GELATIN PRODUCTION FROM FISHERIES WASTES IN IRAN: QUALITATIVE AND QUANTITATIVE PROPERTIES

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ABSTRACT

Gelatin is a water soluble, hydrophilic derived protein which causes it to have useful functional properties such as colloidal dispersion in water, and hassiveness and gel strength in food systems. High amounts of fishes and sharks and also wastes products obtained from fishes processing factories were used in south region of Iran. In this project the use of fishes wastes of the Persian gulf for production of gelatin was studied with two methods of alkaline and acidic. The results obtained showed that the alkaline procedure gave high yield in gelatin production from fishes wastes. Produced gelatin was compared to purchased commercial gelatin from India. The comparison results does not show any significant difference.

Key word: Fish wastes, Gelatin, Acidic process, Alkaline process.

INTRODUCTION

Gelatin is a soluble in water, hydrophilic protein produced by controlled hydrolysis of insoluble in water collagen. To convert insoluble native collagen to gelatin, a treatment is required that will break non covalent bonds to disorganize the protein structure, thus producing adequate swelling and cleavage of intra and intermolecular bonds, leading to subsequent collagen solubilization Kim,. and Cho. (1996). Controlled hydrolysis is needed to convert collagen to gelatin, because continued hydrolysis will result in loss of yield and loss of desirable properties.

Levels of gelatin incorporated into food are usually fairly small. Gelatin is normally used to modify the physical properties of food. Gelatin is used as a food- thickening agent, emulsifying agent and in small quantities for clarifying beer, wine, fruit juice and vinegar, and for pharmaceutical products. Gelatin is also used to manufacture pharmaceutical capsules. Montero, and Borderias, (1995). Gelatin has been developed as a plasma expander for the treatment of hemorrhages, trauma and burns. Gelatin is used in the cosmetic area and in wave-set lotions. Some of its properties used in cosmetics are its adhesive and emulsifying powers. Gelatin is also important in photography and is used to make paper. Films are coated with gelatin, which contains the light- sensitive silver reagent. It is also used in making smokeless gunpowder Herrmann, and Creamp (1989). In this research too distinct production procedures were used to obtain gelatin from collagenous components of some fish species of the Persian gulf. The procedures used were alkaline procedure, and the acid procedure. In the first extraction process gelatin is made at a or slightly acidic condition often the cold alkaline pretreatment of the raw material Ames, (1993). In the second process soaking in acid is by the extraction of gelatin in a moderate temperature at about pH =4. Fish glue or fish gelatin extracted from the bone and skin of fish in comparison to mammalian gelatin has a
little gelling ability. In contrast, collagens of cartilaginous fish make gelatins of better gelling power (Gudmundson and Hafsteinsson 1992). The analysis of the amino acid pattern done by past researches has shown that the proline and hydroxyl proline content are indicators of gelatin power, in other words, low contents of the mentioned amino acids will lead to a poor gel. Osborne, et al., (1990).

**MATERIALS AND METHODS**

In this research, the production of gelatin from fish wastes of a fish factory was investigated. The wastes used were namely fish hoof skin, shark meat and skin, and other fishery wastes. Extraction of gelatin was done by two production procedures—the acidic (A) and Alkaline methods (B) Grossman, and Bergman (1992). The frozen samples were taken to laboratory and kept in freezer until the beginning of experiments. In the first step, the frozen sample were weighed and after being defrosted. They were weighed again. Moisture percentage in samples of edible fish wastes, shark skin, wastes of fish factory and fish hoof skins were respectively 19.75%, 20.97%, 22.39% and 21.37%. In the second step, about 27 to 50 gr. Of defrosted samples were weighed and put in a filter paper then they were put in the suxceleh apparatus containing 200ml. ether for about 4 to 6 hours. After extracting the oil from samples, the empty balloon and the balloon containing oil were weighed. The oil percentage in the above samples was calculated. The average percentage of oil in skin and meat of shark, fish hoof skin, edible fish wastes and wastes of fish factory and fish hoof skins were respectively 14.012%, 4.25%, 9.63% and 9.14%. In the third step, extraction of salts was made by 5% HCL. The oil free samples were put in 200-300 ml. 5% HCL at 25 °C for about 24 hours, and were mixed by a magnetic mixer for salt separation and then they were washed by distilled water. The objective of salt extraction is the extraction of calcium salts, which exist as calcium phosphate of collagen in the form of Hydroxy apatite, Ca5(po4)3(OH)3, and then all the collagen are remained in the form ossein which including mucopolysacarides impurities. The forth step including regulatory washing of ossein by distilled water for eliminating of acid, then it is passed through a Bochner funnel for the separation of salts and finally, for increasing pH, few drops of 4% sodium Hydroxide should be added to it. In the fifth step, regulating the samples at a different pH range (6-7) is made by a digital pH meter, because in this pH, decomposition rate of gelatin solution is in its minimum position and best result are achieved. In the sixth step, the hydrolysis of collagen and conversion of it to gelatin is made by heat and in the presence of water. In this stage, using of autoclave is the most quick way. In this method, samples are put in autoclave, against 20psi vapor pressure at 120 °C for about one hour till hydrolysis of collagen to gelatin is processed.

