The extraction of gelatin from black tilapia fish skins with different acid concentration

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Abstract. Gelatin was extracted from black tilapia fish skins which is considered as one of the potential sources to produce gelatin. It’s mainly used in various food and pharmaceutical applications. The process of extraction gelatin was carried out via acid treatment at different concentration of 0.05 M, 0.1 M, 0.15 M and 0.2 M of hydrochloric acid (HCl) and followed by a final thermal extraction with water at 45°C. The objective of this study was to illustrate the effects of treated fish skins at different acid concentration to the properties in terms of yield, gel strength and moisture content for gelatin. The yield of gelatin for 0.05 M and 0.2 M were 18.86% to 20.95% respectively while for moisture content of gelatin were 6.93% to 8.34% respectively. The gel strength at 0.05 M gives the highest (290.8 g) which suitable as an edible gelatin.

1. Introduction

Gelatin is obtained through hydrolysis of collagen which mainly protein extracted found from animal bones, skins and connective tissues. Global demand for gelatin industry were increase yearly which widely used in several industries such as food, pharmaceutical, cosmetic and photographic [1]. In the food industry, gelatin is mainly used in confections that provide chewiness, texture and foam stabilization while in pharmaceutical industry, it is used in the manufacture of capsules, including hard and soft capsules [2].

The highest gelatin sources from global demand goes to porcine and second from bovine which sources yearly increased [1]. Unfortunately, these mammalian sources have limited concern to communities, where Jews and Muslims are forbidden to consume pig-related products while Hinduism forbid the consumption of cow-related products. Besides that, it also related to safety considerations due to disease called bovine spongiform encephalopathy (BSE) called “mad cow disease” [3]. Therefore, the alternative sources for gelatin may led attention for researcher to investigate and develop which comes from marine source such as fish (skin, bones, scales and fin) even from discarded portions of fishes.

Gelatin production involves three steps of processing includes from raw materials pre-treatment, thermal extraction and recovering process (evaporation and drying) processes. The extraction methods applied is depends on the sources of collagen and the number of covalent cross-linkages and the maturation of fish [4] Fish gelatin give better alternatives to mammalian gelatin because of its qualities of lower melting point and low gel strength [2]. Gelatin that is derived from warm water fish may contain higher of amino acid compared to cold water fish. Therefore, warm water fish species will give more gelatin yield, however, it depends on the species, maturation and size of fish itself [5]. Previous study has been reported that gelatin from black tilapia fish gave highly yield of 10.45% to 22.25% [6].
The yield and quality of gelatin mostly depends on the physicochemical properties which influenced from which species and tissue extracted and also the used of extraction process which includes pH, temperature, time for both pre-treatment and extraction [7,8]. The present study was undertaken to extract and characterize gelatin from the skin of black tilapia (Oreochromis mossambicus) fish skin which classified as a freshwater fish.

2. Materials and Methods

The species used in this study was black tilapia fish. The fish skin waste was collected from fish fillet factory which were packed and stored in a freezer at -20°C until further use. The storage time was less than 2 months to maintain the quality of fish skin. Hydrochloric acid (HCl) used in this study was analytical grade (Brand Q-Rec, Grade AR, 37%).

The frozen fish skins were thawed at room temperature and remove the attached meat and scales manually. The superfluous material from the fish skins were removed by cleaning and rinsing with running tap water. Then, skins were soaked in solution of HCl with different concentration (0.05, 0.1, 0.15 & 0.2 M) for 24 h. After soaking, skins were washed with tap water for several times and rinsed with distilled water. Treated skins were transferred in the flask for final extraction by immersed in distilled water at 45°C for 4 h in a water bath (Model WNB 14, Memmert, Germany) respectively. The solutions obtained were filtered through Whatman No.4 (Sigma Aldrich, St. Louis, Mo, USA), evaporated and dried in the universal oven (Model UFE500, Memmert + Co.KG, Germany) at 60°C for 24 h.

Then, the yield of gelatin was calculated based on wet weight basis. The gel strength was determined by referring to British Standard 757:1975 method (BSI, 1975) which measured by using TA.XR Texture Analyzer (Stable Micro System, UK) while for percentage of moisture content was calculated by using AOAC (1999) method.

3. Results and Discussion

3.1. Yield of Gelatin

Gelatin yield was calculated as percentage on wet wt. basis. Figure 1 shows the yield of black tilapia fish skin gelatin at different acid concentration with extraction temperature of 45°C. From the graph, it shows that significant increasing of percentage yield starting at 0.05 M to 0.2 M of gelatin produced. Treated fish skin at 0.2 M gives the highest yield of gelatin compared to other concentrations. Niu et al., (2013) reported that the optimum protein yield for red tilapia was 24.35% by using 0.05 M HCl pre-treatment [9]. The lower value of yield on lower concentration was observed could be due to loss of extracted collagen during preparation steps especially in washing step after the pre-treatment process or incomplete collagen hydrolysis during extraction process [10]. The quality and percentage of gelatin produce could be influence by the extraction process and also from the species of raw material extracted [8].
3.2. Gel Strength

Gel strength (Bloom) considered as a major physical property of gelatin gel and the commercial value of gelatin commonly refers to Bloom value [11]. Figure 2 shows the gel strength of black tilapia skin gelatin for this study. The highest gel strength was at concentration of 0.05 M (290.8 g) and at 0.2 M was the lowest (150 g). Gelatin that contain more of α-chains gives the higher of gel strength [2]. On the other hand, the low gel forming capability because of the shorter length of molecule chains [12]. The strength had reported 180.76 g for black tilapia while for red tilapia was 128.11g [10]. High concentration of acid may have resulted in lower gel strength, which shows that the ability of forming gel affected to collagen cross-linked due to acid hydrolysis [13].

Figure 1. The yield of black tilapia skin gelatin at different HCl concentrations

Figure 2. The gel strength of black tilapia skin gelatin at different HCl concentrations
3.3. Moisture Content

From figure 3 shows the moisture content which stated from 6.93% to 8.34% for concentration of 0.05 to 0.2 M. From the graph, the moisture contents were gradually increased with increment of HCl concentration. The moisture content of black tilapia skins gelatin in this study was nearly to the moisture content that reported by Jamilah et al., (2011) which for red tilapia (8.51%), walking catfish (7.86%) and striped catfish (7.29%) [14]. Gelatin which apply as an edible gelatin should has less than 15% of moisture content as prescribed limit [15]. The difference of moisture content in gelatin may due to the variation of drying process.

![Figure 3. The moisture content of black tilapia skin gelatin at different HCl concentrations](image)

4. Conclusion

This study reveals that the yield and moisture content of gelatin were increases when the HCl concentration increased. From the results obtained, fish gelatin suitable as an edible gelatin since the prescribe limit <15% for moisture content while the gel strength stays in range of 50–300 g. This study indicates that treated skin with different concentration can be apply for different application according to gel strength value. From that, fish skin by-product had potential to be commercialized to obtain gelatin.

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6. References

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