

Effect of steaming on physical and chemical characteristics White Shrimp (*Litopenaeus vannamei*) from Indramayu Waters

I Rostini* and R I Pratama

Department of Fisheries Product Processing, Faculty of Fisheries and Marine Science, University of Padjadjaran, Bandung Sumedang Highway Km.21 Jatinangor, Indonesia 45363

*e-mail: iis.rostini@unpad.ac.id

Abstract. White shrimp (*Litopenaeus vannamei*) was a fishery product that has potential to be developed, can be used as ready to eat food or as raw material for various processed products. This study aimed to determine the effect of steaming process on the physical and chemical characteristics of white shrimp collected from Indramayu waters. The research method used was experimental consisting of two treatments (fresh shrimp and steamed shrimp), each treatment was repeated 4 times consisting of three levels (headless, peeled tail on, and peeled undeveloped). The parameters observed included physical test (yield, cooking loss, color) and chemical test (moisture, protein, fat, and ash content). The results showed that fresh white shrimp yield after peeled completely of 61.92%, whole steamed shrimp 92.76%, and peeled tail on steamed shrimp was 36.02%. Yield of peeled undeveloped steamed shrimp has the lowest value compared to other that was 54.78%. Cooking loss during shrimp steamed process was 7.24%. The color values of steamed shrimp include L* 68.57, a* 12.17, and b* 47.41. Chemical composition of white shrimp after steaming process decreased water content, while protein, fat, and ash levels increased.

1. Introduction

Shrimp is one of the fishery products favored by all the people in the world, because it tastes good. Shrimps are caught, processed, and sold by several countries more than other fishery products. Shrimp flavor varies depending on the shape and species [1]. White shrimp (*Litopenaeus vannamei*) was a product of high value, for local consumption as well as export [2]. In waters of Indramayu produced lots of *Litopenaeus vannamei*. Shrimp acts as a source of animal protein. Protein content of vannamei shrimp (*Litopenaeus vannamei*) cooked by boiling process was 23.25% [3].

Processing fresh shrimp are various, such as steamed or boiled. Fresh shrimp is generally in the form of frozen whole fresh, head-off tail on, and peeled. Based on the variation of shrimp processing, it is necessary to know the yield obtained from each of the shrimp processing conditions.

Shrimp processing industry generally produce or sell shrimp in the form of frozen. When the shrimp will be used as raw material of steamed shrimp keep in mind how much meat can be obtained from the results of the product. This research aimed to determine the effect of steaming process towards the physical and chemical characteristics of *Litopenaeus vannamei* collected from the waters of Indramayu.



2. Material and method

2.1. Materials

Materials used in the study were vannamei shrimp (*Litopenaeus vannamei*) obtained from Indramayu waters of 40-50 (in 1 kg of 40-50 shrimps), water, ice, packing materials, and chemicals used for chemical analysis.

2.2. Method

The research method used was experimental consisting of two treatments (fresh shrimp and steamed shrimp), each treatment was repeated 4 times consisting of three levels (headless, peeled tail on, and peeled undeveloped). The physical test (yield, cooking loss, and colour test) and chemistry (moisture, crude protein, crude fat, and ash content) was analyzed on shrimps.

2.2.1. Preparation of steamed shrimp. Fresh shrimp washed by cold water, weighted for each treatment then made whole fresh, headless, peeled tail on, and peeled undeveloped. Steam treatment, after washed process shrimp steamed for 30 minutes. Steamed shrimp drained for 5 minutes, 100 °C temperature. Then the sample determined the yield, cooking loss, colour test, and proximate.

2.2.2. Determination of cooking loss. Cooking loss was determined based on the different weight of sample before and after steaming. The equation as follows [4]:

$$\text{Cooking loss (\%)} = \frac{(A-B)}{A} \times 100 \quad (1)$$

where: A = weight before steaming, B = weight after steaming and cooling.

2.2.3. Colour test. Colour measurement objectively using Chromometer CR200 with Hunter notation system (L*a*b*).

L*: the brightness parameter, represents the reflected light that produces white, grey, and black achromatic colours. L* value range from 0 (black) to 100 (white).

a*: red green gradation chromatic colour with plus (+) a value from 0 to 100 for red, and minus (-) a value from 0 to -80 for green.

b*: yellow blue gradation chromatic colour with plus (+) b value of 0 up to 70 for yellow, and minus (-) b values from 0 to -80 for the blue colour.

