

Effect of Protein-Based Edible Coating from Red Snapper (*Lutjanus* sp.) Surimi on Cooked Shrimp

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Abstract. Surimi can be used as a raw material for making protein based edible coating to protect cooked shrimp color. The purpose of this study was to determine consumers preference level on cooked shrimp which coated by surimi edible coating from red snapper and to know the microscopic visualization of edible coating layer on cooked shrimp. The treatments for surimi edible coating were without and added by sappan wood (*Caesalpinia sappan* Linn) extract. Application of surimi edible coating on cooked shrimp was comprised methods (1) boiled then coated and (2) coated then boiled. Edible coating made from surimi with various concentrations which were 2, 6, 10 and 14% of distilled water. The analysis were done using hedonic test and microscopic observation with microscope photographs. Effect of surimi edible coating on cooked shrimp based on the hedonic and colour test results showed that the 14% surimi concentration, added by sappan wood (*Caesalpinia sappan* Linn) extract on edible coating was the most preferable by panellist and giving the highest shrimp colour. The edible coating surimi application on cooked shrimp which gave the best result was processed by boiling followed by coating.

Keywords: edible coating, cooked shrimp, surimi, shrimp colour, shrimp coating

1. Introduction

Cooked shrimp is a value added product with high protein content, specific taste, ready to eat, have an interested colour for consumers, special flavour, and easy to serve. Cooked shrimp meat colour is red or orange. The redness and yellowness of shell were obviously higher than those of muscle, resulting from the higher content of carotenoids in shell than those in muscle [1]. Astaxanthin is the most effective pigment on shrimp colour [2]. Shrimps contain the red carotenoid astaxanthin, which is combined with proteins in the carapace, forming a green carotenoid-protein complex [3]. Protein denaturation caused red astaxanthin was released during the process of shrimp cooking, so that the shrimp colour change to be red [4]. The problems in the cooked shrimp during storage are discoloration, protein denaturation, and changes in texture [5].

Cooked shrimp must be protected from quality deterioration during storage. The effort to protect shrimp from deterioration during storage, in general is glazing [6]. According to [7], to expand the



storage life and maintain product quality can be used edible coating. Edible coating also can be used to inhibit the microbial growth on the surface of fresh processed product [8]. Surimi in food industry can be used as material to make edible packaging or more famous as a protein based edible film and edible coating [9]. Edible film and coating are potential as packaging materials since it has potential to increase the food quality, food safety, and shelf life of the product.

The colour of cooked shrimp was one of the main sensory attribute that affect the quality and acceptance of the product. The ability of surimi edible coating in maintaining cooked shrimp colour can be applied with sappan wood (*Caesalpinia sappan Linn*) as natural dyes. Sappan wood has antioxidant activity [10] and antimicrobial activity [11], so that can be produced with good colour and high quality product. Edible coating and antimicrobial agent can be combined during the film making process to increase the safety and shelf life of ready-to-eat food [8]. The aim of the study were to investigate consumers accepted level on cooked shrimp which coated by surimi edible coating and to know the thickness of edible coating layer on cooked shrimp.

2. Materials and Methods

2.1. Materials

Meat of red snapper fillet waste was obtained from Muara Angke, North Jakarta. Peeled undevined_vannamei shrimp (*Litopenaeus vannamei*) with 60-70 size (in 1 kg exist 60-70 PUD shrimp), sappan wood (*Caesalpinia sappan Linn.*), water, salt, ice, cryoprotectant (sugar), filter paper Whatman No.1, cling film, and Styrofoam.

2.2. Methods

The research consisted of several steps, preparation of surimi from meat of red snapper fillet waste, sappan wood (*Caesalpinia sappan Linn*) extraction, preparation of edible coating in various surimi concentration (2, 6, 10, and 14%), and application surimi edible coating to cooked shrimp.