The seventh step is including chemical refinement of gelatin solutions. In this process, egg white, calcium carbonate or calcium phosphate can be used for removing of samples from autoclave when the solution is boiling 1 ml egg white is added for each 80 ml of gelatin solution. Albumin of egg white will be coagulated by heat and will be able to bond salts such as copper and other impurities to itself then it deposits them and ultimately, in order to remove impurities, solutions should be passed through a filter.

In the eighth step, samples are centrifuged in 2500 R.P.M. at 5 °C for about 10 minutes. In this method, mucopolysacarides such ads Hialoronic acid and Chondroitin sulphate which have high molecular weight are deposited and separated. Hialoronic acid exists in the structure of connective tissues and has high molecular weight. As result of centrifuging the solutions, the impurities in mucopolysacarides are deposited in a certain phase and the above solutions were transferred to Besher (Gomez and Montero, 2001).

The ninth step is evaporating gelatin solution by vacuum. The diluted gelatin solutions were put in a oven under vacuum at 65 °C for about 24 hours.
At this stage, gelatin liquids were changed into a layered shape. Vacuum and low temperatures are, since gelatin is sensitive to high temperatures. In the final, dried layers of gelatin are powdered by a mixer and then they should be weighed again. In above process, an an percentage average of gelatin powder is obtained by acidic and alkaline methods.

RESULTS AND DISCUSSION

The gelatin percentage produced from gelatinous sources with acidic procedure(A) and Alkaline procedure(B) were compared in Table1. As it can be observed the Alkaline procedure was the best method for higher gelatin production from Persian gulf fisheries wastes. High amounts of sea sources (different kinds of fishes) which are fishery wastes can be used in gelatin production are available in Iran. The gelatin which was produced in this research, was transferred to organization of standards and industrial researches for making physiochemical tests such as measuring of moisture, Ash, Protein, pH, glassiness, Pb, Cu and Fe.

Table 1: Gelatin percentage obtained from gelatinous sources by A and B processes.

<table>
<thead>
<tr>
<th>Process/Samples</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline</td>
<td>19.76</td>
<td>18.05</td>
<td>21.58</td>
<td>9.26</td>
</tr>
<tr>
<td>Acidic</td>
<td>20.85</td>
<td>18.65</td>
<td>18.29</td>
<td>no</td>
</tr>
</tbody>
</table>

1) Fish hoof skin  2) Shark skin
3) Wastes of fish factory  4) Wastes of edible fishes

Table 2: Physiochemical properties of produced gelatin.

<table>
<thead>
<tr>
<th>Kind of analysis/ kind of sample</th>
<th>Produced sample</th>
<th>India standard sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-transparence</td>
<td>moderate</td>
<td>Intense</td>
</tr>
<tr>
<td>2-Moisture(%)</td>
<td>9.1</td>
<td>Max.15</td>
</tr>
<tr>
<td>3-protein based on nitrogen(%)</td>
<td>14.5</td>
<td>Max.15</td>
</tr>
<tr>
<td>4-pH</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>5-Copper(p.p.m)</td>
<td>2.6</td>
<td>Max.30</td>
</tr>
<tr>
<td>6-Lead(p.p.m)</td>
<td>0.3</td>
<td>Max.5</td>
</tr>
<tr>
<td>7-Ash</td>
<td>0.178</td>
<td>Max.3</td>
</tr>
<tr>
<td>8-Iron(p.p.m)</td>
<td>1.6</td>
<td>no</td>
</tr>
</tbody>
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Table 2 showed a comparison of standardized gelatin samples in Iran and India, it is observed that protein percentage based on nitrogen is approximately equal in both samples and percentage of ash and other impurities in standardized samples of Iran was lower. Industrial method of gelatin production from fisheries wastes have economical value.

REFERENCES