Studies On The Gel Strength Of Red Seaweed Extract, *Gracillaria verrucosa* From South Sulawesi

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Abstract

The worldwide production of gelating agent agar mainly relies on marine algae of the class Rhodophyceae - *Gracilaria* and *Gelidium*. Agar is hydrophilic colloids composed of polysaccharides, agarose and agarpectin, which have strong gelating ability for many applications in pharmaceutical industries. This study conducted the potential of seaweed extracts *Gracillaria verrucosa* from South Sulawesi based on the gel strength characteristic for pharmaceutical purposes, particularly the material of hard capsule shell. *Gracillaria verrucosa* collected from Sinjar, Takalar and Palopo in South Sulawesi was extracted using acid extraction procedures and the gel strength of the extracts were determined using Nishin Shee set. The gel strength values of *Gracillaria verrucosa* extract from Sinjar, Takalar and Palopo are 141 g/cm³, 163 g/cm³, 250 g/cm³ respectively. Among these three regions, the extract collected from Takalar and Palopo are eligible to be used as hard capsule shell material due to their gel strength characteristics. None of these extracts meet the export standard requirements for widely-used industrial production.

Keywords: Gel Strength, *Gracillaria verrucosa*, South Sulawesi.

Introduction

Many kinds of seaweeds harvested from nature and marine culture have been reported in abundance on the shores of eastern sea of Indonesia. Some of these seaweeds have been cited as possible sources for industrial use while others are valuable foods for daily life.

Agar is the hydrophilic colloidal substance. It is isolated from the red-purple seaweeds which growth or cultivated in nearly all of the seas of South Sulawesi. Agar has been shown to contain, in addition to insoluble dextrin, proteinaceous material and soluble and insoluble salts, two major separable polysaccharides, Agarose and Agarpectin (6). Agarose is a strongly-bounding, non-ionic polysaccharide which is regarded as consisting of 1,3- linked β-D-galactopyranos and 1,4-linked 3,6-anhydro-

α-L-galactopyranose units. Agarpectin, is a less clearly defined, more complex polysaccharide having sulfate groups attached to it. Therefore, Agar has the ability to form strong gels that are used for food and medicine as well as widely used materials in biotechnology and industries. Agar has been used for years in the pharmaceutical industry, and is known for its ability to form gels and films, enhance viscosity, stabilize aqueous systems, and act as a binding agent in drug formulations.

Agar extracted from *Agarophyta* Gelidium, *Gelidium*, and related red algae, has a strong gel strength. Gel strength is the major physical properties of Agar which show its ability in the formation of the gel. Gel formation is a phenomenon of cross-binding polymer chains to form a continuous three-dimensional bond that captures the
water inside and creating a strong and rigid structure as solid. The main standard requirement for Agar as a capsule shell raw material is the gel strength of 130-270 g/cm², whereas the gel strength standard for industrial material of exported production is 600-1000 g/cm² (7).

Gracilaria verrucosa is a common marine red algae (Rhodophyceae), found in various South Sulawesi areas that has geling properties. Therefore, we extracted Agar from Gracilaria verrucosa seaweed collected from various regions of South Sulawesi, and examined its gel strength value as a standard material for capsule shell and industrial export production.

Material and Methods:

Material

Seaweed Gracilaria verrucosa are collected from 3 different water locations, Sinja, Takalar, and Palopo and they are obtained from Seaweed Factory PT. Bantamabang Ledah, Lan District, Aile Police, Moron, South Sulawesi. All the other chemicals used were of analytical grade.

Methods

Preparation of Agar: An air-dried sample of the seaweed (100 g) was heated on a heating mantle with 3% NaOH solution at 80°C for 3 h to interrupt the cell wall before extracted. This seaweed then was extracted by heating it on 0.5% CH₃COOH for 2 h. When the mixture was boiling, it was neutralized at pH 6.0-8.0 with KOH and stirred continuously until viscous. The mixture was heat filtered. The solution was kept to form solid Agar and cut in many pieces before it was dried by sun-light.

Gel Strength Measurement: Four dried pieces of Agar was dissolved on 200 ml distilled water for 1 h, and heated to form transparent solution. The ager solution was placed on petri dish and cooled at 0°C for 15 h. The gel strength of Agar was measured with a Nishin Shisei.

The gel strength value was calculated and analyzed statistically.

Results and Discussion

Gel strength is a very important properties which shows the gelling ability of Agar as thickening agent.

Table 1 Example of double column table format. If the title of the table more than one row, the second row should be formatted using hanging indent following the above limit.

<table>
<thead>
<tr>
<th>Region</th>
<th>Replication of Gel Strength Measurement (g/cm²)</th>
<th>Average of Gel Strength (g/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Sinja</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Takalar</td>
<td>130</td>
<td>170</td>
</tr>
<tr>
<td>Palopo</td>
<td>230</td>
<td>250</td>
</tr>
</tbody>
</table>

In this study, samples of Gracilaria verrucosa were cleaned and heated in alkaline solution NaOH to interrupt the cell wall, thus Agar content could easily extract and any pollutants dissolve on the water. To minimize the microbial growth, moisture content of seaweed was reduced by direct exposure to sunlight. The dried seaweed was extracted by acid procedure to obtain consistent molecular textures, and Agar isolated was powdered.

For measuring the gel strength of Agar, powder was dissolved in to heated water and then replaced to freezer on 0°C for 15 hours. Nishin Shisei set was used as its standard procedure and the gel strength value was measured triple. The average of gel strength Gracilaria verrucosa extracted from Sinja was found 110 g/cm², the one
extracted from Takalar was 163 g/cm² and that extracted from Palopo was 250 g/cm². Since the standard gel strength to be used as capsule shell material was 130-270 g/cm², of the three regions, the seaweed from Palopo and Takalar fulfilled this standard requirement. None of the extracts from the three regions met the general standard of gel strength of industrial material for export production due to their lower than 600-1000 g/cm² gel strength.

The mean difference in gel strength results of the three extract samples are probably influenced by post-harvest processing which are not well handled. Post-harvest processing in the cultivation of seaweed Gracillaria vermiculata and the total water content of salt and pollutant of each of the three regions are different from the propat standard i.e. water content is 14-18% and total salt and pollutants are 3% from this study; it is observed that the seaweeds from Sape, Takalar and Palopo have moisture content of 20%, 18.16%, and 18.85% respectively.

Conclusion:

1. The gel strength values of Gracillaria vermiculata extract from Sape, Takalar and Palopo are 110 g/cm², 163 g/cm², 250 g/cm² respectively.

2. Among the three regions, the extract collected from Takalar and Palopo is eligible to be used as hard capsule shell material due to their gel strength characteristics. None of these extracts meets the export standard requirements for widely-used industrial production.

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References