2.2.1. Preparation of surimi from meat of red snapper (*Lutjanus sp.*) fillet waste [12]. Fish meat that has been separated from the rest of the fillet was milled using a meat grinder in order to produce a smooth and homogeneous meat without bones, thorns, and filth. After that, fish meat was washed twice using cold water (15 ± 1) °C and 0.3% saline solution (w/w). Immersion in cold water (ratio water : the meat is 3 : 1) performed for 10 minutes to clean the dirt still attached to the meat and mashed to dissolve the sarcoplasmic proteins. Fish meat then dewatering by using calico cloth to remove the water. Second submersion with saline solution 0.3% (w/w) (the ratio of the volume saline solution : meat is 3 : 1) for 10 minutes, then filtered again using calico cloth, made extortion. Cryoprotectant as much as 2% (w/w) was added and mixed using a food processor until homogeneous. The addition of cryoprotectant was done to prevent protein denaturation in surimi. Surimi was packaged with polyethylene plastic and stored in a freezer at -15 °C, then used as raw material for edible coating.

2.2.2. Sappan wood (*Caesalpinia sappan Linn*) extraction. Dry sappan wood milled to reduce the size by using the Hammer Mill screened with 40 mesh sieve. Sappan wood shaving used for the next stage of the extraction stage. Wooden sappan pigment extraction is done using [13] method with water as solvent. Material (100 g) extracted with 1 L of water and repeated 3 times for 30 minutes at 80 °C. after that was filtered with a vacuum filter using Whatman No.1 paper and the filtrate pH was measured. Extract was concentrated by vacuum evaporator at 40 °C to remove residual solvent in order to obtain the extract in the form of dry powder. Sappan wood extract powder was mixed into edible coating as a natural dye for cooked shrimp as much as 2.5 mg/ml. Sappan wood extract on that concentration had the highest antioxidant activity [14], so hopefully defend cooked shrimp color during storage.

2.2.3. Preparation of the surimi edible coating. Surimi based edible coating from meat of red snapper fillet waste method is a modification from [9], found that a stable edible film has been formed from

Alaska Pollack with a concentration of 2%. According to [15], showed that elected edible film from by trash fish surimi was edible with added by 10% surimi. Based on these results, the range used in this study the addition of surimi for edible coating are 2, 6, 10, and 14% (w/v) of distilled water. Frozen surimi thawed for 20 minutes. After the thawed surimi was stirred in distilled water to 150 ml for 30 min, 55 °C temperature, pH the coating solution was adjusted to 11 with 1 M NaOH. The surimi solution dispersed thoroughly using 150 mesh nylon, the filtrate that resulted was surimi edible coating. The treatments for surimi edible coating were without and added by sappan wood extract.

2.2.4. Preparation of cooked shrimp. Shrimp used in the study was Vannamei shrimp (*Litopenaeus vannamei*) PUD (peeled undevine) form with size of 60-70 (in 1 kg contained as much as 60-70 PUD shrimp). Fresh shrimp peeled and then washed with cold water. Shrimp simmered in boiling water for 5 minutes. Determination of long boiling based on [16]. After cooked, drained for the next shrimp dipped in edible coating and packed.

2.2.5. Application of edible coating to cooked shrimp. Surimi based edible coating that has formed, then applied as a coating of cooked shrimp with dipping method (30 minutes). Determination of long immersion was based on [17], state that immersion cooked shrimp for 30 min in a solution of edible coating can maintain the shelf life of cooked shrimp. The steps of surimi edible coating application consist of five types:

K = without edible coating

A = coated, boiled- without sappan wood extract

B = coated, boiled- added by sappan wood extract

C = boiled, coated– without sappan wood extract

D = boiled, coated- added by sappan wood extract.

Cooked shrimp that has been coated with edible coating, thickness of the coating was observed using an electron microscope with a magnification of 10 times. Surface cooked shrimp was also observed using an electron microscope to determine the brightness and color of the surface.

2.2.6. Organoleptic test.

Organoleptic test was conducted to determine the level of preference of panellist to appearance, colour, aroma, and taste of cooked shrimp coated edible coating. organoleptic assessment done by the hedonic test [18], that is somewhat trained panellist used as many as 30 people. Material presented at random with a given code numbers, then panellists were asked to pass judgment on any of the criteria hedonic scale. Observations presented in numbers of 1-7, in the following order: 1 (strongly dislike), 2 (do not like), 3 (somewhat like), 4 (neutral), 5 (somewhat like), 6 (likes), and 7 (strongly like).

