www.ijarp.com ISSN 2456-9992 Page: 01-14

International Journal Advanced Research Publications

Research Article

Volume: 02
Issue: 11

CHARACTERISTICS OF TILAPIA SKIN GELATIN (*OREOCHROMIS NILOTICUS*) WITH DIFFERENT DEFATTING METHODS

Dea Monika Putri, Laras Rianingsih*, Lukita Purnamayati dan Slamet Suharto

Department of Fishery Products Technology, Faculty of Fisheries and Marine Sciences, Diponegoro University, Jl. Prof. H. Soedarto S.H., Tembalang, Kec.Tembalang, Semarang City, Central Java 50275, Indonesia.

Article Received: 27 September 2026, Article Revised: 17 October 2026, Published on: 06 November 2026

***Corresponding Author: Laras Rianingsih**

Department of Fishery Products Technology, Faculty of Fisheries and Marine Sciences, Diponegoro University, Jl. Prof. H. Soedarto S.H., Tembalang, Kec.Tembalang, Semarang City, Central Java 50275, Indonesia.

Doi: https://doi-doi.org/101555/ijarp.1996

ABSTRACT

Defatting is a process which aims to reduce fat content on gelatin raw materials. A good gelatin is gelatin that has a low fat content, It is even expected that it does not contain fat. High fat content in gelatin can affect quality, storage capacity and sensory characteristics of gelatin. The objectives of this study are to find out the influence of the defatting method different in the manufacture of tilapia skin gelatin (Oreochromis niloticus) to fat content, Peroxide Numbers (PV), TBA value, gel strength, white degree and aroma sensory test, and know the best defatting process to be applied to the manufacture of gelatin. The research method uses experimental laboratories using Complete Random Design (CRD). The treatment in this study is defatting with aquades immersion at 70°C, immersion in an alcohol solution (50% ethanol), soaking of alkaline solution (NaOH 0.6%) and control treatment without the defatting process. Parametric data were analyzed by Analysis of Variance (ANOVA) and Honestly Significant Difference (HSD), while non-parametric data analyzed with Friedman Test. Test results show a difference in defatting has a noticeable effect on all test parameters (P>0,50) on tilapia skin gelatin. All gelatin produced from research meet gelatin quality standards, However, gelatin has chemical characteristics and the best sensory are gelatin with defatting process immersion at aquades temperature of 70°C. Gelatin produced by the defatting process has an average fat content of 0.47%, Peroxide Numbers 1,62 mg.eq/kg, TBA value 1.79 mg.malonaldehide/kg, gel strength 179.93 bloom, and white degrees 75.48%. Based on the results obtained, The best defatting method to be applied to the

manufacture of gelatin is Defatting with soaking of raw materials in aquades at a temperature of 70°C.

KEYWORDS: Defatting; Degreasing; Fish Skin; Gelatin; Tilapia.

INTRODUCTION

Indonesia is a maritime country which has abundant aquatic commodity products, based on data from the Ministry of Marine Affairs and Fisheries in 2020 The total fishery yield reached 19.47 tons. Many of the fishery products are sold in fresh conditions and in processed form. Processing fish into a product often produces by-products such as bones, fish skins and scales that become waste and can pollute the environment if not used. One example of utilizing fish skin waste is by utilizing the fish skin waste into gelatin. Gelatin is a protein-derived compound obtained from animal collagen extracts. Gelatin sold in the market is generally made from cow and pig bones. Gelatin has many roles in the food and non-food sectors. According to Miskah et al. (2013), gelatin contains 9 essential amino acids out of the 10 essential amino acids needed by the body, One essential amino acid that is almost not contained in gelatin is tryptophan. The functions of gelatin in various examples of types of food products include as a thickening agent, coagulant, making the product elastic, emulsifier, stabilizers, foaming agents, water binders, thin coatings, and nutritional enrichers. Making gelatin from fish skin is also an alternative For people who cannot consume gelatin obtained from cow or pork bones due to religious restrictions, For example, Muslims who cannot get gelatin from pigs and Hindus who cannot consume gelatin from cows. According to Benjakul et al. (2012), the outbreak of mad cow disease (Bovine Spongiform Encephalopathy or BSE) provoke customer anxiety against gelatin, in addition, gelatin obtained from pork rinds and pork bones cannot be used in Kosher and Halal foods due to religious restrictions. Gelatin made from fish has challenges where the fat content in fish is quite high. The content of fish meat consists of 1-22% fat, 15-24% protein, 1-3% carbohydrates, 66-84% water, and 0.8%-2% other organic matter (Ramlah et al., 2016). The fat content in gelatin will affect the nutritional quality of gelatin and its sensory appearance which will have an impact on the storage capacity. According to Siburian et al. (2020), the fat content in gelatin affects the quality and storage period. Good gelatin has a low fat content, It is even expected that it does not have fat content. Fats contained in gelatin during storage can experience firmness which will ultimately have an effect on gelatin sensory and gelatin shelf life.

