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The Gel Strength and Profile Texture of Liquid Crude Extract from Fish Bone Gelatin by Pineapple Waste Combined Water Extraction

Y Atma[1*], A. Z Mustopa[2], M. Pertiwi[1], R. Maisarah[1]
[1]Department of Food Science and Technology, Universitas Trilogi. Jl. Taman Makam Pahlawan Kalibata No.1, South Jakarta 12760, Indonesia
[2]Biotechnology Research Center, Indonesia Institute of Science (LIPI), Jl. Raya Bogor Km. 46, Cibinong, West Java 16911, Indonesia

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ABSTRACT

The gel strength and profile texture was the most important physical characteristic of gelatin. Unfortunately, the gelatin based on alternative source such as bone of fish has low gel strength and profile texture value compared mammalian gelatin. In another side, the extraction gelatin method has been using more saver solvent such as citric acid and water. The aim of this research was extracted gelatin from bone of fish using pineapple waste and water. Then continued with the gel strength and profile texture analysis of gelatin crude extract. The result shown that the fish bone gelatin successful extracted using pineapple waste combined with warm water at pre-treatment and main extraction respectively. The gel strength of fish bone gelatin was 430 g.bloom. Profile texture of crude extract fish bone gelatin including hardness was 9.83 N, cohesiveness of 0.46, springiness of 2.91, and gumminess of 4.52 N and chewiness of 14.30. The result suggested that liquid crude extract of fish bone gelatin was comparable toward mammalian and another fish gelatin.

INTRODUCTION

The problem related on gelatin derived from mammals are non halal status [1], animal diseases outbreak [2] and communities' culture obstacle [3]. This condition make seeking of gelatin from alternative sources has been increase over the last decades. Some alternative source of gelatin are chicken bones [4], insect [5] and fish processing by-product. The gelatin from fish processing by product has been the most potential alternative source to be developed in the future [6]. In among the waste of fish processing, the bone have large portion and useless.

However, gelatin from fish bone has some weakness compared to mammalian gelatin. Fish bone gelatin has low gel strength and texture profile. Whereas it was the most important physical quality of gelatin [7]. Nevertheless, studies in fish bone gelatin keeps growing. It is because the potency to improving the quality of gelatin in the future for example by modified engineering [8,9,10]. Generally, fish bone gelatin from warm water species has better physical quality than gelatin from cold water species [11]. Study by Mahmoodani et al. (2014) showed that the gelatin of Pangasius catfish bones had gel strength that almost resembled with cow gelatin. Pangasius catfish species is categorized warm water fish. The fish bone gelatin from Pangsius catfish was also has highest gelatin yield as well as chemical parameters (proximate) that confirm to the standard [7].

Gelatin extraction from bone of Pangasius catfish has been done using hydrochloric acid [7] or citric acid [12] in combination with water. The application of safer solvents has been more recommended for industrial applications. Therefore, the industry prefers gelatin that extracted using citric acid as

* Corresponding author.
E-mail address: yoniatma@trilogi.ac.id

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a weak acid in combination with water [13]. The fish bones that have been studied by extracting them using citric acid are bones of Milkfish [14], Mackerel [15, 16], Catfish [17, 18], White spotted whipray [19] and Red snapper [20], and Asian (silver) carp [21].

In this study, we have done extract of gelatin from Pangasius catfish bone using pineapple liquid waste combined with warm water. Then, the liquid crude extract from fish bone gelatin was analyze for the their gel strength and profile texture. There are three reason why choosing of pineapple waste i.e. high content of citric acid, abundant and useless [22]. The gelatin physical quality from fish bone was lower compared mammalian gelatin [7, 17] and also the correlation between safer solvent or mild acid with the gel strength and texture profile of fish bone gelatin [2, 13] was being consideration conducting this research.

The crude extract of fish bone gelatin actually remain has a high gelatin concentration. Although gel strength and gelatin texture profiles measurements are recommended by Gelatin Manufacturing Institute of America (GMIA) [23] and Gelatin Manufacturing of European (GMIE) [24] at concentrations of 6.67%. The gel strength and texture profile analysis of the crude extract are expected to obtain the physical quality of fish bone gelatin comparable to commercial gelatin, although the extraction performed using a useless, safe and cheap solvent such as pineapple waste and water.