2.2.7. Method of slice

Edible coating thickness measurements on cooked shrimp, done by making preparation with glass objects to do a photo shoot under the microscope [19]. The method of slice sliced by hand. Slice method is a method of making preparation by making an incision with a certain thickness, so it can be examined under a microscope. Method of slice by hand is a follows: a piece of tissue is held between the thumb pointer, then the network is cut crosswise with a sharp knife several times in rapid, parallel and as close as possible to the surface of tissue to be cut, in order to obtain slices as thin as possible. Furthermore, these thin slices that can be observed under the microscope.

3. Result and Discussion

3.1. Organoleptic assessment with hedonic test

Hedonic test performed in this study aimed to determine the level of consumer acceptance of cooked shrimp coated edible coating. Edible coatings composed of two types, there are without and added by sappan wood extract as much as 2.5 mg/ml. Characteristics tested include appearance, colour, aroma

and flavour. Hedonic test result cooked shrimp are coated surimi edible coating presented in Figure 1. And the hedonic test result for cooked shrimp that coated surimi edible coating with added by sappan wood extract presented in Figure 2.

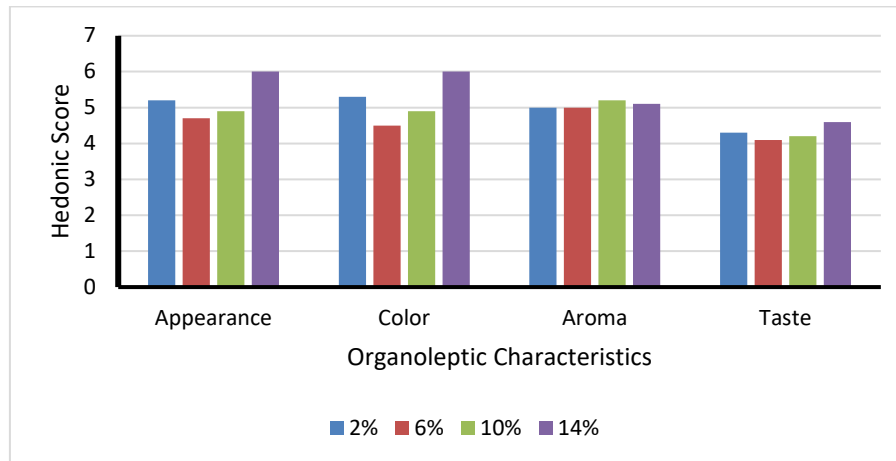


Figure 1. Hedonic test result on cooked shrimp coated surimi edible coating without sappan wood extract.

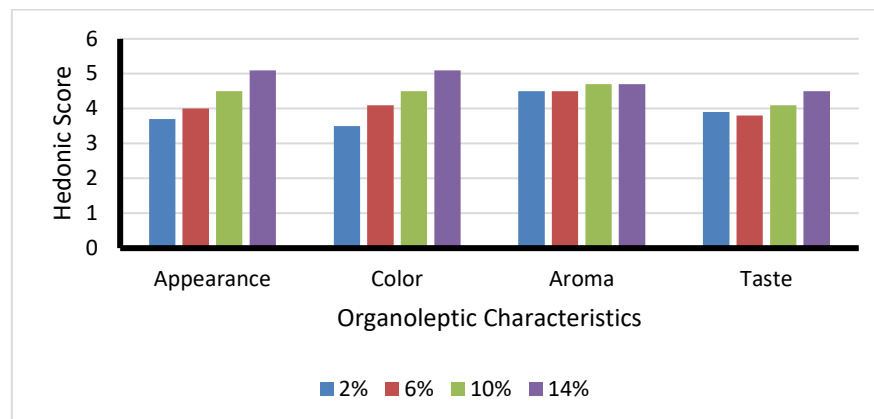


Figure 2. Hedonic test result on cooked shrimp coated surimi edible coating added by sappan wood extract 2.5 mg/ml.