According to Said et al. (2019), fat damage to food can occur in the processing process and storage period.

Fat spoilage can cause food to become smelly which then decreases in quality and nutritional value. Fat breakdown in gelatin can also have an effect on the sensory quality of gelatin. The fat content contained in the skin tissue of the fish triggers the oxidation of fat and causes a fishy smell in the fish gelatin. According to Saelaw *et al.* (2016), lipids contained in fish skin can be oxidized during extraction at high temperatures, thus increasing lipid oxidation and causing an unpleasant odor in the gelatin results. The fishy smell in fish gelatin has a negative impact on its application and acceptance for consumers. Therefore, it is necessary to carry out fat removal treatment on the skin of the fish before the gelatin extraction process as an effort to reduce the fishy smell that will be produced from fish gelatin. The purpose of this study is to determine the influence of different defatting methods on the production of tilapia skin gelatin.

2. MATERIALS AND METHODS

2.1 Ingredients

The raw materials in the study were tilapia shells obtained from PT Aquafarm Nusantara Demak, Central Java, Indonesia. Acetic acid, ethanol, NaOH (Merck, Germany) and aquades were obtained from Toko Kimia Indrasari, Semarang, Indonesia.

2.2 Preparation of Tilapia Gelatin

The process of making gelatin from tilapia skin refers to Rahmawati *et al.* (2012) with different modifications of the defatting process namely immersion in a 0.6% NaOH alkaline solution referring to Wijaya and Surti. (2015), and immersion in an alcohol solution, namely 50% ethanol, referring to Saelaw *et al.* (2016). The making of gelatin is done by preparing tilapia fish skins and cutting them into small pieces, Next, the defatting process or fat loss process is carried out. Gelatin A as a control sample was not defatting. The manufacture of gelatin B is carried out by defatting process by soaking in aquades at a temperature of 70°C for 5 minutes, then for gelatin C, a defatting process is carried out by soaking in a 50% ethanol solution with a ratio of indigo peel and solution is 1:5, The soaking process is carried out for 2 hours. Gelatin D is defatting by soaking in a NaOH solution with a concentration of 0.6%, The ratio of tilapia to the solution is 1:6. Soaking in a NaOH solution is carried out for 12 hours. The next process is the washing of the soaked indigo skin, Then a demineralization process is carried out by soaking the skin of the tilapia in a 4% acetic acid solution,

With a ratio of skin and solution of 1:4, the demineralization process is carried out for 12 hours. The soaked skin is then washed to a neutral pH, then an extraction process is carried out. The extraction process was carried out using a waterbath with a temperature of 70°C for 2 hours with a ratio of tilapia and aquades is 1:2. The next stage is the filtration process which is carried out using a blush cloth, and then the gelatin extract is dried in an oven at a temperature of 60°C for 48 hours.

2.3 Rendemen

The calculation of tilapia skin gelatin yield was based on AOAC ((2005) by comparing the dry weight of gelatin with the wet weight of the raw material used before the extraction process was multiplied by 100%.

