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POTENTIAL OF *LATES CALCARIFER'S* BONE WASTE AS A SOURCE OF MAIN INGREDIENT FOR *EDIBLE FILMS*

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ABSTRACT

This research aimed to utilize the bones of white snapper fish as a material for making gelatin, besides, the specific goal was to found out the best *edible film* characteristics of white snapper bone waste. The making of edible films was conducted at the Fisheries Products Technology Laboratory, which was conducted from February to August 2019. Testing of edible film characteristics was carried out by the Fisheries Product Technology Laboratory of the Faculty of Fisheries and Marine Sciences, Padjadjaran University, Biotechnology Laboratory of the Faculty of Fisheries and Marine Sciences, Padjadjaran University, Laboratories Soil Chemistry and Plant Nutrition, Faculty of Agriculture, Padjadjaran University, PPBS Basic Physics Laboratory, Padjadjaran University, and Textile Physics Evaluation Laboratory, Bandung Textile Technology College. *Edible films* that tested were *edible films* with 3 treatments and 3 repeatation with the addition of 5%, 10%, and 15% gelatin treatment. The characteristics of *edible films* that observed were thickness, transparency, tensile strength and elongation. The best edible film results were produced by adding 10% gelatin with 1,10 – 1,22 transparency, value 0,22 – 0,38 mm thickness, 8,87 – 12,24 MPa tensile strength and 13,5 – 22,5% elongation and the results were approriate with SNI 7818: 2014 standards.

Keywords: *edible film, gelatin, fish bone, waste, white snapper*

1. INTRODUCTION

White snapper is a reef fish that has economic value and high nutritional value as a consumption fish (Matthew 2009). White snapper is a cultured fish species in Indonesia which has an increasing market demand. White snapper Import demand in 2012 in Europe (Italy, Spain and France) reached 14,285 tons, and in 2014 it increased to 18,572 tons (Hardianti et al. 2016). This was supported by the production of white snapper in Indonesia in 2015 it reached up to 5,082 tons / year (KKP 2015 in Fara Mustika 2016). According to Purba et al. (2016) White snapper is one type of seawater that has an omega-3 content, about 20% protein content, and has a fat content of 5%. Based on the protein and fat content of snapper including type A fish with high protein category (15-20%) and low fat content (5%); and 80.3% water content; 0% carbohydrate; and ash 1.1% (Afrianto and Liviawaty 2005). White snapper was usually used by people as processed products, one of which is made as a filet.

Fish filet is a fishery product with the raw material of fresh fish that is subjected to weeding, cutting, with or without

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skin removal, tidying, washing, with or without freezing, packing and storing fresh or frozen (DG P2HP 2006). The process of making fish fillets could produce waste, such as fish bones, fish skins, scales and fins.

Fish bones as waste have not been used optimally, it was only used as an ingredent of making feed or fertilizer so that the economic was less valuable. Fish bones have only been thrown away, even though it has a high enough collagen content that can be used as one of the ingredients in gelatin making. According to Nurilmala 2004, the collagen content of hard boned fish (Telestoi) ranged from 15-17%, besides cartilage fish (Elasmobranchi) ranged from 22-24%.

Gelatin is a type of protein othat btained from natural collagen found in the skin and bones (Yi et al. 2006). Gelatin is a derivative protein from collagen fibers found in animal skin and bones. Amino acids that form peptide bonds are a composition of gelatin. The composition of the amino acid is almost similar to collagen, which is glycine as the main amino acid and is 2/3 of all amino acids that made it up, while 1/3 of the remaining amino acids are filled with proline and hydroxyproline (Yustika 2000). One of the benefits of gelatin in the food industry is as edible film.

Edible film is one type of environmentally friendly packaging. Edible film is a thin layer that can be consumed and cummonly used as a food coating (Bourtoom 2008). Edible film can be defined as a thin layer of edible material, which is placed on top or on food components and aims to inhibit the migration of water vapor, oxygen, carbon dioxide, aroma, and lipids wich carrying food additives (for example antioxidants, antimicrobials, flavor) and / or improve mechanical integrity or handling of food characteristics (Krochta 1997 in Cahyaning 2008).

Research on edible film has been carried out by using carbohydrate sourced ingredients such as sago starch, cassava starch, and corn starch. Research on the addition of white snapper bone gelatin to the edible film formulation has not been studied spesifically, so research was needed on the optimum concentration of white snapper bone gelatin to get good edible film characteristics.

2. MATERIALS AND METHODS

The materials used to make gelatin in this study were fresh white snapper bone size of 300 gram fish size as much as 10 kg, white snapper bone was gotten from Ciroyom Market, Bandung, fresh water, 5% HCl and distilled water, while the material used to make edible films were gelatin, modified tapioca flour, acetic acid 2%, distilled water and glycerol 2%.