The range average value of cooked shrimp appearance coated by edible coating is 4.7 to 6.03. The lowest value was given cooked shrimp surimi edible coating by 6%, while the highest values were found in cooked shrimp coated with edible coating concentration of 14% surimi. The range average value of cooked shrimp appearance which coated by surimi edible coating with sappan wood extract addition is 3.7 to 5.1. The highest value at a concentration of 14%. Based on Kruskal-Wallis test, the result that surimi concentration of surimi edible coating did not give significant effect on the appearance of cooked shrimp, surimi edible coating with added sappan wood extract providing significant effect on the appearance of cooked shrimp. The average value of the appearance of cooked shrimp are coated surimi edible coating and cooked shrimp are coated surimi edible coating with addition of sappan wood extract has the highest value at a concentration of 14% surimi. This happens because the concentration of 14% surimi to form edible coating well. Edible coatings can cover the surface with a perfectly when applied, so as to make the surface of cooked shrimp looks clear, transparent, shiny and bright. According to [20], the use of edible coatings can reduce the rate of damage during the process, improve the texture and appearance of the product.

Colour is a very important sensory attributes and should always be considered, because it has a direct influence on the quality of a product [21]. Good pigmentation and homogenized in a food is to the quality characteristics that determine consumer acceptance. Products with attractive colours will be more accepted by consumers, although with a more expensive price [22]. The average value of the range of colour coated cooked shrimp surimi edible coating is 4.5 to 6. The lowest value was given cooked shrimp surimi edible coating 6%, while the highest values were found in cooked shrimp coated with edible coating concentration of 14% surimi. The range average value of cooked shrimp colour that coated edible coating surimi given the sappan wood extract is 3.5 to 5.03. Lowest value at a concentration of 2% surimi and surimi highest value at a concentration of 14%. Based on the analysis using the Kruskal-Wallis test, the result that the surimi concentration of the surimi edible coating and surimi edible coating with sappan wood extract giving significant effect to the colour of cooked shrimp. The average value of cooked shrimp colour that coated by surimi edible coating and cooked shrimp with edible coating with sappan wood extract addition has the highest value at a concentration of 14% surimi. Concentration of 14% in the surimi edible coating was applied to improve the colour of cooked shrimp, cooked shrimp have brighter colours and shiny, and also liked by the panellists. Edible coatings are effective in reducing the decline in sensory quality products that include colour, smell, and firmness [23].

The average value of cooked shrimp aroma that coated by edible coating ranged from 5.06 to 5.13. The lowest value was given cooked shrimp surimi edible coating of 2%, while the highest values were found in cooked shrimp coated with edible coating concentration of 14% surimi. The average value of cooked shrimp aroma that coated by surimi edible coating with sappan wood extract ranged from 4.50 to 4.73. The lowest value at a concentration of 6% surimi and the highest value at a surimi concentration of 14%. Based on the analysis using the Kruskal-Wallis test, resulted that the surimi concentration of the surimi edible coating and surimi edible coating with sappan wood extract giving non significant effect on the aroma of cooked shrimp. This happens because the surimi edible coating has a neutral flavour, so when applied to the aroma of cooked shrimp poses no scent in defiance of cooked shrimp.

Taste is an important factor on which to base decisions taken by the customer to the receipt of a product. If a product has a bad taste, then the product will not be accepted by consumers, although the colour and smell good [24]. Average yield assessment panellist to taste cooked shrimp are coated surimi edible coating ranged 4.16 to 4.66. The lowest value was given cooked shrimp surimi edible coating 6%, while the highest values were found in cooked shrimp coated with edible coating concentration of 14% surimi. Averaging the results of the taste panel assessment of cooked shrimp are coated surimi edible coating with sappan wood extract ranged from 3.83 to 4.56. Lowest value at a concentration of 2% surimi and surimi highest value at a concentration of 14%. Based on the analysis using the Kruskal-Wallis test results obtained surimi concentration in the edible coating and surimi edible coating with sappan wood extract giving significant effect to the taste of cooked shrimp.

