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REVIEW ARTICLE: THE UTILIZATION OF FISH BONE FOR GELATIN

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Abstract

Gelatin is made from fish bones that has a good potential in Indonesia, in addition to be guaranteed halal, gelatin is made from fish bone meal. It is expected to overcome the problem of fishery waste which can have a negative impact on the environment. This article contains how to determine the processing and methodological of making fish bones into gelatin. Based on the literature study, there was an information that the manufacture or extraction of gelatin from fish bones consisted of 4 stages, namely preparation, demineralization, swelling and hydrolysis or extraction.

Keywords: Waste, potential, stages, demineralization.

PRELIMINARY

Fish is one of the foodstuffs that have a high enough content of nutritional, therefore it is in great demand by the public. Based on KKP data (Ministry of Marine Affairs and Fisheries) that fish consumption in 34 provinces of Indonesia in 2019 reached 55.95 kg/capita/year. In addition, the large demand for fish consumption will cause a problem, namely fishery waste.

Fishery waste can come from industrial waste fishery products in the form of solid or liquid. The form of fishery solid waste is fish heads, fish bones, fish scales and fish innards, while liquid waste can be in the form of washing products from fish processing, fish blood and so on (Vatria, 2020). One of the largest wastes that can pollute the environment is fish bone waste with an amount of about 20% of the total body weight of fish (Panjaitan, 2016). One of the optimal utilization of fish bone waste is the manufacture of gelatin.

Gelatin is a polypeptide bond that results from the denaturation of bone and skin collagen. Gelatin is one of the ingredients that is widely used in the pharmaceutical and food industries (Panjaitan, 2016). Gelatin has properties such as gel strength, viscosity and melting point which are important for the use of food ingredients. In the manufacture of gelatin, it can be done in two ways, namely acid and alkaline methods. Gelatin production can increase gross domestic income. The countries who is gelatin supplier to Indonesia are China with a total of 3,887 tons, Japan with 969 tons, and France with 278 tons. The purpose of this paper is to find out the processing and methodological of making fish bones into gelatin

Fishbone potentially as raw material for gelatin

Based on the results of research which was conducted by Junianto *et all*., 2006 that the manufacture of gelatin from fish bones can show that the highest gelatin yield is obtained in the extraction of tilapia bones, followed by a mixture of tilapia and tuna. Gelatin extraction is the utilization of canning or fillet industry waste which produces

waste in the form of fish bones. Fish bones as waste cannot be utilized optimally and are only reprocessed into feed or fertilizer which has low economic value.

Figure 1. Fish Flour Gelatin

Gelatin is a protein derivative that it is made of collagen fibers found in bone, skin and cartilage. Gelatin is soluble in water, acetic acid, and alcohol solvents but is insoluble in alcohol, acetone, carbon tetrachloride and others. Gelatin can be dissolved at a temperature of 49°C or at a temperature range of 60-70°C (Montero *et al*., 2000). From its shape, gelatin (Figure 1) can change reversibly from a sol to a gel, swell and/or expand in cold water and can form a film, affect the viscosity of a material, and can protect colloidal systems (Parker, 1982).

Utilization of Fish Bones for Gelatin

Fish bones can be reused as raw material for gelatin. The process method in processing fish bones into gelatin is a clean processing. Clean production is a processing concept that can reduce environmental pollution (Wicaksono, 2017). Gelatin can be used as a food ingredient that has a function for muscle growth precursors and keratin, as a flavor enhancer. In addition, gelatin has high protein and low calorie properties and is free from sugar content.

Processing of Making Fishbone for gelatin

The manufacture process of gelatin is divided into two processes, namely the acid process and the alkaline process. These two processes have differences in the immersion process (Junianto *et al.,* 2006). Acid soaking is done by soaking in acid (usually hydrochloric or HCL) weak (dilute) in a not too long time. The acid soaking process aims to convert collagen into a form suitable for extraction, namely by the interaction of H+ ions from the acid solution with collagen. The raw material for this acid process is in the form of young animal skins which can be obtained from ossein (soft bone) (Rosalina *et al.,* 2018). This technique will produce type A (Acid) gelatin (Arief, 2016).

