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Yield And Quality of Alginate from Brown Seaweed *Halidrys dioica*.

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Abstract: Alginates demand has increased considerably worldwide due to its various industrial applications, mainly associated with their rheological properties. This study aimed to analyze the yield and quality parameters (viscosity and gel strength) of the alginate obtained from *Halidrys dioica* seaweed, in order to determine the feasibility of using this species as an alternative resource for the production of this important phycocolloid. Alginate extraction was performed by ion exchange reactions, beginning with an acidic pre-extraction (HCl 1N), followed by alkaline extraction (Na_2CO_3 10%) and subsequently filtered. The clarified solution was precipitated in alcohol (96%) to being obtained alginate fibers, which are being dried to finally determine yield. Determining the quality of the alginate was performed using a Brookfield viscometer (Model LTV) and gel strength was measured with a texture analyzer (Model TA.TXPlus). Based on our results, the brown alga *H. dioica* has great potential to be considered as an alternative resource for extraction of alginates. It had a yield of 20% (comparable with the genera *Macrocystis* and *Eisenia*). Their quality parameters were acceptable, the viscosity of 80 mPa·s thus may have application as a thickener in food industries, while its gel strength which is 939g cm^{-2} has potential for biotechnological application type, pharmaceutical and food industries.

Key words: Seaweed, alginate, yield, viscosity, gel strength.

INTRODUCTION

Brown algae are economically important because they are used for extraction of polysaccharides, such as alginate and fucoidan, but also they are used as food and biofertilizers production. Alginates are present in all species of brown algae, but only the genera belonging to Laminariales and Fucales orders produce enough biomass to produce this phycocolloid, in order to sale it as a gelling and thickening agent[1].

Alginates are salts (Na^+, K^+, Mg^+ and Ca^+ etc.) derived from alginic acid found in the cell wall and intercellular spaces (cell matrix) which serves to maintain the structure of the alga tissues. They are the most abundant polysaccharide and constituted between 18-40% of the dry weight[2-4]. Alginates are used mainly for industries such as pharmaceutical, biotech, food, textile and cosmetic to produce various products as: antacids, dental impressions, textile printing, cosmetics, tooth paste and meat products, etc.[5]. These applications are commonly based on its properties as thickening agent, water retainer, and gelling[6]. Due to the limited knowledge that exists on the biological and chemical composition of *H. dioica*, this study was carried out to determine the yield and quality parameters of alginate. This information may contribute to the industrialization of this alga to produce this phycocolloid, based on the viscosity and gel strength properties.

METHODS

Alginate extraction was carried out by the method proposed by Arvizu-Higuera *et al.*[7] and quality control techniques proposed by Hernández-Carmona *et al.*[5]. Alginate extraction was carried out by triplicated, starting with an ion exchange pre-extraction reactions by using acid HCl (pH 4), followed by an alkaline extraction. For alkaline extraction each sample was treated with 10% Na_2CO_3 at pH 10 maintaining a temperature of 80 °C in a water bath for 2 h with constant stirring. The paste obtained was vacuum filtered to obtain clarified alginate solution.Precipitation of sodium alginate. The clarified sodium alginate solution was precipitated with 96% alcohol in a proportion of 1:1. The fibers were obtained by manual stirring. The fiber obtained was pressed to reduce the excess of alcohol, dried and placed in the oven at 55° C for 20 h, and then placed in a desiccator.

Yield. The alginate fibers obtained were weighed on an analytical balance. Subsequently sodium alginate yield was calculated: Yield (%) = weight of dry alginate/weight of algae * 100

Viscosity. The alginate fibers were dissolved to 1% maintaining magnetic stirring. Temperature was adjusted to 22°C, and was measured on a Brookfield Model LTV viscometer (60 rpm). A second measurement of viscosity but carried out, but after adding 0.5% of sodium hexametaphosphate $(NaPO_3)_6$ to obtain the real viscosity. Viscosity was calculated:

Viscosity (mPa.s) = Factor (60 rpm) * Final Viscosity

Gel strength. To determine gel strength, a poromolecular membrane was used, which was cut into strips of 17 cm. These were hydrated in distilled water. The bottom end of the membranes was closed with a clip and the sodium alginate solution was poured in the cylinder and closed. Three dialysis tubes were used for each sample and allowed to dialyze for 22 h in a solution of 10% $CaCl_2$. The alginate gel was cut into three units of 2.5 x 2.5 cm, with three units per sample. The units were analyzed with a texturometer model TA.TXPlus

RESULTS

The alginate obtained from *H. dioica* showed 19.1 % yield (table 1). The viscosity was 80 mPa·s (table 2) and the gel strength was 939 g cm^{-2} (table 3). These results suggest that the alginate from this specie may have an application as a thickener in food industries, because its alginate gel strength is comparable to other commercial species.

Table 1: Alginate yield from *H. dioica*

Samples	**Yield**	**Average**
Sample 1	19.8 %	
Sample 2	20.1 %	20 %
Sample 3	20.2 %	

Table 2: Alginate viscosity from *H. dioica*

Samples	**Viscometer Measured**	**Average**
Sample 1	80.2 mPa·s	
Sample 2	79.8 mPa·s	80 mPa·s
Sample 3	80.4 mPa·s	

Table 3: Alginate gel strength from *H. dioica.*

Samples	**Texturometer Measured**	**Average**
Samples 1	927 g cm^{-2}	
Samples 2	940 g cm^{-2}	939 g cm^{-2}
Samples 3	951 g cm^{-2}	

The average yield of *H. dioica* can be considered high if compared with the 15% yield obtained from some other species from *Sargassum* genus such as *S. sinicola* and *S. cymosum*, and even higher than yield obtained from other genus such *Laminaria* or *L. digitata*. Previous studies report that the amount of alginates from brown algae tends to change seasonally and geographically. This may be related to various factors such as waves, currents, nutrient availability, depth and temperature. These physical and biological characteristics will directly influence the content of alginates[8,9]. Based on the viscosity classification established by Hernández-Carmona *et al*.[5]: very low (25-35); low (70-100); medium (340-460) and high (680-920), the viscosity of this alginate is classified as low. Nevertheless, low viscosity alginate also found applications in some food products[10]. The gel strength (939 g cm^{-2}) obtained surplus the quality required by the industries producing alginates (750 g cm^{-2})[11].

CONCLUSIONS

It is possible to produce alginate from *H. dioca*, with the processes developed for other algae (*Sargassum*, *Laminaria*, *Macrocystis*). The yield obtained for this species is acceptable, compared with the other species previously mentioned. The viscosity of the alginate is low, however, it may have application in some the food industries. The gel strength of the alginate has a high potential for biotechnological applications requiring encapsulation techniques, such as certain chemical compounds, microorganisms or just as food preservative.

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