2.2.4. Proximate analysis. Water content was measured by drying a sample of shrimp meat in an oven at 105 °C for 16 hours until the weight was constant. Crude protein content was analyzed by Kjeldahl method. Crude fat content was extracted with a 40-60°C boiling point petroleum ether. Ash content is measured by heating at 550°C for 4-5 hours using a muffle furnace [5].

3. Results

The vannamei shrimp have lost during the cooking process. The percentage of cooking loss during the steaming process is 7.24%. To know the part of shrimp vannamei that can be used as raw material for processed products then calculated the yield of the shrimp. Yield is the most important parameter to know the economic value and effectiveness of a product of material or material. Yield used to estimate how many body parts can be used as food ingredients [6]. Various forms of processed fresh shrimp and steamed are presented in figures 1 and 2.

The value of steamed vannamei shrimp was 92.76%. The heating process causes the denaturation of muscle protein denaturation and degree vary at each species [4]. Processing can destroy the protein or protein formation can produce a new one as a result of changes in protein conformation [7].

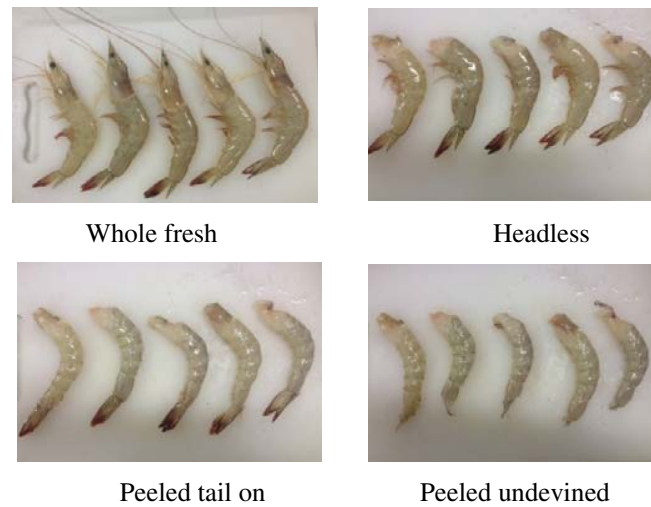


Figure 1. Forms of processed fresh shrimp.



Figure 2. Forms of steamed shrimp.

The value of yield was decreased both in the process of headless, carapace, and tail removal, as well as on the process of steaming shrimp vannamei (figure 3). The steamed shrimp has decreased in weight. This occurs because during the cooking process, the shrimp loses water levels as a result of the heating process that causes the occurrence of protein denaturation. Thus the ability to bind water has decreased, consequently there is water coming out of shrimp meat.

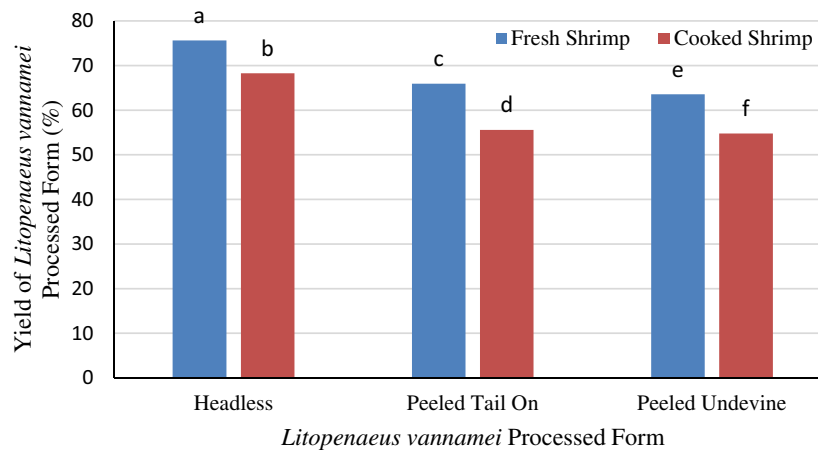


Figure 3. Yield of *Litopenaeus vannamei* processed form in fresh shrimp (blue bars) and cooked shrimp (red bars). Means followed by the same letter are not significantly different ($P < 0.05$) (t test).

There are several changes that occur in cooking shrimp. In general, shrimps show a loss of water content and shrink no more than 30% while thermal conductivity decreases no more than 5% and density increases not exceeding 4% of raw shrimp [8]. Examines the development of textures and histologic changes in collagen during thermal processing in shrimp. Thermal processing can increase the hardness and shrinkage deformation of the cooked shrimp [9].

