Analysis of the Physicochemical Properties of Gelatin From Mahi-Mahi Skin *(Coryphaena hippurus)*

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Abstract- Gelatin is a protein resulted from partial collagen hydrolysis made from animal's skin or bones. Mahi-mahi or lemadang fish is one of the large pellagic fish commercialized as *fillet* while its bone and skin was mostly unused and thus suitable to produce gelatin. Objective of this study was to found out the best physicochemical properties of gelatin made from mahi-mahi skin after curing for 6, 7 and 8 hours using tartaric acid. Best result shown in 8 hours curing with rendemen 14,04%, gel strength 14,75 N, viscosity 6,52 cP; protein content 86,18%; fat content 0,46%; water content 8,18%; pH 4.87 and glicyn amino acid content 23,09% and prolin 13,22 as the main amino acid structure in gelatin.

Index Terms- gelatin, gel strength, viscosity, yield, proxsimate

I. Introduction

Gelatin is denatured protein made from collagen tissue through *thermo-hydrolysis* process and is *reversible*. Gelatin has typical trait such as able to expand in cold water, able to form film, affect material's viscosity, and able to protect colloid system (Saputra, 2015). Physical trait that highly affect gelatin's quality were gel strength, viscosity and melting point. These traits were influenced by several factors such as solution used in *curing* process, solution's concentration, curing duration, heating temperature, pH and salinity. Factors during gelatin extraction process, such as curing duration and extraction temperature might also influence its trait (Tazwir et al., 2007). *Curing* process is a collagen denaturation process (*triple helix*) into *single helix*. *Curing* process might use acid or alkali solution however acid solution was common to use in order to produce more rendemen and shorter duration compared to using alkali solution (Siregar et al., 2015).

Mahi-mahi fish is one of the fish commercialized as fillet product thus its skin and bones were unused and contributing to higher environmental pollution. Therefore, this study would like to produce gelatin made from the skin of mahi-mahi fish through modifying the *curing* treatment in order to found out the best physicochemical characteristic of gelatin made from mahi-mahi fish.

II. MATERIALS AND METHODS

Main materials used were skin of mahi-mahi fish and obtained from CV. RUM Seafood, Sidoarjo. Other materials were tartaric acid ($C_4H_6O_6$), NaOH, aquadest, aluminum foil and filter paper.

Method used in this study was complete random design with 3 treatments and 6 replications. Treatments used were variation in curing duration for 6, 7 and 8 hours. Gelatin production processes were cleaning the skin from any meat and debris. It was cut into 1-2 cm, and weighed to 100 gr to be cured in NaOH 0,1N for 2 hours with ration 1:3 (w/v) to eliminate non-collagen protein. It was rinsed with aquadest to reach neutral pH and then cured using tartaric acid solution 0,05 M with variation in duration of 6, 7 and 8 hours using ratio 1:3 (w/v) and rinsed to reach neutral pH. Aquadest was added with 1:3 ratio (b/v) and extracted using water-bath in 60°C for 12 hours. Next, it was filtered and poured into tray to be dried in the oven using 60°C for 48 hours and gelatin sheet was obtained. Analysis was done for rendemen, gel strength, viscosity and amino acid to obtain the best treatment.

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III. RESULT AND DISCUSSION

3.1 Yield

Rendemen yield in gelatin made from mahi-mahi fish with curing variation was ranged between 11.87%-14.04%. Figure 1 shows that longer curing produce higher rendemen. This occurs due to acid that could change the triple helix structure of collagen into single helix structure in which longer interaction between acid with collagen would means more collagen converted into gelatin. It would brought more result during gelatin extraction process. According to Trilaksani et al., (2012) rendemen value would highly relate with the amountof collagen converted and transformed into gelatin. Amount of gelatin rendemen would be influenced by amount of H^+ ion to change its *triple helix* into *single helix* structure. The tendency to hydrolyze collagen would reach its limit if H^+ ion hydrolyzes collagen further and thus changing its physical and chemical properties.

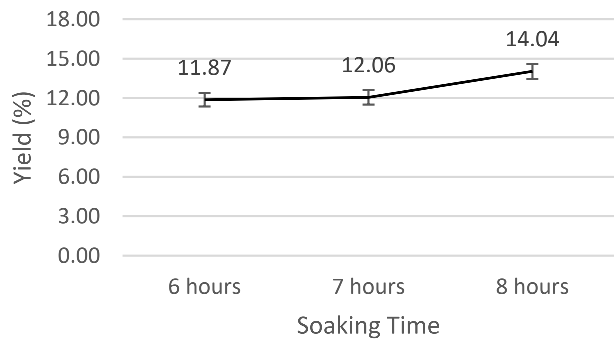

Figure 1. Yield of gelatin from mahi-mahi skin

3.2 Gel Strenght

Gel strength of gelatin made from mahi-mahi fish under curing treatment was ranged between 13.87-14.75 N. Figure 2 shows that longer curing means higher gel strength. Gel strength value was influenced by the length of amino acid chain being formed. Longer amino acid chain means higher gel strength. According to Azara (2017), collagen hydrolysis by H+ ion occurs during curing process whereas longer curing means hydrolysis process would also continue and thus would affects the polypeptides chain length.