2.4 Gel Strength

The strength of the gel is expressed in bloom units. The strength test of gelatin gel refers to British Standard 757 (1975), where a gelatin sample of 6.67% (b/v) was dissolved in aquades until it reaches a volume of 100 ml and transferred to a 100 ml cup cup, then heated until the gelatin dissolves, The solution is then cooled to a temperature of 100C for 17 hours. The solution that has formed a gel is then analyzed using the LFRA Texture Analyzer.

2.5 White degree

The degree of white is the ability of a material to reflect light that hits the surface of the material. The calculation of white degree values is carried out by preparing samples in a metric cup evenly, then measured the white degree using the Oppo F7 smartphone camera with Color Grab software. The results obtained on the Color Grab software are L, a, and b values. The L value or lightness is the brightness level of the sample, the value of a indicates the value of the red-green degree and the value b indicates the degree of yellow-blue (Dewantoro *et al.* , 2019).

2.6 Fat Content

Fat content analysis using the sokhletation method based on BSN (1995). A sample of 1-2 grams is put into a paper sleeve lined with a cotton swab. The sample is then dried in an oven at a temperature of no more than 80°C for one hour. The sample was then put into a Soxhlet device that had been connected to a fat gourd filled with boiling stones that had been dried and had a known weight. The extract process is carried out using n hexane for approximately 6 hours, The next procedure is to distill hexane. The fat extract is dried in a drying oven at 105°C. The fat extract is then cooled and weighed. Drying is repeated until a fixed weight is obtained. The fat content is calculated by dividing the amount of the extract by the sample number multiplied by 100%.

2.7 Peroxide Value

Peroxide Value is a number that determines the degree of damage to fat. The peroxide value test to be carried out refers to Montolalu *et al.* (2019), namely a sample of 10 grams of sample is put in a closed Erlenmeyer and added 30 ml of a mixture of glacial acetic acid solvent: chloroform (3:2 v/v), after the sample is completely dissolved then 0.5 ml of saturated potassium iodine is added and beaten for 1 minute and 30 ml of aquades is added. The iodine released by the peroxide is titrated with a standard solution of sodium thiosulfate (Na2S2O3) 0.1015 N with an amylum indicator until the blue color is lost.

2.8 Thiobarbituric Acid Value

TBA testing is performed by preparing 10 g of carefully weighed samples and put it in a waring blender which is then added 50 ml of aquas and crushed for 2 minutes. The sample was then quantitatively transferred into a distillation flask while washed with 47.5 ml of aquades. A total of 2.5 ml of HCl 4 N (1 part concentrated HCl in 2 parts water) is added until the pH becomes 1.5. Distillation with the highest possible heating is carried out for 10 minutes until 50 ml of distillation is obtained. The distillate is stirred and transferred as much as 5 ml into a closed 50 ml erlenmeyer and 5 ml of TBA reagent is added so that a red complex is formed (Dewi, 2021).

3. RESULTS AND DISCUSSION

Table 1. Physical properties of gelatin with different defatting methods.

Sample	Rendemen (%)	Gel strength (bloom)	White Degree
A	37,22%±2,54^{c}	146,79±2.03^{b}	58,77±2,47^{a}
B	31,00%±1,00^{ab}	175,93±4.49^{c}	75,48±4,72^{b}
C	33,66%±2,08^{bc}	95,04±1.42^{a}	62,82±3,82^{a}
D	26,00%±1,41^{a}	313,70±10.28^{d}	64,76±3,82^{a}

Note: The data is the result of an average of 3 repetitions ± standard deviation. - Data followed by different lowercase marks show a noticeable difference (P<0,05). A: Gelatin without defatting process B: Gelatin with a high-temperature aquades defatting process (70°C) C: Gelatin with alcohol solution defatting process (50% ethanol) D: Gelatin with alkaline solution defatting process (NaOH 0.6%)

