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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 (degrossing) 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 (Suroño *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 Suroño *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).

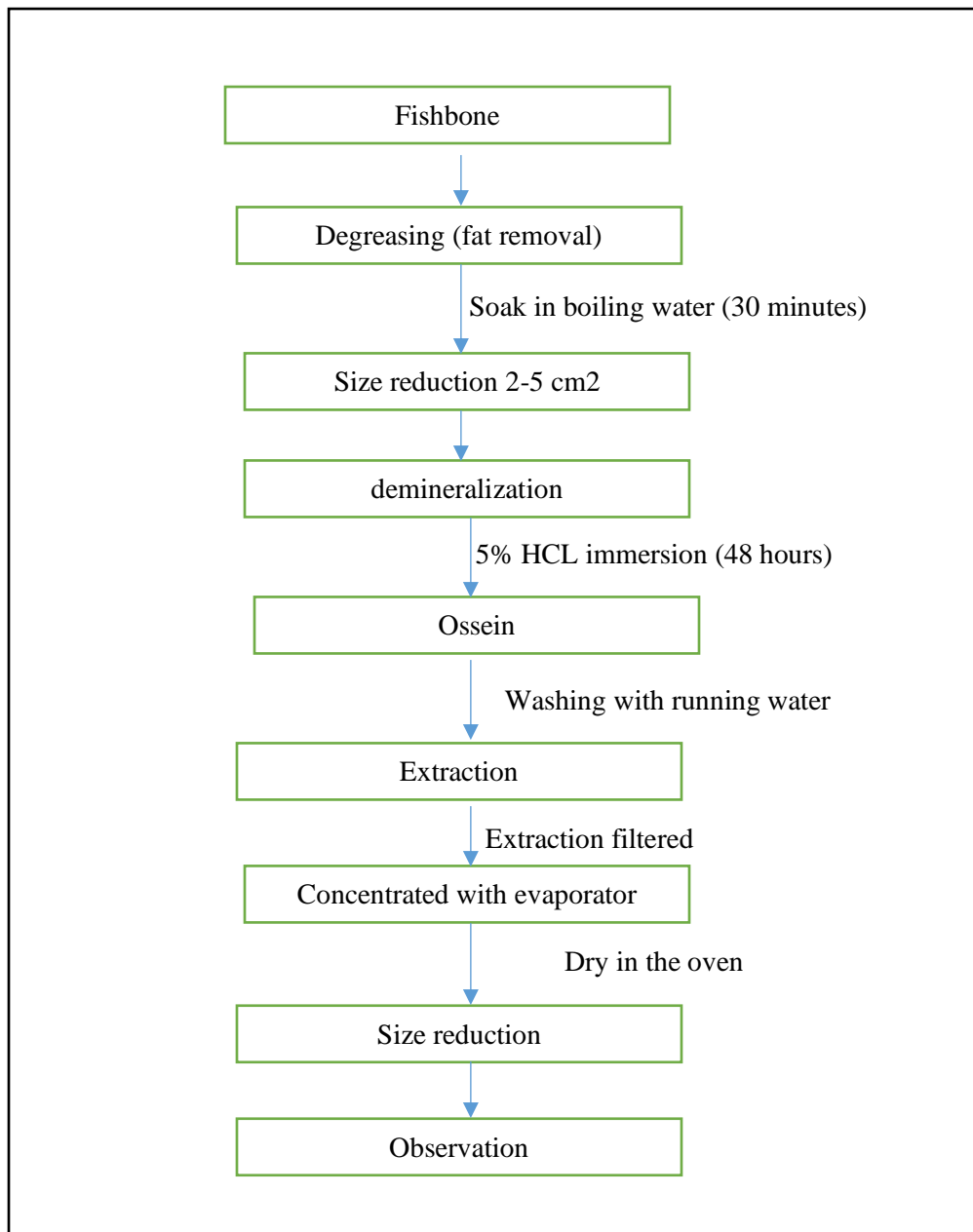


Figure 2. The Process of Making Fish Bones into Gelatin

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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