

Characterization of Fucoidan Extracted from *Sargassum polycystum* Different Habitats

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Abstract— The objective of this research is to characterize of fucoidan extracted from one species of brown seaweeds from the different habitat. Fucoidan characteristics affected the environment in which growing, harvesting, extraction methods, species of brown seaweed. In this research, characterization of fucoidans extract from three different environments (Lampung, Banten and Batam) of the same species are *Sargassum polycystum*. Brown seaweeds sampling conducted in each place, namely: South Lampung at S 60°08 E105° 09 624 549; Banten at the position 06°50 S 727 E 105°53.337, and Batam in position N 00°57.873 E 104°02.415 ". The highest yield obtained from brown seaweed Lampung and lowest obtained from Batam. In contrast ash contents of fucoidan derived from Batam highest and lowest from Banten. The yield of fucoidan inversely related to ash content of each the brown seaweed.

Keywords— Brown Seaweeds, Fucoidan, Habitat, *Sargassum polycystum*.

I. INTRODUCTION

IN Indonesia, there are various species of brown seaweed. Brown seaweeds that have been widely known are from the genus's *Sargassum sp*, *Turbinaria sp*, *Padina Sp*. *Sargassum sp* have hundreds of species [1]. Similar it was found also at the Yucatan Peninsula (Mexico) turbinata *Turbinaria* types of brown seaweeds, *Sargassum filipendula*, *Dictyota caribaea* and *Padina perindusiata* [2]. In the brown seaweeds are the main polysaccharide's alginate compound, laminarin and fucoidan while, fucoidan is a sulfated polysaccharide compound bound sulfate that is only found in brown seaweed and sea cucumbers [3]. Fucoidan, a cell-wall matrix polysaccharide in brown seaweed and some echinoderms, is composed of -L-fucose and ester sulfate, including minor amounts of D-Gal, D-Man, D-Xyl, D-Glc, D-GlcA and acetic acid. Fucoidans have been extensively investigated because of their various biological activities [5].

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Fucoidan found in marine invertebrates and brown seaweed [4]. Salts of alginic acids (alginates) and complex sulfonated polysaccharides (fucoidans) [6] occur in cell walls and intercellular space. The latter exhibit a broad spectrum of biological activity. Structure–activity relationships of the polysaccharides are rather difficult to establish because their structures are heterogeneous, irregular, branched, and highly sulfonated. The structural characteristics of fucoidan are likely to be dependent on the extraction technique [7], algal maturity [8], species of seaweed, season of harvest [9], and geographic location [10].

The study of seasonal variations of the polysaccharide composition and structure of individual polysaccharides is of practical significance for determining the optimal times for collecting algae in order to standardize preparations of these polysaccharides for use in medicine and the food industry [11]. The contents of fucoidan in brown seaweed are influenced by several factors, among others are the method of extraction, growth, season, and species, these characteristics affect the bioactivity of fucoidan. Binuangun (Banten) is one of the producers of brown seaweed that has been widely studied in Indonesia [12]. However, during this study brown seaweed is still on the macro compounds in the brown seaweed. This research focus on the characteristic of compounds in three different habitat of brown seaweed from species *Sargassum polycystum*.

II. MATERIALS AND METHODES

Materials

Raw material brown seaweeds *Sargassum polycystum* used in the research were obtained from Banten, Lampung and Batam. Chemical reagents CaCl₂ from Merck, ethanol CHCl₃, methanol, HCl and H₂SO₄ p.a.

Methodes

Fucoidan Extraction

The fucoidan was extracted from fresh brown seaweeds that were form foreign substances the fresh seaweeds were maceration in MeOH-CHCl₃- H₂O with ratio 4:2:1 for 12 hours then the wet biomass was washed with acetone and was dried outside [13]. Dry seaweed used was powdered into 60 mesh size. Seaweed powder soaked with dilute HCl pH 4 with a ratio of 1: 10 for 6 hours while stirring, then filtered through 350 mesh nylon. The filtrate was collected and added 4M CaCl₂ then was incubated for 30 minutes. The mixture was filtered, the filtrate was collected and until be concentration become 2M CaCl₂ solution and then was centrifuged at 10,000 rpm for 15 minutes, then added 3M CaCl₂. Then centrifuged at a speed of 10,000 rpm for 15 minutes. Filtrate collected and

added ethanol at a ratio of 1: 2, then left. The precipitate was collected separately by centrifugation with a speed of 10,000 rpm for 15 minutes. The precipitate was collected and dissolved with aquabidest. Then last was dried using freeze dryer to obtain fucoidan extracts. All yields are calculated on the weight of seaweed flour converted in two percent.