While alkaline soaking, this raw material is soaked using an alkaline solution (usually lime/calcium hydroxide). The basic process is described that collagen is reacted with NaOH and goes through a long lime step before being extracted. After soaking, the collagen can be washed to make it free from bases and reacted with acid to remove the salts contained in the raw material and reach the desired extraction pH. To remove excess salt, an ion exchange mechanism must be used. If it is reacted with an excess of base, the collagen becomes soluble in cold water, this can cause the collagen to dissolve in the solution phase and have an impact on a lower yield.

According to Hinterwaldner (1977), there are three stages in the gelatin production process, namely: 1) the raw material preparation stage (removal of non-collagen

components), 2) the conversion stage of collagen into gelatin, and 3) the gelatin purification stage by filtering and drying.

1. Stages of preparation

   The preparation stage starts with cleaning the fish bones from the remaining meat. In cleaning process the bones can use boiling water for 1-3 minutes to facilitate. The process of removing fat contained in bone tissue (degressing) is carried out at a temperature of 32-80° which can produce optimum fat solubility (Wars and Courts 1997).

2. Demineralization Stage

   Demineralization aims is to remove calcium salts and other salts contained in the bone so as to produce melted bone (ossein) (Utama, 1997). According to Hinterwaldner (1977) this process is carried out for up to two weeks in an acid-resistant container.

3. Sweeling Stage

   The swelling stage (sweeling) aims is to remove residual impurities and can convect collagen into gelatin (Surono *et al.*, 1994). This stage uses a solution of organic acids such as acetic acid, fumarate, citric, malic, succinic, and other acids. Based on the results of a studied, conducted by Surono *et al.*, (1994) the manufacture of shark bone into gelatin, the duration of immersion at the stage of skin swelling is 24 hours with a concentration of 4% acetic acid.

4. Extraction Stage

   The steps of extracting skin and ossein with water aim to convert collagen into gelatin. The required temperature ranges from 40-50°C (Choi and Regenstein 2000). This extraction is carried out in an acidic environment with a pH ranging from 4-5. The extracted solution was then concentrated and then dried. The resulting gelatin is more reactive and easier to use (Utama, 1997).