EXPERIMENTAL METHOD

This research is an experimental research. The research was conducted in two stages. First, pineapple liquid waste preparation and the gelatin extraction. Second, the gel strength and texture profile analysis of fishbone gelatin.

Pineapple Liquid Waste Preparation

Skin and central core of pineapple fruit was separated by knife. Both of this part was then crushed in a blender. The crushed *pulp* then was filtered using filter cloth. The filtrate crushed *pulp* called pineapple liquid waste. The extract of pineapple liquid waste was put into a Schott bottle and sterilized at 121 °C, 2 atm for 30 seconds in order to Bromelain inactivation. Then, the extract of pineapple liquid waste was stored in refirigerator temperature 4 ^{o}C before using as solvent extraction.

Fish Bone Gelatin Extraction

The bone of Pangasius catfish was cleaned from the remains attached flesh. Then, the bones was boiled approximately 2-3 minutes to remove the fishy smell and minimize the mineral bond. The fish bone is then cooled and stored in the freezer. After that, the fish bone minced in a meat grinder to increase the fishbone surface area in extraction stage. The extraction stages was done in 2 steps i.e. Pre-treatment and main extraction. Pre-treatment of fish bones was done by soaking bone in pineapple liquid waste extract for 56 hours at room temperature. It was obtained ossein. While the main extraction was carried out for 5 h by soaking of ossein in water at 75 ^{o}C. Then, the gelatin was filtered by a filter paper. The gelatinous liquid extract in this filtration step namely liquid crude extract of gelatin. It was then stored in refrigerator before further analysis.

Gel Strength

Gel strength (bloom gel strength) was analyzed using texture analyzer method described da Trindade Alfaro *et al.* [25]. The liquid crude extract of gelatin was pour into standard bloom jar. It was then heated at 60 °C for 30 minutes to dissolve the gelatin and obtain a homogeneous gelatin solution. The homogeneous of liquid crude extract of gelatin incubated in refrigerator for 16-18 hours at temperature of 4 ^{o}C. The, the gel strength was determined using a Texture Analyzer set with a 4.5 kg load cell, cross-head speed 1 mm / s and 0.5 in diameter. The bottle of bloom containing the gelatin solution was t placed in the middle and then the penetration of the probe is allowed to a depth of 4 mm. Furthermore gel strength data will be recorded through a computer device connected with the equipment. The measurement were done in triplicate.

Profile Texture Analysis

Preparation for texture profile analysis was done in the same way as gel strength analysis. It was just after cooled in refrigerator, then the gelatin sample incubated in a chilled temperature (15 ^{o}C), for 30 minutes. Texture profiles were analyzed using Texture Analyzer according Mahmoodani *et al.* [7]. The liquid crude extract of gelatin pressed with 100 mm diameter aluminum plate probe until deformation occurs up to 30% at a speed of 1 mm/s. The measurement were done in triplicate. The textural parameters including hardness, springiness, cohesiveness, gumminess and chewiness.

RESULTS AND DISCUSSION

The Gel Strength of Fish Bone Gelatin

The gel strength is a main physical quality of gelatin. The commercial gelatin has gel strength around 200-300 g.bloom. While the gel strength of fish gelatin has been reported in a wide range 124-426 g [1]. Actually, Gelatin Manufacture Institute of America (GMIA) and European (GMIE) establish of gel strength value of gelatin for application is in range 50-300 g bloom [23, 24].

In this research, the gel strength of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction is 430 g.bloom. It is higher compared gel strength of both fish bone gelatin from Pangsius catfish [7] and Catfish [17] extracted using hydrogen chloride and water. Fish bone gelatin from this research also has gel strength higher compared bovine (commercial) gelatin. Figure 1. shows comparison between of fish bone gelatin in this research with another similar type of fish bone gelatin and commercial (bovine) gelatin.