3.1 Rendemen

Based on the results of the research, the most yield is obtained from the gelatin manufacturing process without the defatting process. Yield is one of the parameters used to assess a production process as a basic material for financial analysis. The yield of gelatin without the defatting process is higher than that of defatting treatment because in control gelatin there is no fat removal process, The defatting process is suspected to have dissolved a lot of collagen content in raw materials, So that the gelatin extract obtained is less than the gelatin produced from the manufacturing process without the defatting process. According to Saelaw *et al.* (2016), the defatting process has a bad effect on the yield of gelatin. The yield of gelatin produced by the defatting process is less than that of gelatin without the defatting process. The highest gelatin yield was gelatin without treatment as much as 37.22%, and the lowest gelatin yield was gelatin with 0.6% NaOH soaking treatment of 26.00%. The range of gelatin yield produced from the study was 26.00% to 37.22%, the results were more than other studies. The gelatin yield produced in the research of Febryana *et al.* (2018), using 1% citric acid produced a tilapia peel gelatin yield of 12.98% and the research of Nurimala *et al.* (2017), the yield of gelatin from tilapia skin extracted using 0.2% citric acid as much as 19.64% and research by Irvan *et al.* (2019), The result of gelatin yield using 3% acetic acid yields a gelatin yield of 13.60%. According to Wijaya and Surti (2015), the yield of gelatin extract depends on several factors such as the type of skin raw material, pre-treatment process and extraction process.

3.2 Gel strength

Based on the results of the gel strength test obtained, there was a significant difference in the value of gel strength between defatting treatment using NaOH of 0.6% compared to other treatments. NaOH in the gelatin manufacturing process plays a role in removing fat while dissolving non-collagen proteins, The dissolution of non-collagen proteins can maximize the process of collagen hydrolysis thereby increasing the purity of gelatin. The higher the purity of the gelatin produced, the higher the value of the gel's strength. According to Siburian *et al.* (2020), the more collagen is hydrolyzed into gelatin, the more the amino acid composition contained in gelatin becomes denser and longer, and the water absorption will be stronger and the strength of the resulting gel will also be higher. Based on Febryana *et al.* (2018), the high value of gel strength in gelatin proves that the conversion of collagen to gelatin is going well. The lowest gel strength is in gelatin with the defatting method using a 50% ethanol solution, which is 94.59 bloom.

This can happen because the defatting process using alcohol groups causes proteins to become susceptible to solvents and causes aggregation and increased hydrophobic properties. According to Saelaw *et al.* (2016), alcohol groups such as isopropanol, ethanol and other alcohol groups used during the defatting process compete with proteins in binding water resulting in a lot of water loss from protein molecules. This results in a poor gel development process. The average strength of the gel produced in the study ranged from 94.59 to 325.54 blooms. The value of the gel strength has met the requirements of GMIA (2012), where the strength of the gelatin gel ranges from 50 to 300 blooms. The results of the gel strength value obtained are higher than previous studies, As in the research of Febryana *et al.* (2018), the gel strength produced by tilapia skin is 132.54 blooms. Hidayat *et al.* (2016), tilapia skin gelatin using phosphoric acid produced a gel strength of 303.18 bloom and research by Nurilmala *et al.* (2017), the strength of tilapia skin gelatin gel processed using 0.2% citric acid is 59.73 blooms.

3.3 White Degree

The calculation of the white degree value is obtained from the results of the values a, b and L which are then converted into the white degree formula. A value indicates the red-green color degree value, b indicates the yellow-green color degree and L indicates the brightness of the sample. BBased on the results of the study, the average white degree value of tilapia skin gelatin was found in gelatin with the defatting method of soaking aquades at a temperature of 70°C, which was 75.48 with an average L value of 88.7 and the sample with the lowest white degree value was the sample without defatting treatment, which was 58.77 with an average L value of 79.1. L value indicates the brightness of the product, L value 0 to 50 is included in brightness with a low level indicating color darkness and the value of L 50 to 100 indicates a high level of color brightness, so the higher the L value, the brighter the color of the product. The results of the white degree on gelatin in the study showed that the defatting method carried out had an effect on the value of white degrees. The gelatin produced in the study has a yellowish-white color, but has a different brightness level. The white degree value in gelatin samples produced using the heating defatting process was higher than in gelatin samples without the defatting process. The sample with the highest fat content had a yellower and darker color than other samples with lower fat content. According to Nurmillah (2018), the color that tends to be darker is thought to be caused by the presence of a fat component that is influenced by temperature in the gelatin drying process.

