble Protein was measured after it was homogenized by using 20 ml salt solution for a minute in an ice bath. Homogenate was centrifuged for 10 minutes at 3020x g and the filtrate was separated. Filtrate was centrifuged for 10 minutes at 3020x g and supernatant was decanted. A ml of supernatant was used to determined Salt-Soluble Protein by using Kjehdahl method.

Statistical Analysis

One-way ANOVA was used to compare the treatments effects. Duncan's Multiple Range Test was set to determined significant differences among mean values. The level of significance was P<0.05.

RESULTS AND DISCUSSION

Physical Characteristics

The physical characteristics results are presented in Tabel 1. Value of pH and WHC obtained tended to be lower from 3% to 5% sucrose supplementation ($P<0.05$). Honikel (1987) reported that pH has a profound effect on the physical properties such as WHC, tenderness and color in meat. Ini this study, the decrement of pH was followed by the decrement of WHC and it was parallel to Kristinsson and Hultin (2003). They reported that an increment of surimi gel pH led to a considerable increment of WHC. Various researchers have found that decrement of pH significantly correlated with the loss of textural qualities such as gel strength (Nowsad *et al*., 2000). Medina and Garrote (2002) reported that cryoprotectant could not prevent gel strength from decrease. This research showed that there was no different with gel strength value.

In this study, cryoprotectant had influenced pH and WHC of beef surimi and had not influenced on gel strength. The pH of P1 (4.85) was no different from P2 (4.73) but significantly different from P3 (4.63), whereas, P2 was no significant value. The pattern of pH decline was not followed by WHC's pattern which the WHC at P1 (54.44) was marked different from P2 (45.99) and P3 (43.32), and between P2 and P3 was no different statistically. Nowsad *et al*. (2000) reported that cryoprotectant could not protect the gel strength or breaking strength, but it could protect water retention of surimi. The cryoprotectant used by Nowsad *et al*. (2000) was combination of sucrose, sorbitol and Na-tripolyphospate. The difference result of these was probably affected by different cryoprotectant used. This study used sucrose as a single agent of cryoprotectant so that the effect of the cryoprotectant was different from Nowsad's study. The highest value of the physical variable was 3% sucrose added to the surimi material.

Chemical Characteristics

The result of the effect of sucrose level on the chemical characteristics is presented in Table 2. The moisture of surimi was significantly increased. Contrary, crude protein tended to decrease markedly. However, sucrose could not affect ash and fat content as well as salt-soluble protein.

Moisture expressed the water content of surimi. Water content of material is not parallel with the WHC value. In various cases, the higher of water content the lower of WHC value. In this study, WHC of the surimi was decreased (Table 1), while the moisture of surimi was increased significantly (Tabel 2). The average of the moisture of the study was matching to the normal moisture of fresh meat hich contains 68-80% (Aberle *et al*., 2001). Ash content and crude fat were no significant response.

Tabel 1. The pH, Water holding Capacity (WHC) and Gel Strength of beef surimi

Variabels	Sucrose level		
	3 % (P1)	4 % (P2)	5 % (P3)
pH	4.85+0.03a	4.73+0.07ab	4.63+0.04b
WHC (%)	54.44+0.38a	45.99+0.71bc	43.32+0.52c
Gel Strength (gf/cm2)	421.62+1.72	361.52+1.29	411.63+1.47

Note: a-c different superscript within a row are significantly different ($P<0.05$).

Tabel 2. Proximate Composition and Salt-Soluble Protein of beef surimi

Variabels	Sucrose level		
	3 % (P1)	4 % (P2)	5 % (P3)
Moisture (%)	77.2 ± 0.64a	79.87 ± 0.40b	78.57 ± 0.27b
Ash content (%)	0.66 ± 0,02	0.45 ± 0.01	0.57 ± 0.02
Crude fat (%)	3.30 ± 0.09	3.16 ± 0.12	3.76 ± 0.26
Crude protein (%)	16.16 ± 0.86a	14.63 ± 1.3ab	13.39 ± 0.77b
Salt-Soluble Protein (%)	1.8 ± 0.03	1.85 ± 0.04	1.79 ± 0.04

Note: a-c different superscript within a row are significantly different ($P<0.05$).

The interesting here was that crude protein and salt-soluble protein of surimi. The crude protein was decline distinctly between P1 (16.16%) and P3 (13.39%), while P2 (14.63 was no different, but the salt-soluble protein response was no different. This fact indicated that the increment of sucrose added could not protect protein content of the surimi although it was no change the salt soluble content of the surimi. The decline of the crude protein corresponded to the decrement of the WHC. One of the factor affecting WHC is protein content which the protein molecules bind the water molecule (Aberle *et.al.,* 2001). This study resulted that 3% This study resulted that 3% sucrose added had the highest value of the variables.

CONCLUSIONS

The increase of sucrose level added to beef surimi decreased pH, WHC and crude protein, but it could not change the responses of gel strength, ash content, and crude fat and salt-soluble protein. The suitable sucrose level for the best characteristic of beef surimi was 3% sucrose as a single agent of cryoprotectant.

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