The tools that used in making gelatin and edible film in this study were oven blowers, pH meters, waterbaths, magnetic stiirrers, beaker glass, pipettes, hot plates, analytical balance, plastic molds measuring 10 x 17 cm, spectrophotometers and screw micrometers.

Methods

The method used in this research was an experimental method, with three treatments and three repeatations and a comparative descriptive method. Therefore the determination of the concentration of gelatin addition based on the volume of distilled water as much as 100 ml was carried out by three treatments with three repeatations, namely 5% gelatin concentration, 10% gelatin concentration and concentration gelatin 15%. This research was divided into three stages. The first stage was the process of making gelatin from white snapper bones. The second stage was the process of making edible film

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packaging formulas from tapioca and gelatin as main ingredients. The third stage was the analysis of data according to predetermined parameters.

Manufacture Of Gelatin

The procedure for making gelatin from white snapper bones includes the process of degreasing (removal of fat):

1. Snapper bone was steamed for 30 minutes at 100 ° C.
2. After steaming, fish bones were cleaned and dried in the sun for 2-3 days.
3. The dried snapper bone was cut into small pieces with a size of 2-3 cm.
4. The next process was demineralization (removal of calcium and mineral salts) with the following steps:

1. The bones that has been cut were soaked in a 5% HCl solution with a 24-hour soaking time. The ratio of bone and HCl solution was 1: 4.
2. After soaking, filtering results soaking produced ossein and 5% HCl solution.
3. Ossein been washed using a basin under flowing water to reach a neutral pH (7).
4. Ossein was put into a beaker glass, extracted with distilled water using a water bath with a temperature of 80-90 ° C for 6 hours long.
5. The extracted filtrate was filtered with a filter cloth and placed into a beaker glass.
6. The filtrate was placed on a mold and dried out using an oven blower at 40-50 ° C for ± 24 hours until the gelatin sheet was obtained.
7. The gelatin sheets obtained was crushed using a blender to got a powder finish.

Making Edible Film

The procedure for making edible films is as follows:

1. Gelatin powder with various mass (5%, 10%, and 15%) was put into the beaker glass, added with 2% tapioca flour and dissolved with 100 ml of distilled water.
2. 2% acetic acid was added to the mixture so that the gelatin dissolves completely.
3. Glycerol 2% was added to the mixture of the solution.
4. The mixture was stirred for 40 minutes with a magnetic stirrer at a temperature of 80-90 ° C.
5. After the mixture was homogeneous, the mixture was restedfor to cooling down for 5 minutes to avoid the presence of bubbles in the mixture.
6. Next, the mixture was stirred again then carried out molding by pouring it into a plastic mold measuring 10 x 7 cm.
7. After printing, the mixture was dried out in the oven at 40-50 ° C for 5 hours long.
8. The mixture was taken out from the oven, then the mold was allowed to cooling down for 10 minutes, at room temperature until the mixture can be removed from the mold.
9. Edible film can be analyzed.

Data analysis

Data obtained from the observations of edible films (thickness, tensile strength, percent elongation (elongation) and

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transparency) were analyzed in a comparative descriptive methode supported by the presence of tables and figures.

1. THICKNESS EDIBLE FILM

Thickness is an important parameter that influences the use of film in forming the product to be packaged. The thickness of the film was affected by the amount of total solids inserted in the edible film solution and the size of the mold. The film formed would be thicker if the concentration of gelatin was poured more into the same mold. Likewise, the total solids that will form a thicker film with a greater amount. Thick films will increase tensile strength, but has less elongation values (Ariska and Suyatno 2015). Measurement of film thickness using a digital micrometer screw. The thickness of the film was obtained from measurements at 5 random position spots and then the average was gotten. The thickness of the edible film must be adjusted according to the product it would packaged in. The observation of edible film thickness were presented in Table 1.

Table 1. Edible Film Thickness Test Results Based on Gelatin Concentration

Treatment (Gelatin concentration)	Thickness Range (mm)
A (5 %)	0,11 - 0,25mm
B (10 %)	0,22 – 0,38mm
C (1,5%)	0,31 – 0,47mm

Based on the results of the edible film thickness test in each treatment A (5%), B (10%), and C (15%), the thickness range values are 0.11 - 0.25mm, 0.22 - 0.38mm, and 0.31 - 0.47mm. Treatment A with the addition of 5% gelatin on edible film packaging has the lowest thickness value of 0.11-0.25mm and in C treatment with the addition of 15% gelatin has the highest thickness value of 0.31-0.47mm. The thickness of the edible film really depends on the composition, properties and content of the constituent polymers, but does not depend on the plasticizer (Vanin et al. 2005).