The drying process of gelatin at a temperature of 60°C is suspected to result in a hydrolysis process in the fat components contained in the gelatin. The fat hydrolysis reaction produces free fatty acids that can cause the color of the food to darken further.

Table 2. Chemical properties of gelatin with different defatting methods.

Sample	Fat content (%)	Peroxide Value (meq/kg)	Thiobarbituric Acid Value (mg malonaldehid/g)
A	0,63±0.04^{c}	3,84±0.05^{c}	7,41±0.03^{c}
B	0,47±0.04^{a}	1,62±0.03^{a}	1,79±0.01^{a}
C	0,58±0.08^{bc}	5,38±0.04^{d}	9,72±0.04^{d}
D	0,53±0.00^{ab}	3,17±0.03^{b}	3,72±0.04^{b}

Note: The data is the result of an average of 3 repetitions ± standard deviation. - The data followed by different lowercase marks showed a noticeable difference (P<0.05). A: Gelatin without defatting process B: Gelatin with high temperature aquades defatting process (70°C) C: Gelatin with alcohol solution defatting process (50% ethanol) D: Gelatin with alkaline solution defatting process (NaOH 0.6%)

3.4 Fat Content

Based on the fat content test carried out, the results were obtained that gelatin with the heating defatting process had the lowest fat content compared to the soaking treatment of NaOH and also ethanol. This is because soaking gelatin raw materials in hot water at a temperature of 70°C is effective in dissolving the fat in the raw material, where the temperature of 32-80°C is the melting point of fat. Menurut Pertiwi *et al.* (2018), The gelatin defatting process is usually carried out using a temperature of 32-80°C, the temperature range is the point of fat solubility and albumin coagulation. The use of temperatures above 80°C can reduce the amount of gelatin extract produced. The more fat dissolves in the defatting process, the less fat content in the gelatin will be. Gelatin is produced using the defatting method of 0.6% NaOH solution has an average fat content of 0.53%, based on these results, it can be seen that the defatting process using an alkaline solution of natirum hydroxide can reduce the fat content contained in gelatin raw materials. This is because alkaline compounds such as sodium hydroxide have heat properties that can erode the fat content contained in food. The process of fat erosion by sodium hydroxide is called fat hydrolysis, in the process of fat hydrolysis, the fat in the material is converted into the constituent components of fat, namely fatty acids and glycerol so that fat will be easier to remove from the material.

The process of fat hydrolysis can occur due to the action of lipase enzymes, where lipase enzymes are included in alkaline enzymes. According to Nurdiani *et al.* (2019), Sodium hydroxide can catalyze the fat content that remains in the fish's skin. Sodium hydroxide dissolved in water can erode the fat contained in the material so that the soaking of raw materials in the NaOH solution is one of the factors that affect the fat content contained in gelatin.

The defatting method using a 50% ethanol solution produces gelatin with an average fat content of 0.58%. The fat content is not much different from gelatin produced without using the defatting process. Based on these results, it can be concluded that the defatting process using an alcohol solution can reduce the fat content in gelatin, although it is not as significant as other defatting methods. Ethanol removes fat in skin tissue by breaking lipid bonds with other materials so that some of the lipids in the raw material are also dissolved in ethanol solvents. According to Karepu *et al.* (2020), ethanol is a universal solvent and has been labeled as food grade that can dissolve all compounds, both non-organic compounds and organic compounds such as fats, carbohydrates and others, Susanti *et al.* (2014) states that ethanol is one of the common and widely used solvents in industry and has a low boiling point. Fats have general properties that are soluble in organic solvents such as ether, benzene, acetone, chloroform but slightly soluble in the alcohol group. Based on the results of the gelatin fat content test, the average fat content in tilapia skin gelatin produced in the study was 0.55%, with the highest average fat content found in control gelatin, namely gelatin without defatting or fat removal treatment of 0.63% and the lowest fat content is found in gelatin with a defatting process by immersion in hot water at a temperature of 70°C of 0.47%. The average gelatin fat content obtained is still higher than that of gelatin sold commercially. According to Rahmawati and Pranoto (2012), the fat content contained in commercial gelatin is 0.23 to 0.25%. The average level of tilapia gelatin fat obtained is still higher than that of commercial gelatin, but the average gelatin fat content obtained still meets the SNI gelatin standard. According to Panjaitan (2017), one of the important requirements of gelatin is that the limit of fat content contained in gelatin does not exceed 5%. Fat in gelatin related to the quality of fat breakdown can cause a decrease in nutritional value, as well as cause a deviation in the taste and smell of gelatin. The lower the gelatin fat content, the better the quality of the gelatin.