Discoloration of the shrimp happen after cooking (figure 4). The colour was white initially, shrimp after cooking was transformed into the orange a bit red. Thermal causes denaturation of muscle protein, including carotenoprotein. Consequently, the carotenoid shows the original colour range from orange to red. Shrimp colour varies, depending on the species, seasons, food, and the environment [10].

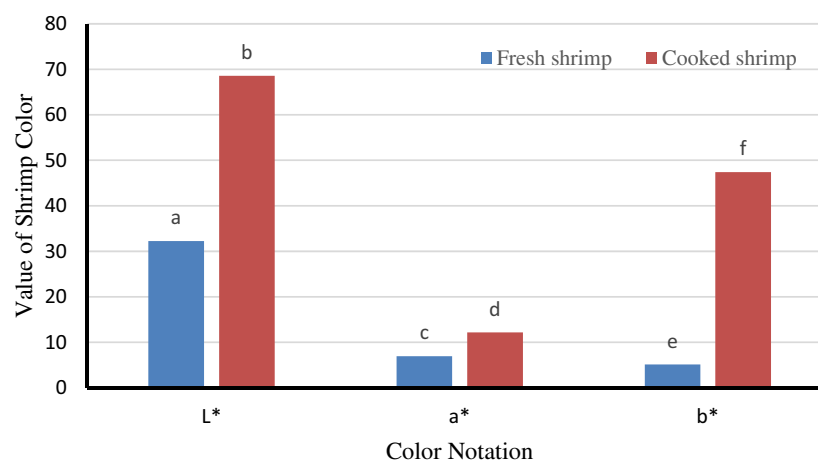


Figure 4. Value of fresh shrimp (blue bars) and cooked shrimp (red bars) colour. L* shows the brightness achromatic color, a* shows red green gradation chromatic color, and b* shows yellow blue gradation chromatic color. Means followed by the same letter are not significantly different ($P < 0.05$) (t test).

According to [4], with increasing temperature, water content of cooked shrimp meat was declining, while the fat content and the protein increases. The results of the Vannamei shrimp proximate analysis from Indramayu Waters are presented in table 1.

Table 1. Proximate composition of shrimp (*Litopenaeus vannamei*) from Indramayu waters.

Parameter	Raw shrimp ^a (before steaming)	Cooked shrimp ^a
Moisture (%)	77.59 ± 0.12 ^a	69.74 ± 0.12 ^b
Crude protein (%)	19.25 ± 0.32 ^c	26.63 ± 0.07 ^d
Crude fat (%)	0.30 ± 0.01 ^e	0.82 ± 0.01 ^f
Ash (%)	1.38 ± 0.11 ^g	1.52 ± 0.01 ^g

^aMean ± Standard Deviation, n = 4. Means followed by the same letter are not significantly different (P < 0.05).

The shrimp nutrients content was various in value depending on the habitat. Water is a major component of food. The content of water in the food ingredients also determine the acceptability, freshness and shelf life of foods [11]. Water content of fresh vannamei shrimp from Indramayu waters was 77.59%

The chemical composition of the most much reduced during cooking process is the water content. Water content in the flesh of steamed shrimp has decreased. A decrease in water content affected by the factors that cause the liquid from inside the meat seeped out. This decrease in water content resulted in the relative increase in protein, fat, and ash content. Decrease in water content caused by the occurrence of the protein denaturation process during steaming shrimp. The water is probably lost as a result of heat-induced denaturation of proteins during cooking of the meat. This causes less water to be entrapped within the protein structures held by capillary forces [12].

Thermal process causes the denaturation of muscle proteins [4]. This led to earlier denaturation of various kinds of shrimp proteins, that is, myosin, actin, sarcoplasmic proteins, and connective tissue (collagen is the main content of connective tissue). When protein denatured and coagulated myofibrillar proteins and collagen shrank and lost their water-holding capacity [2]. Protein aggregation induced by heating and also internal forces caused by pressure from connective tissue shrinkage [13].

The effect of steaming on changes in the chemical composition of fresh shrimp and cooked shrimp was compared using a *t*-test. The steaming process showed significantly different results on water, protein, and fat content of the shrimp.

4. Conclusion

Steaming process affect the physical and chemical characteristics of *Litopenaeus vannamei* shrimp. Yield in the form of processed peeled undevine cooked shrimp has the lowest value compare to the other of 54.78%. The Percentage of cooking loss during steaming process is 7.24%. After going through the process of ripening colour shrimp turns into a somewhat orange red. Chemical composition of white shrimp after steaming process decreased water content, while the protein, fat, and ash content increased.

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