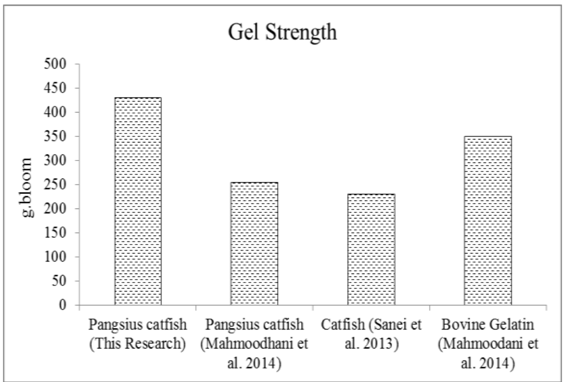

Fig. 1. The gel strength of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

Gel strength of gelatin are influence by source of species, extraction process and composition of gelatin. Gel strength of fish based gelatin was lower compared mammalian gelatin. Gelatin from warm-water fish has higher gel strength compared cold water fishes. The Gel strength among fish bone gelatin was higher in fish bone gelatin extracted using strong acid compared mild acid. Muyoga et al. [26] stated that low gel strength was due to low concentrations of imino acids (proline and hydroxyproline). The proline and hydroxyproline contents are approximately 30% in mammalian gelatins, 22%-25% in warm-water fish gelatins, and 17% for coldwater fish gelatins. In addition, another suggested that the gel strength may depend on isoelectric point and may be controlled, to certain extent, by adjusting the pH [27].

Profile Texture

The physical quality of gel strength was not represent overall parameter of gelatin texture. Therefore, analysis of profile texture further was still required. The texture of gelatin was tested using texture analyzer that the principle is like chew a food in two time of bite. At least there is five parameters in profile texture analysis that represent a texturize characteristic of gelatin. It is such as hardness, springiness, cohesiveness, gumminess, and chewiness. It was obtained by pressing force.

Hardness is the non-deformation material endurance to break apart due to compressive forces provided. Springiness is the material endurance to break due to tensile strength. Cohesiveness is the tensile strength between molecules of material to maintain its shape when given the force. Gumminess is the change in the shape of material influenced by the force of cohesion and adhesion. Chewiness is the energy needed to chew food until it is ready to be swallowed. The chewiness value obtained from springiness and gumminess multiplication (Faridah et al. 2009). The profile texture of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction.

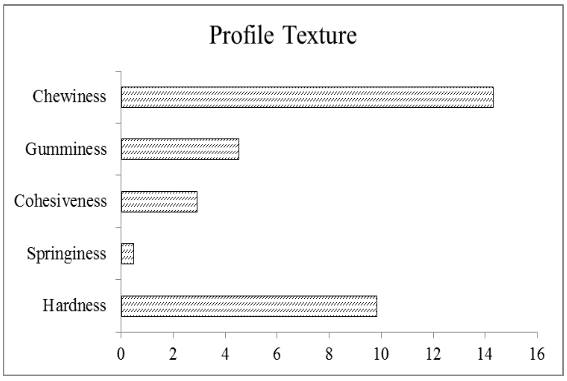

Fig. 2. Profile texture of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction.

a. Hardness

In this research, the hardness of liquid crude extract of fish bone gelatin was 9.83 N. The crude gelatin from this extraction method was obtained cohesiveness of 0.46, springiness of 2.91, and gumminess of 4.52 N and chewiness of 14.30. The value of hardness in crude gelatin in this research was lower compared fish bone gelatin from another Pangsius catfish, Catfish and bovine gelatin as shown in figure 3.

The profile texture of gelatin and fish bone gelatin has been not specified. However the analysis of texture is to characterize the profile texture a gelatin that are generally has same pattern. The profile texture of gelatin are influenced on source of gelatin, extraction method, protein content especially prolin and hydroxyproline content [7,17,26]

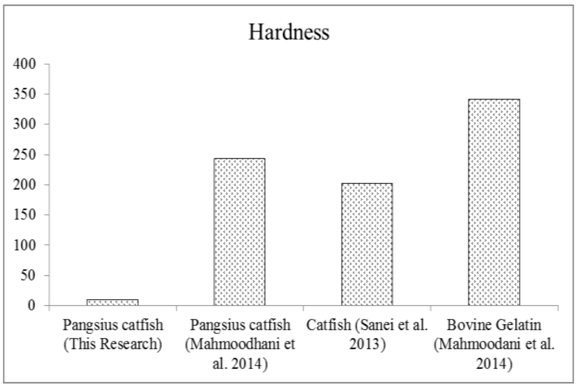

Fig. 3. The hardness of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

b. Springiness

The value of springiness of crude gelatin in this research was lower compared fish bone gelatin from another Pangsius catfish, Catfish and bovine gelatin, but it is relatively comparable. The springiness of fish bone gelatin from Pangsius catfish by pineapple waste combined water extraction is shown in figure 4.