3.5 Peroxide Value

Based on the results of the peroxide value in indigo skin gelatin, the results were obtained that the highest peroxide value was found in gelatin with a defatting process using a 50% ethanol solution and the lowest peroxide value is found in gelatin with the defatting process by heating. The peroxide value (PV) is an early indication of the early stages of fat oxidation, The higher the gelatin peroxide number, the higher the presence of hydroperoxide produced through the lipid oxidation process. The lowest peroxide number is in gelatin with a heating defatting process, with an average peroxide value of 1.62 mg.eq/kg, This is suspected because the gelatin has the lowest fat content compared to gelatin with other defatting treatments. The higher the fat content contained in gelatin, the greater the likelihood of lipid oxidation in the gelatin. According to Saelaw *et al.* (2016), the removal of phospholipids from raw materials before the protein hydrolysis process in gelatin has been shown to reduce the level of gelatin oxidation, although lipid oxidation can still occur at a certain level. The gelatin with the highest peroxide value is gelatin produced by the defatting method using 50% ethanol. This can happen because the fat content in the gelatin is still high compared to gelatin with other defatting methods, allowing the oxidation process that occurs to be high. Ethanol works by breaking down lipid bonds with proteins and other substances found in skin tissue, It is suspected that when ethanol works to break lipid bonds with other materials, the pro-oxidant content is also broken down, causing the oxidation process that occurs in the sample to be faster. According to Saelaw *et al.* (2016), defatting using alcohol removes lipid substrates and some pro-oxidants on the skin. Some lipids and pro-oxidants that are still present in the sample can speed up the oxidation process. Other factors that can affect the oxidation of fats are the presence of oxygen, temperature and light in the product storage environment. According to Christie *et al.* (2016), the amount of oxygen will affect oxidation, The more oxygen, the faster the product will oxidize. Storage temperature also affects oxidation where products stored at room temperature are more easily oxidized than cold temperature storage. Light also affects the oxidation process where the higher the light that comes into direct contact with the product will accelerate the oxidation of the product. The gelatin peroxide number obtained in the research ranged from 1.67 to 3.84 mg.eq/kg. The peroxide number is relatively low compared to the peroxide number produced in the research of Saelaw *et al.* (2016), who tested the value of peroxide on gelatin of snapper skin that was processed without defatting treatment and with defatting treatment using isopropanol solution.

The peroxide value produced was 9.20 to 14.1 mg.eq/kg, and in another study on snapper skin gelatin with the defatting process and with the addition of tannic acid antioxidants, a peroxide figure of 35.71 mg.eq/kg was produced.

3.6 Thiobarbituric Acid value

Based on the research conducted, the highest TBA content was found in tilapia skin gelatin with 50% ethanol immersion with an average TBA rate of 9.72 mg.malonaldehyde/kg and the lowest TBA content was found in gelatin with heating defatting with an average TBA figure of 1.79 mg.malonaldehyde/kg. TBA is the result of the decomposition of hydroperoxide into secondary oxidation which is the advanced stage of the fat oxidation process. The TBA number is an indicator to measure secondary products of lipid oxidation, especially those derived from polyunsaturated fatty acids (PUFAs) and indicates the level of stirring. According to Saelaw *et al.* (2016), hydroperoxide decomposes in several stages, produce a wide range of decomposition products, including aldehydes, and others. Lipid oxidation produces a variety of secondary aldehydes of the product, including n-alkanal, trans-2-alkene, 4-hydroxy-trans-2-alkene, and malonaldehyde. These secondary lipid oxidation products can cause rancid odors in gelatin. TBA value have an effect on the sensory characteristics of gelatin, Because the hydroperoxide formed at the beginning of oxidation turns into ketones and aldehydes which have an effect on the sensory smell of gelatin. The fat loss process that has been carried out does not rule out the possibility of oxidation, kMolonaldehyde arenas are highly labile and highly reactive to proteins and fatty acids, Therefore, the change in TBA value at the time of storage is unstable. According to Puspasari *et al.* (2017), malonaldehyde resulting from fat oxidation is labile and highly reactive to amino acids and proteins. This results in the value of TBA during storage being unstable. The average range of TBA values in gelatin obtained from the study was 1.79 to 9.72 mg.malonaldehide/kg. The levels of TBA that are still classified as safe in food are kadar TBA on gelatin produced using the heating defatting method is 1.79 mg.malonaldehide/kg. According to Dewi (2021), the maximum limit of the number of TBA in food products is 2 malonaldehyde/kg.