Based on the results of the hedonic test, the application of surimi edible coating on cooked shrimp showed that the concentration of the edible coating was applied to the cooked shrimp, which is most preferred by the panellists was 14%. The concentrations of both most preferred edible coating without or added by sappan wood extract on edible coating.

3.2. Visualization of surimi edible coating application on cooked shrimp

Coating method used in this study is the method of immersion (dipping). This method is a method of coating applications, where the product to be coated is dipped in surimi edible coating is used as a coating on the packaging or cooked shrimp. The entire surface of the cooked shrimp will be covered by edible coating after the dipping process. Edible coating thickness can affect the appearance of the packaged product. Thickness is formed due to the expansion or development of the denatured protein molecules in surimi red snapper fillet waste so open reactive groups that exist in the polypeptide chain. Bonds between protein reactive groups that hold all the liquid, it will be formed gel [24].

Based on the results of a microscopic photograph (Figure 3), reflecting the differences among all treatments. Visually, the difference in the step of application an edible coating of cooked shrimp has different effects on edible coating thickness. Controls which were not given edible coating surface appears shrimp with a clear surface lines. Shrimp fed edible coating before cooking, it does not look clear edible coating layer on the surface of cooked shrimp once through the cooking process. This happens because during the process of cooking shrimp, edible coating suffered due to denaturation temperature is as high as 100 °C and the physical pressure of the boiling water movement, so that the edible coating that covers the shrimp become detached as a result of unstable layer (Figure 3, A and B). Gel structure on edible coating contained surimi also be destroyed at temperatures above 50 °C. When heating the gel increased to above 50 °C, the gel structure will be destroyed, the enzyme will break down the structure of the three-dimensional gel network that has been formed so that surimi gel will be brittle and lose its elasticity [12]. Edible coating thickness results visualization under a microscope is presented in Figure 3.

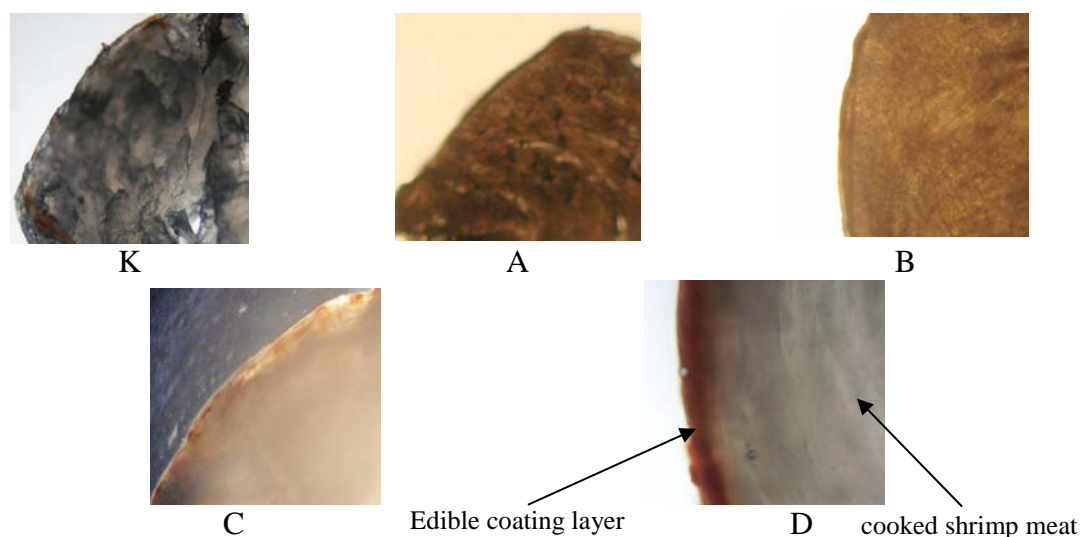


Figure 3. Cross section of cooked shrimp on a variety of surimi edible coating treatments (magnification 10 times). K = without edible coating; A= coated, boiled-without sappan woods extract; B=coated, boiled-added sappan wood extract; C = boiled, coated-without sappan wood extract; D = boiled, coated-added sappan wood extract.