Determination of Chemical Composition

Fucose content of fucoidan was determined according to Dubois methods using phenol-H₂SO₄ reagent and L-fucose (Sigma) as the standard [14]. The sulfate content was quantified using the BaCl₂-gelatin method using K₂SO₄ (BDH Limited) as the standard using hydrolyzed fucoidan. Fucoidan was hydrolyzed (15 mg) in 3 M HCl for 17 h at 100 °C [15]. For ashes, powder seaweed samples were incinerated in a furnace at 550 ° C for 16 h and weighed [16]. Uronic acid content of fucoidan was determined using the carbazole-sulphuric acid borate reaction using d-glucuronic acid (Sigma) as the standard [17], respectively. All yields were calculated from the dried weight of fucoidan and converted into a percentage. Absorbance measurements were recorded in triplicate using an Ultrospec 2100 UV/visible spectrophotometer.

III. RESULTS AND DISCUSSION

In this research, the characterization of fucoidans extract from three different environments of the same species that is *Sargassum polycystum*. Sampling brown seaweeds did in each place, namely: South Lampung at S 60°08 E105° 09 624 549; Binuangeun, Banten at the position 06°50 S 727 E 105°53.337, and Batam in position N 00°57.873 E 104°02.415". Pretreatment on seaweed that is sorting and washing, which aims to remove dirt and rocks and other seaweeds. Next step was maceration with (MeOH: CHCl₃: H₂O) with ratio of 4:2:1. To purpose of this a soaking to remove pigment and fat seaweed After the macerated and next rinsed acetone to speed up the drying and following aerated in an open space until dry seaweed then used as powder (60 mesh). This treatment is performed three repetitions. The results of the yield obtained from each powder brown seaweed such as in Figure 1.

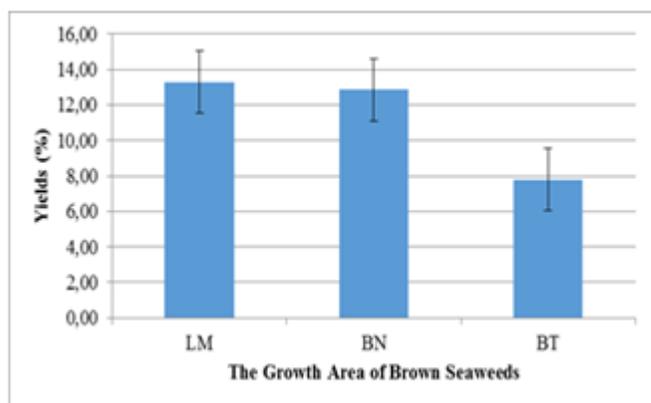


Fig. 1. The Yields Powder Brown Seaweeds LM. Lampung; BN. Binuangeun; BT. Batam

Results of yield the highest brown seaweed powder obtained from Lampung (13.29%) and the lowest from Batam

(7.8%). However, the results of statistical tests yield powder brown seaweed Lampung and Binuangeun declared not significantly different while in Batam significantly different. The yield of the lowest powder shows that it contains other ingredients such as seaweed and coral another and attached to a higher salt content. Seaweed powder quality testing done of the parameters' moisture content and ash content. Results of powder quality brown seaweed is as shown in Figure 2.

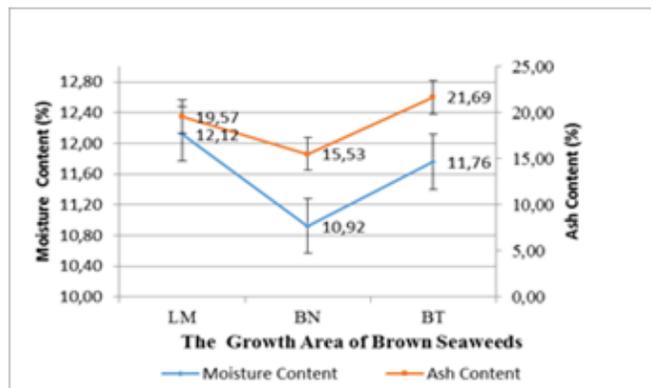


Fig. 2. Powder Quality of Brown Seaweeds LM. Lampung; BN. Binuangeun; BT. Batam

The highest of ash content in brown seaweed is obtained from Batam (21.69%). The ash content is identical to the content of the metal oxide derived from salts. It is seen from the highest ash content data obtained from brown seaweed that of Batam about 21.69%, also obtained high salinity levels in Batam (27.31 ppt). In contrast low ash content obtained from Binuangeun (15.53%) and salinity (25.87 ppt). However, lowest salinity obtained from Lampung (21.66 ppt) and ash (12.12%). This indicates that in addition to the salt content, there may be other factors that affect the amount of ash content. The high ash contents other possible causes' accumulation of inorganic compounds remaining from the dialysis. Several factors that caused differences in chemical composition, and physical fucoidan include the condition of the place grow whether ocean currents wave, and the harvest season [18], the length of seaweed contact with the open air [19], the age of leaves where the older age of seaweed higher fucose content.