4. CONCLUSIONS

Different methods of defatting or fat removal have an effect on the physical and chemical characteristics of tilapia skin gelatin. Different defatting methods affect the control of fat content parameters, peroxide value (PV), and TBA value, However, there is no significant difference in the white degree parameters.

Based on the results obtained, the best defatting method to be applied to the manufacture of gelatin is defatting by soaking raw materials in aquades at a temperature of 70°C.

5. REFERENCES

1. Association Of Official Analytical Chemist. (2005). Official Method of Analysis of The Association of Official Analytical of Chemist. Arlington: The Association of Official Analytical Chemist, Inc.
2. Benjakul, S., Kittiphattanabawon, P., & Regenstein, J. M. (2012). Fish gelatin. In B. K. Simpson (Ed.), *Food biochemistry and food processing* (2nd ed., pp. 388–405). Wiley-Blackwell.
3. British Standards Institution. (1975). *Methods for sampling and testing of gelatin (physical and chemical methods)* (BS 757:1975). BSI Group.
4. Christie, T. M., Ma'ruf, W. F., & Susanto, E. (2016). Reducing oxidation of salted dried catfish (*Arius thalassinus*) jambal roti using edible film coating during room temperature storage. *Jurnal Pengolahan dan Bioteknologi Hasil Perikanan*, 5(1), 94–100.
5. Dewantoro, A. A., Kurniasih, R. A., & Suharto, S. (2019). Application of tilapia fish scales gelatin (*Oreochromis niloticus*) as thickener in pineapple syrup. *Jurnal Ilmu dan Teknologi Perikanan*, 1(1), 37–46.
6. Dewi, Y. K. (2021). Thiobarbituric Acid (TBA) value and Total Plate Count (TPC) of red, black, and white rice sponge cake during storage. *CERMIN: Jurnal Penelitian*, 5(1), 150–158.
7. Febryana, W., Idiawati, N., & Wibowo, M. A. (2018). Gelatin extraction from featherback fish (*Chitala lopis*) skin with acetic acid treatment process. *Jurnal Kimia Khatulistiwa*, 7(4), 116–123.
8. Gelatin Manufacturers Institute of America. (2012). *Gelatin handbook*. GMIA.
9. Hidayat, G., Dewi, E. N., & Rianingsih, L. (2016). Characteristics of tilapia bone gelatin hydrolyzed using phosphoric acid and papain enzyme. *Jurnal Pengolahan Hasil Perikanan Indonesia*, 19(1), 69–78.
10. Irvan, M., Darmanto, Y. S., & Purnamayati, L. (2019). Effect of addition gelatin from different fish skin on the characteristics of chikuwa. *Jurnal Ilmu Pangan dan Hasil Pertanian*, 3(1), 78–93.
11. Karepu, M. G., Suryanto, E., & Momuat, L. I. (2020). Chemical composition and antioxidant activity of coconut paring (*Cocos nucifera*). *Chemistry Progress*, 13(1), 32–38.