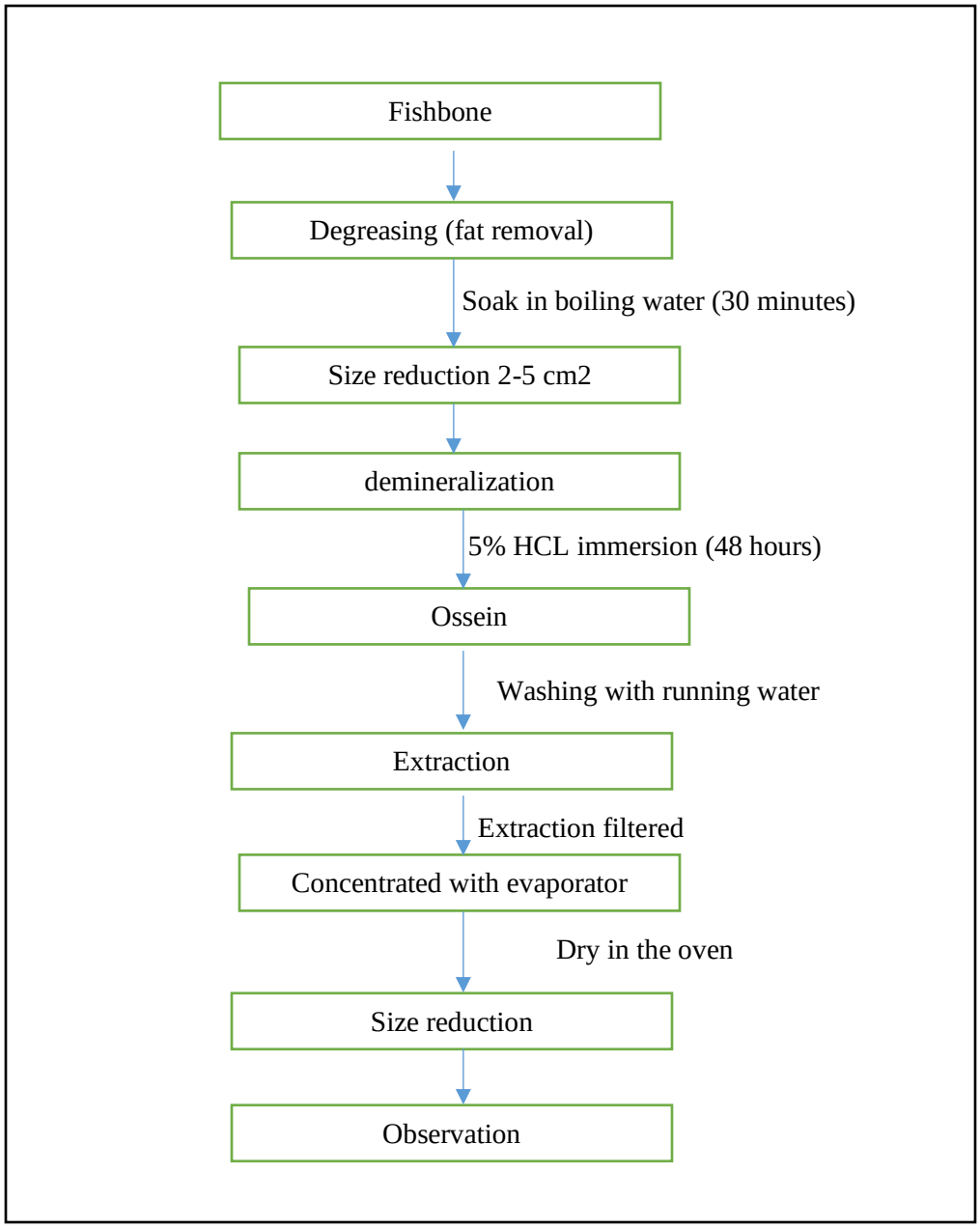

Figure 2. The Process of Making Fish Bones into Gelatin

Quality Gelatin Products From Fish Bones

The results of the utilization of fish bones into gelatin has to be applied in the food industry such as for food additives (texturizer, stabilizer, and emulsifier) while for the pharmaceutical industry, gelatin is used as capsules, coating material for health nutrition supplements, and tablet binders (Suryanti, 2020). The development aspect of

halal gelatin application from industrial waste is very broad in the food and non-food fields. The food industry creates low-calorie foods by adding gelatin, gelatin has a function that can bind large amounts of water and provide a feeling of fullness so that gelatin can overcome diseases caused by obesity.

Table 1. Gelatin Quality Requirements Based on SNI (1995)

Quality Characteristics	Condition
Color	Colorless
Smell, taste	Normal (acceptable by consumers)
Water content	Maximum 16%
Ash content	Maximum 3.25%
Heavy metal	Maximum 50 mg/kg
Arsenic	Maximum 2 mg/kg
Copper	Maximum 30 mg/kg
Zinc	Maximum 100 mg/kg
Sulfite	Maximum 1000 mg/kg

Market Conditions for Gelatin From Fish Bones in Indonesia

The potential utilization fish bones for gelatin is very large to reduce the amount of industrial waste and reduce the amount of gelatin imports to fulfill the domestic market. The gelatin necessary in Indonesia is still obtained by imports from several countries, and almost 50% of imported gelatin is still made from pork (Rosalina *et al.*, 2018). In Indonesia, the production of gelatin from fish bones and skins has been developed by the Research Center for Marine and Fisheries Product Processing and Biotechnology (BBRP2B) of the Indonesian Ministry of Maritime Affairs and Fisheries.

The demand for gelatin has been almost 100% met through imports. The percentage value of the average increase in gelatin imports in Indonesia is 51.20% (Handayani *et al.,* 2021). The projections for gelatin demand from 2020 to 2023 are as follows:

Table 2. Projected amount of gelatin demand to Indonesia

*Source :*Handayani et al. 2021

Year	Projected Amount of Imports (tons)
2020	46,780,431
2021	70,734,308
2022	106,953,747
2023	161,719,315

From the table, it can be seen there is an annual increase. It can also be seen that the growth trend is that the industry that uses gelatin has increased. Apart from imports, the national supply of gelatin also comes from two local producers, namely PT EMS Gelatin Indonesia and CV Multi Extraction, with annual production capacities for both companies are 60 tons and 24 tons. This capacity is very small and insignificant compared to the total national gelatin requirement.

Conclusion

Based on the literature study, there was an information that the manufacture or extraction of gelatin from fish bones consists of 4Stages, namely: preparation, demineralization, swelling and hydrolysis or extraction.

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