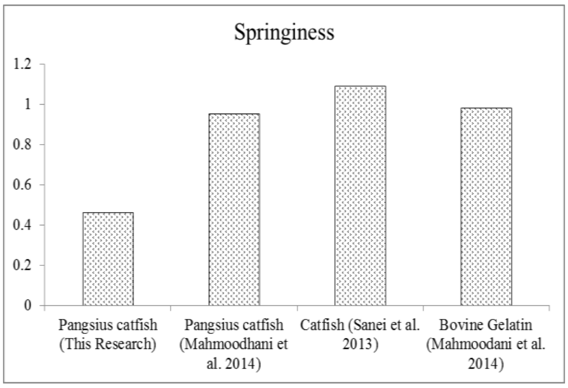

Fig. 4. The springiness of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

c. Cohesiveness

The cohesiveness of crude gelatin in this research was higher compared fish bone gelatin from another Pangsius catfish, Catfish and bovine gelatin as shown in figure 5.

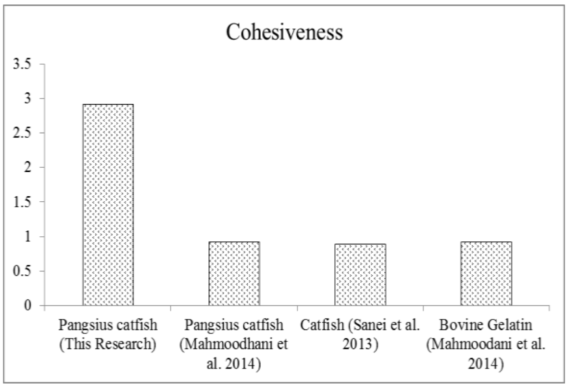

Fig. 5. The cohesiveness of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

d. Gumminess

The gumminess of crude gelatin of liquid crude gelatin in this research was lower compared fish bone gelatin from another Pangsius catfish, Catfish and bovine gelatin. The gummines of fish bone gelatin from Pangsius catfish by pineapple waste combined water extraction is shown in figure 6.

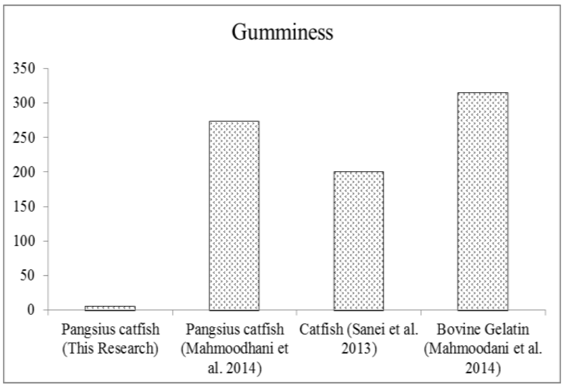

Fig. 6. The gumminess of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

e. Chewiness

The chewiness of crude gelatin in this research was lower compared fish bone gelatin from another Pangsius catfish, Catfish and bovine gelatin as shown in figure 7.

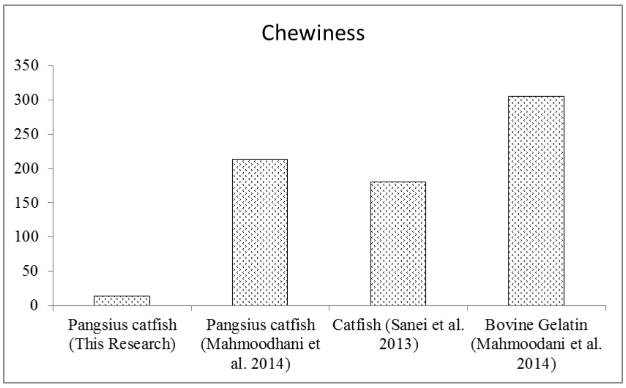

Fig. 7. The chewiness of liquid crude extract from fish bone gelatin of Pangasius catfish with pineapple waste combined water extraction, fish bone gelatin of Pangasius catfish, Catfish and Bovine Gelatin.

CONCLUSION

The fish bone gelatin successful extracted using pineapple waste combined with warm water. The gel strength of crude extract fish bone gelatin was 430 g.bloom. Profile texture of crude extract fish bone gelatin including hardness was 9.83 N, cohesiveness of 0.46, springiness of 2.91, and gumminess of 4.52 N and chewiness of 14.30. This research suggested that liquid crude extract of fish bone gelatin was comparable toward mammalian and another fish gelatin.

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