The application step of edible coating to shrimp after cooking, edible coating layer on the surface of the shrimp can be seen clearly (Figure 3, C and D). This happens because the entire surface is covered shrimp stick coating evenly. Surimi edible coating has formed gel strength is stable so that when applied to the cooked shrimp capable shrimp paste and cover the surface. Fish myofibril proteins have the ability to form a three-dimensional gel network is stable [25]. Edible coatings are also applied to the cooked shrimp after untreated can cause damage to the stability of edible coating. Edible coating added by sappan wood extract layer shows the results of bright red on the surface of cooked shrimp. Edible coatings without sappan wood extract shows the results of a transparent coating, bright and shiny. Giving edible coating after the cooking process the meat showed was more soft texture and compact. The use of edible coating to reduce the rate of damage during the process, improve the texture and appearance of the product [20].

Cooked shrimp coated surfaces by edible coating has a bright and shiny appearance. Cooked shrimp are coated edible coating with the addition of sappan wood extract has a red colour. The red colour on cooked shrimp sensory attributes that affect the quality and acceptance of food products. Microscopic observations of the surface of cooked shrimp is presented in Figure 4.

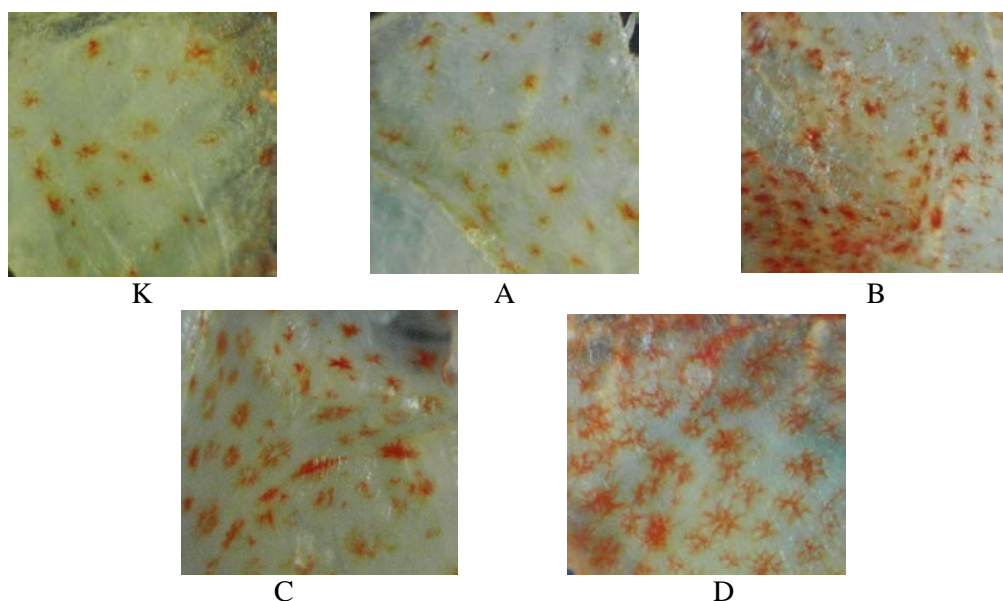


Figure 4. Cooked shrimp surface with a variety of surimi edible coating, treatment was observed by microscopy (magnification 10 times).

Microscopic observations on surface cooked shrimp without coated by edible coating possess a faint appearance compared to all treatments. Cooked shrimp which were edible coating all surfaces have a transparent appearance, bright and shiny. Edible coatings are added by sappan wood extract gives red colour to the cooked shrimp.

4. Conclusion

Effect of surimi edible coating on cooked shrimp based on the hedonic test results showed that the 14% surimi concentration, added by sappan wood extract on edible coating was the most preferable by panellist and giving the highest shrimp colour. The edible coating surimi application on cooked shrimp which gave the best result was processed by boiling followed by coating.

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