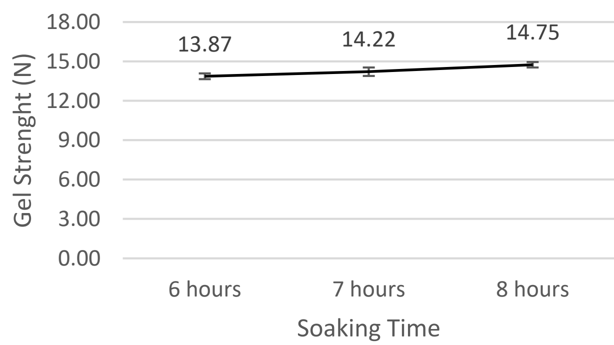

Figure 2. Gel strength of gelatin from mahi-mahi skin

3.3 Viscosity

Viscosity result from gelatin made from mahi-mahi fish skin was ranged between 5.61-6.52 cP. Figure 3 shows that longer curing means higher viscosity value. Viscosity value would be related with the gelatin's molecular weight while molecular weight was also related with amino acid chain length. Longer amino acid chain length means higher viscosity. Other than this, viscosity value would also caused by hydrodynamic interaction between molecules, pH and concentration of the curing solution/agent (Juliasti et al., 2014). Viscosity result in this study was in line with gelatin standard value according to GMIA which ranged from 1.5-7.5.

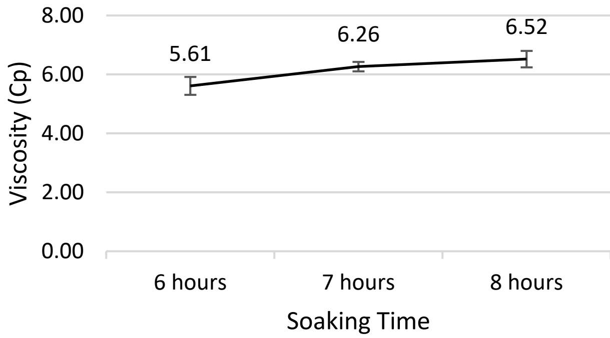

Figure 3. Viscosity of gelatin from mahi-mahi skin

3.4 Protein Content

Protein content of gelatin made from mahi-mahi fish skin was ranged between 80.97%-86.18%. Figure 4 shows that longer curing causing higher protein content. This might occur because during acid curing process, it would change the *triple helix* structure into single helix. Longer curing would also means that interaction between acid and collagen would be longer and erode more gelatins during extraction and thus its protein content was quite high. Gelatin with high protein content indicates that it has good quality. Gelatin with high protein content was expected to add more nutrients into its subsequent processed food made from it (Sasmitaloka et al., 2017).

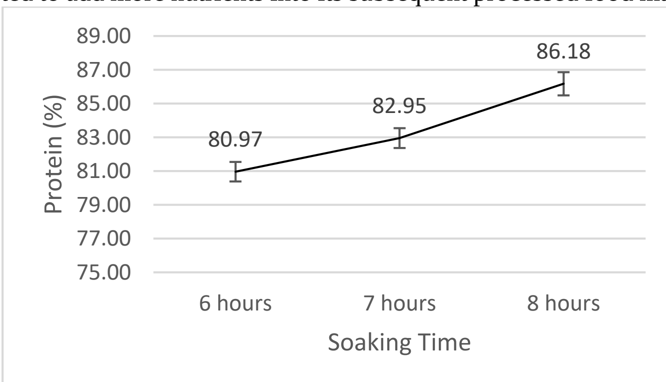

Figure 4. Protein content of gelatin from mahi-mahi skin

3.5 Fat Content

Fat content of gelatin made from mahi-mahi fish skin under various curing treatment was ranged 0.46-0.83%. Figure 5 shows that longer curing causing lower fat content. Curing that use alkali solution and acid solution might decrease gelatin's fat content. High fat content would affect its quality whereas lower fat content means higher quality because it lowers the possibility of rancid gelatin (Shon et al., 2011).