Chemical Composition

Testing the content of total sugar by comparison to fucose, which is the predominant monomer in fucoidan using Dubois [14]. Dominant polysaccharide contained in brown seaweed is those are alginate, fucoidan and laminaran. The test results of total sugars' highest fucoidan derived from Lampung (LM) of 83.26% and the lowest came from Batam by 75.53%. Based on the statistical test of Lampung total sugar significantly different from the total sugar Binuangeun and Batam.

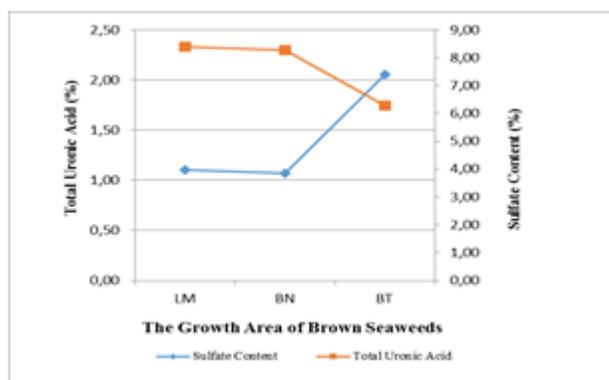


Fig. 3A. Total Uronic Acid of Fucoidan

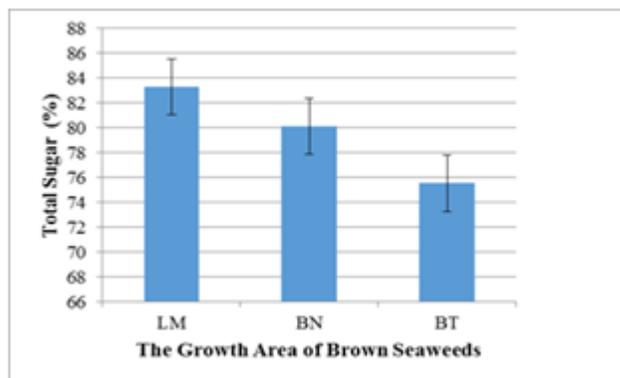


Fig. 3B. Total Sugar of Fucoidan LM. Lampung; BN. Binuangeun; BT. Batam

Fig.3. Quality of Fucoidan

The difference totals sugar content influenced by several things, among others harvesting. Based on yield, the highest content of fucoidan derived from Binuangeun. However, a total amount of sugar, the highest total amount of sugar obtained from Lampung. The process formation of glucose metabolism in brown seaweed begins with formation of glucose. After the mature (adult) with the help of enzymes form fucose. Brown seaweed that is grown characterized by the formation a spore. This was supported by the results of research Zvyagintseva [8] which stated the content of fucoidan derived from seaweed, which has sporofil (period grow longer) have a higher yield than the brown seaweed has no sporofil [9,10].

The characterization results fucoidan (uronic acid and sulfate content) of Binuangeun and Lampung almost the same results, but with a different quality of fucoidan from Batam. When viewed from the lowest yield derived from Batam, however, higher uronic acid content, identical to the content of alginate is also [10]. The external factors affecting uronic acid content, among others, the environment in which grow. One of the characters is the environment in which grow the depth and brightness of a grow seaweed. Results of testing the condition of the ocean currents and brightness in Binuangeun and Lampung are almost the same that is grown in the area of ocean currents and waves are higher, the brightness of about 50-100 cm, while in Batam lower marine currents, higher brightness around 175-250 cm. This causes the difference yield and chemical composition of content of fucoidan. Higher

content of fucoidan obtained in brown seaweed that the ocean currents and high waves. Several studies state the difference content of fucoidan influenced by the species of seaweed, the harvest season [20], geographic locations [10], and maturity / harvesting [8].

IV. CONCLUSION

The characteristics of fucoidan from the same species (*Sargassum polycystum*) obtained the highest yield of Binuangeun (Banten) by 4.22 % and the lowest (2.43%) from Batam. The yield of fucoidan inversely related to ash content of each the brown seaweed. The salt content one of factors that affect the amount of ash content. The environment in which grow the depth and brightness of a growth seaweed.

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