12. Miskah, S., Ramadianti, I. M., & Hanif, A. F. (2013). Effect of CH_3COOH and HCl concentration as solvent and soaking time in making gelatin from chicken feet bone/skin. *Jurnal Teknik Kimia*, 19(1), 1–8.
13. Montolalu, G. T., Fatimah, F., & Kamu, V. (2019). Quality test of commercial skipjack tuna (*Katsuwonus pelamis*) bakasang based on Free Fatty Acid (FFA) and Peroxide Value (PV) parameters. *Chemistry Progress*, 12(1), 22–26.
14. National Standardization Agency of Indonesia. (1995). Gelatin quality and test methods. Indonesian National Standard (SNI) 06-3735-1995. Jakarta, Indonesia.
15. Nurdiani, R., Yufidasari, H. S., & Sherani, J. S. (2019). Characteristics of edible film from red snapper (*Lutjanus argentimaculatus*) skin gelatin with pectin addition. *Jurnal Pengolahan Hasil Perikanan Indonesia*, 22(1), 174–186.
16. Nurilmala, M., Jacoeb, A. M., & Dzaky, R. A. (2017). Characteristics of yellowfin tuna skin gelatin. *Jurnal Pengolahan Hasil Perikanan Indonesia*, 20(2), 339–350.
17. Nurmilah, S. I. T. I., & Mujdalipah, S. (2018). Gelatin extraction from snapper (*L. macolor niger*) bone using acid method. *Pangan*, 27(1), 31–38.
18. Panjaitan, T. F. C. (2017). Optimization of gelatin extraction from yellowfin tuna (*Thunnus albacares*) bone. *Jurnal Wiyata: Penelitian Sains dan Kesehatan*, 3(1), 11–16.
19. Pertiwi, M., Atma, Y., Mustopa, A. Z., & Maisarah, R. (2018). Physical and chemical characteristics of gelatin from catfish bones with citric acid pre-treatment. *Jurnal Aplikasi Teknologi Pangan*, 7(2), 83–90.
20. Puspasari, A. R., Dewi, E. N., & Rianingsih, L. (2017). Antioxidant application of seagrass (*Cymodocea rotundata*) extract on eastern little tuna (*Euthynnus affinis*) oil. *Agritech*, 37(2), 115–120.
21. Rahmawati, H., & Pranoto, Y. (2012). Yield and proximate composition of eel and catfish skin gelatin in fresh and dry conditions. *Fish Scientiae*, 2(2), 111–123.
22. Ramlah, R., Soekendarsi, E., Hasyim, Z., & Hassan, M. S. (2016). Comparison of nutritional content of tilapia *Oreochromis niloticus* from Lake Mawang, Gowa Regency and Lake Hasanuddin University, Makassar City. *BIOMA: Jurnal Biologi Makassar*, 1(1), 39–46.
23. Sae-leaw, T., Benjakul, S., & O'Brien, N. M. (2016). Effect of pretreatments and drying methods on the properties and fishy odor/flavor of gelatin from seabass (*Lates calcarifer*) skin. *Drying Technology*, 34(1), 53–65.

24. Said, M. I., Abustam, E., Wahab, A. W., Taba, P., Gani, A., & Wahid, A. M. (2019). Effect of ethanol used in a degreasing process on Bali cattle bones on the physicochemical properties of extracted collagen. *Bulgarian Journal of Agricultural Science*, 25(2), 418–423.
25. Siburian, W. Z., Rochima, E., Andriani, Y., & Praseptiangga, D. (2020). Fish gelatin (definition, manufacture, analysis of quality characteristics, and application): A review. *International Journal of Fisheries and Aquatic Studies*, 8(4), 90–95.
26. Susanti, C. M., Sugiharto, R., Setyani, S., & Subeki, S. (2014). Effect of ethanol solvent volume and fractionation temperature on the characteristics of cocoa butter extracted from non-alkalized cocoa powder. *Jurnal Teknologi Industri dan Hasil Pertanian*, 19(3), 307–319.
27. Wijaya, O. A., & Surti, T. (2015). Effect of NaOH soaking duration in degreasing process on the quality of tilapia (*Oreochromis niloticus*) bone gelatin. *Jurnal Pengolahan dan Bioteknologi Hasil Perikanan*, 4(2), 25–32.