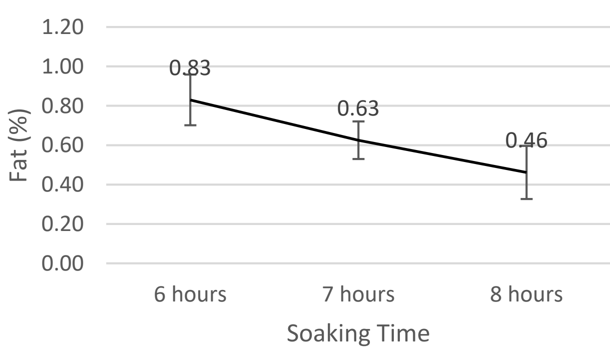

Figure 5. Fat Content of gelatin from mahi-mahi skin

3.6 Water Content

Water content of gelatin made from mahi-mahi fish skin under various curing treatment was ranged between 6.91-8.18%. Figure 6 shows that longer curing causing higher fat content. Longer curing would cause longer contact of H+ ion with the skin and causing higher water content due to hydrogen bond in tropocollagen would be hydrolyze and creating tropocollagen chains that losing its triple helix structure and would be making the skin puffed and more solution/agent would penetrate the skin (Fauziyyah et al., 2017). Water content within gelatin would be influenced by its drying and curing process. Drying process would relate with the water loss in gelatin while curing would related with its water absorption.

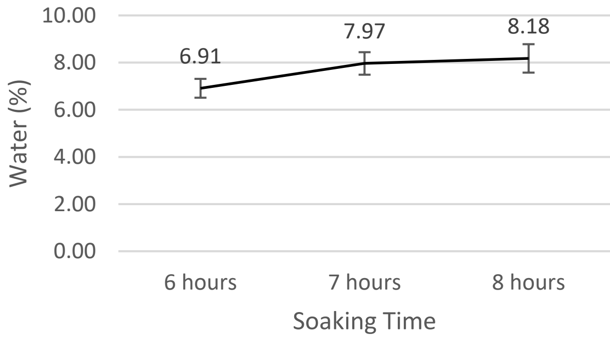

Figure 7 Water content of gelatin from mahi-mahi skin

3.7 Acidity

Acidity of gelatin made from mahi-mahi fish skin under various curing treatment was ranged 4.87-6.02. Figure 8 shows that longer curing means stronger acidity. In other words, curing would create better pH value or almost neutral because in curing process, the acid would not be absorbed into the fibril collagen tissue and thus during rinsing, this acid solution would be cleaned easily. Standard of gelatin pH based on GMIA is 3,8-5,5.

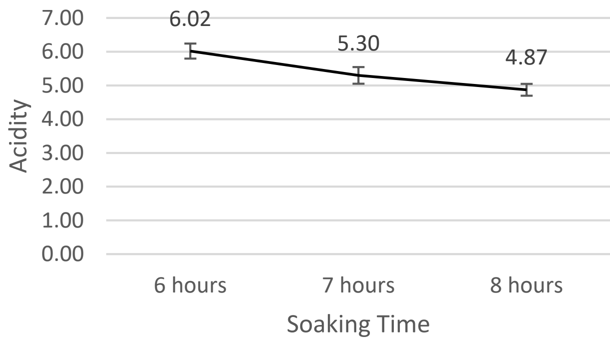

Figure 8 Acidity of gelatin from mahi-mahi skin

3.7 Amino Acid Profile

Amino acid is protein constituent and consists of one C central atom which binds covalently. Amino acid can be grouped into two main category, essential amino acid and non-essential amino acid. Essential amino acid is amino acid that cannot be produce by the body and should be obtained from the food while non essential amino acid is the amino acid produced by the human body. The profile of amino acid in gelatin made from mahi-mahi skin with best curing treatment for 8 hours can be seen in Table 1.

No	Parameter	Unit	Result
1	L-Serin	%	3.29
2	L-Asam Glutamat	%	10.21
3	L-Fenilalanin	%	1.74
4	L-Isoleusin	%	1.34
5	L-Valin	%	2.44
6	L-Alanin	%	9.42
7	L-Arginin	%	6.49
8	Glisin	%	23.09
9	L-Lisin	%	4.03
10	L-Asam Aspartat	%	5.21
11	L-Leusin	%	2.85
12	L-Tirosin	%	0.24
13	L-Prolin	%	13.22
14	L-Threonin	%	2.21
15	L-Histidin	%	0.56

Largest amino acid content of gelatin made from mahi-mahi fish skin was glycin with 23.09% followed by L-proline 13.22%, while the least amino acid was L-tirosin 0.24%. Glycin and proline is the main amino acid that constitutes the gelatin. Amino acids constituting gelatin would form peptide-bond with transformed unit glycin-proline-hydroxyproline, whereas composition and sequence of amino acid in gelatin would be different from one to another, depends on its species and its tissue type but it will always contain glycin, proline, and hydroxyproline with high percentage (Puspaswati et al., 2017). Gelatin with high glycin and proline as its amino acid would have higher gel strength (Santoso et al., 2015). Glycin and proline amino acid also has its important role in the physical characteristic of gelatin. Glycin content in gelatin was highly important in water binding effort when applied to the products (Pranoto et al., 2011)

IV. CONCLUSION

The best treatment in the making of gelatin made from mahi-mahi fish skin was 8 hours curing process with rendemen of 14.04%, gel strength 14,75N, viscosity 6,52 cP, protein content 86.18%, fat content 0.46%, water content 8.18%, pH 4.87 also glycin content of 23,09% and proline content of 13,22%. .

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