Edible film in treatment A (addition of 5% gelatin) has a lower thickness value than film added gelatin with more concentration. It was because the thickness of the film is influenced by the total amount of gelatin as a solid in solution and the volume of the mold. The use of the same mold in each treatment can make the film packaging formed thicker if the volume of solution poured into the mold was greater.

Edible film thickness value according to Japanese Industrial Standard (JIS) for food packaging which is categorized as good has a maximum thickness of 0.25mm, beside a thick coating (> 0.25mm) is not good because it can limit the exchange of gas respiration so that the product might be damaged quickly (Ariska and Suyatno 2015). Unlike the case with the statement Basu et al. (2012) which stated that the edible film thickness requirement is 0.33 - 0.41mm. According to SNI 7818: 2014 thickness values range from 0.25 to 0.41mm. The treatment of adding 5% gelatin complied the Japanese Industrial Standard (JIS) since it has a thickness was less than 0.25mm. The treatment of adding 10% gelatin meets SNI 7818: 2014 because it has a thickness range of 0.22 - 0.38mm.

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2. TRANSPARENCY EDIBLE FILM

Transparency is the ability of a material to transmit light. Transparency is an aesthetic assessment in marketing edible films. Transparency values represent the level of clarity of the films that has been produced (Mustapa et al. 2011). Transparency is a very important aspect in edible film to increase consumer acceptance if it will later be used as food packaging material. Film packaging transparency were tested using a spectrophotometer with a wavelength of 550 nm. The transparency value of edible film packaging results based on gelatin concentration were presented in Table 2.

Table 2. the value of Edible Film Transparency Based on Gelatin Concentration

Treatment (Gelatin concentration)	Average Transparency Value	Average Clarity Value (%)
A (5 %)	0,65 – 1,24	99,10%
B (10 %)	1,10 – 1,22	98,85%
C (15 %)	1,20 – 1,55	98,57%

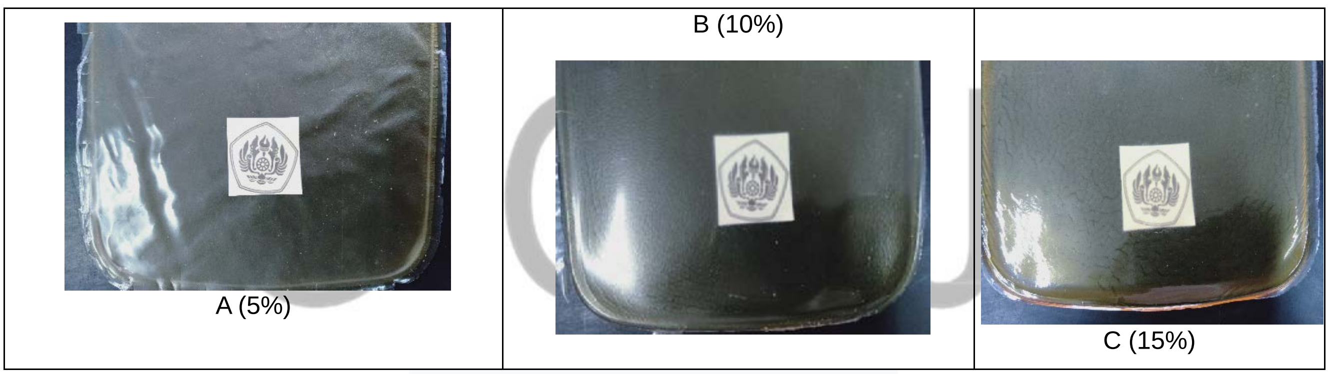

Figure 1. Edible Film Transparency valye

The results of the edible film transparency test based on the concentration of gelatin in each treatment in table 6 showed that treatment A (addition of 5% gelatin) has the lowest transparency value so that the degree of clarity of the edible film package was highest, namely 99.10% and treatment C (addition of gelatin 15) %) has a high transparency value wich means the degree of clarity of edible film packaging is higher, that is 98.57%.

The degree of clarity decreased due to the addition of glycerol to the edible film, this is related to the increase in the amount of glycerol and gelatin solids which causes the thickness of the edible film to increase. The higher thickness value of the edible film will increase the assimilation of the light so that the object of the edible film will appear more turbid and the clarity will be lower. As stated by Al-Hasan and Norziah (2012) that, with the increasing value of transparency, the degree of film clarity would be decreased.

The higher concentration of gelatin were added, the higher transparency would be. The gelatin produced in this research was brownish yellow, so that when the edible film packaging was produced the suspension was not clear but rather yellowish. The transparency value of the edible film packaging in this research ranged from 0.65 to 1.55. The value of

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plastic transparency according to SNI 7818: 2014 as a comparison that is equal to 1.14. Therefore, all edible film packaging complied with SNI 7818: 2014.

3 TENSILE STRENGTH EDIBLE FILM

Tensile strength or breaking strength is the maximum pull that can be achieved until the film persists before breaking. The tensile strength value indicates the maximum force used to decide edible film. This parameter represent the maximum force that occurs on the film during measurement (Fatma 2014). Tensile strength measurements are performed to determine the magnitude of the force achieved to achieve maximum pull in each unit area of the film to stretch or elongate (Krocha and Mulder-Johnston 1997 in Purwanti 2010). The result of edible film thickness were presented in Table 3.

Table 3. Tensile Strength Test Results Based on Gelatin Concentration

Treatment (Gelatin concentration)	**Range Tensile Strength (MPa)**
A (5 %)	10,34 – 11,07 Mpa
B (10 %)	8,97 – 13,24 Mpa
C (15 %)	12,93 – 15,53 Mpa

Based on the results of tensile strength test of edible film packaging, the average value of tensile strength of each treatment A (addition of 5% gelatin), B (addition of 10% gelatin) and C (addition of 15% gelatin) was 10.34 - 11, 07 MPa, 8.97 - 13.24 MPa, and 12.93 - 15.53 MPa. Treatment A (gelatin 5%) has the lowest tensile strength value of 10.34 - 11.07 MPa and treatment C (gelatin 15%) has the highest tensile strength value of 12.93 - 15.53 MPa.

Increased concentration of gelatin in the composition of edible films would increase the tensile strength of edible films to be not easily broken, it was due to an increase in the concentration of collagen in gelatin (Hasdar 2011). The greater value of the tensile strength showed the film produced was stronger because it required a more force to pull (Hendra et al. 2015). The addition of gelatin and plasticizer can improve the properties of a film. The film undergoes a change from hard and fragile to high tensile strength and flexible.

4. PERCENT ELONGATION EDIBLE FILM

According to Nurindra et al (2015) percent elongation is the percent increase in length of edible film material measured from the initial length at the time of withdrawal to breaking up. This characterization of elongation is related to the tensile strength and it was tested at the same time and using the same tool, namely Digital Univeral Testing Machine Auto Strain from Instron. The results of percent elongated edible film test were presented in Table 4.

Table 4. Percent Test Results for Edible Film Elongation Based on Gelatin Concentration

Treatment	

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(Gelatin concentration)	Average Lengthening Percentage Value (%)
A (5 %)	12 – 19%
B (10 %)	13,5 – 22,5%
C (15 %)	14,5 – 27,5 %

Based on the results of the edible film elongation test in this research, the average value of each treatment A (5%), B (10%), and C (15%) were 12-19%, 13.5 - 22.5 % and 14.5 - 27.5%. The highest percent elongation value was in treatment C (15% gelatin addition) of 14.5 - 27.5% and the lowest percent elongation value was in treatment A (5% gelatin addition) of 12-19%. The elongation percent value according to SNI 7818: 2014 is at least 70%, but the elongation value in this research did not complied the SNI 7818: 2014 standard. That was because the concentration of plasticizer wich was glycerol used for each treatment had the same amount, while the percent elongation value is influenced by the concentration of plasticizer. Plasticizer is able to reduce the fragility and increase the flexibility of polymer films by disrupting hydrogen bonds between adjacent polymer molecules so that the tensile strength of intermolecular polymer chains is reduced (Hidayati et al. 2015).

The elongation value of each treatment has increased from treatment A (0%) to treatment C (15%), it was estimated because of the physical properties of gelatin which is capable of forming a thin film layer that is transparent, strong, and elastic (Dianti 2008). The varying concentration of gelatin can cause differences in the character of different films (Sari et al. 2014). The addition of gelatin gave an increase in the value of elasticity because gelatin gives the flexural properties of plastic edible film. Nadiah (2010) stated, gelatin makes films have flexible properties.

CONCLUSIONS

Based on the research results it can be concluded that edible film can be formed from white snapper gelatin. The best edible film characteristics were produced by the addition of 10% gelatin with the results of transparency 1.10 - 1.22, thickness 0.22 - 0.38 mm, tensile strength of 8.87 - 12.24 Mpa and elongation of 13.5 - 22, 5% also the results complied SNI 7818: 2014 standards.

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