Domestication of Red Seaweed (Gelidium latifolium) in Different Culture Media

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Domestication of Red Seaweed (*Gelidium latifolium*) in Different Culture Media

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Abstract

Gelidium latifolium is one of red seaweed types potentially can be developed as an industrial raw material. Since Gelidium is currently taken from ocean, the availability of seaweed from aquaculture is necessary to overcome the small number of its availability in nature. In Indonesia, G. latifolium cultivation has not been carried out so that domestication is required. The use of macro and micro nutrients in growth media is essentially needed for the domestication process. Domestication requires fast media and place for growth. The purpose of this study is to determine the growth of biomass and the survival of G. latifolium in different culture media. The study was conducted in a semi-outdoor research laboratory. The method used in this research is laboratory experimental method and Completely Randomized Design (CRD) with the treatment applied using 3 types of culture media (Urea: Za: TSP) by comparison (A) 100: 50: 50% (2 g.L^{-1}), (B) 75: 75: 50% (2 g.L^{-1}) and (C) 75: 50: 75% (2 g.L^{-1}), with 3 replications. The seaweed was kept in 10 L of water in aeration equipped aquarium and filled with 10 g of G. latifolium on each treatment. The best growth rate of G. latifolium biomass is 5.67± 0.58 g and 100±0% are survived in C culture medium with a concentration of 75% Urea: 50% ZA: 75% TSP (2 g.L^{-1}).

Keywords: *red seaweed, weight growth, survival, culture media, semi-outdoor*

Introduction

Indonesia has high seaweed resource potential and it is spread almost in all sea waters of the country, including *Gelidium latifolium.* As one of red seaweed types, this species has high potential for industrial raw material. Red seaweed particularly can be used as a source of products in pharmaceuticals, food, and aquaculture (Widowati *et al*., 2014). The seaweed cultivation has prospect since its demand in global trade is relatively high and it is increasing (Sanjeewa *et al*., 2017).

Gelidium is usually used for jelly production (Kang *et al*., 2013), paper (Seo *et al*., 2009), natural antifungal against fungus *Candida albicans* (Lutfiyanti *et al*., 2012), antioxidant (Seo *et al*., 2012), raw material in bioethanol production (Meinita *et al*., 2013; Hong *et al*., 2014; Meinita *et al*., 2017), antimicrobial (Kang *et al*., 2016),and for reducing hepatic lipids and plasma in diabetics (Yang *et al*., 2017). To date Gelidium grows in fast-growing parts of the banks, farmers still depend on the season, and harvest from nature so that it is feared that sustainable use will cause Gelidium to experience extinction so that it needs domestication (Sjafrie, 1999). To have a normal growth and high survival, the seaweed need an adaptation from conditions in nature to cultivation. The trial of the cultivation has been carried out on the *Gelidium amansii* (Aries and Jubaedah, 2011).

Domestication requires a sufficient nutrient for growth Growth stimulant is one of the media components demanded for growth and regeneration (Fadel *et al*., 2013). The purpose of this study is to determine the growth of biomass and the survival of *G. latifolium* in different culture media.

Materials and Methods

The study was conducted in a research laboratory (semi-outdoor). Samples of *G. latifolium* seedlings were taken from Kebumen Coastal Waters-Southern coast of Central Java. Seedlings were acclimatized in the laboratory for 1-2 weeks. The selection of seedlings was based on their quality, number of branches, healthy, natural-bright colored, clean, disease-free, have good *thallus* and

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holdfast and those that are young shoots (Yong *et al.*, 2011). The seaweed domestication was kept by used 10 L of water in aeration equipped aquarium and filled with 10 g of *G. latifolium* seaweed in each treatment. The research used 3 types of culture media as treatments (Urea: Za: TSP) i.e. (A) 100: 50: 50% (2 $g.L^{-1}$), (B) 75: 75: 50% (2 $g.L^{-1}$) and (C) 75: 50: 75% (2 $g.L^{-1}$), with 3 replications for each treatment.

Observed parameters

The weight gain or biomass of seaweed (G) is the ratio between the differences in the final weight of the experiment (W_1) minus the initial weight of the experiment (W_0). This research was conducted by weighing the seeds using analytical scales. The weight gain can be calculated by the Effendi formula, (1979).

Survival rate (SR) is a comparison between the percentage of the total number of seaweed individuals that live at the end of the experiment (N_t) divided by the total number of seaweed individuals at the beginning of the experiment (N_0). Survival rates calculated using the formula of Goddard, (1996).

Data Analysis

The data obtained were analyzed descriptively in the form of tables and graphs. To find out the difference in growth rate and survival rate of treatment, ANOVA test was used. If there is distinction between treatments ($P<0.05$) then the analysis will be proceed with Tukey test. Data analysis was performed by using SPSS software version 24.

Results and Discussion

Absolute Growth Rate

The results of observations of absolute biomass growth rate on different culture media showed that the highest *G. latifolium* biomass was in C culture medium treatment of 5.67± 0.58 g, followed by B culture medium of 3.33± 1.15 g, and the lastly, the lowest in A culture medium of 2.67±0.058 g (Figure 1). ANOVA resulted that the combination of Urea, ZA, and TSP fertilizers between treatments showed a significant difference ($P <0.05$) to increase the of *G. latifolium* biomass. Meanwhile the results of further Tukey tests showed that the addition of *G. latifolium* biomass in the treatment of C culture medium was significantly different ($P <0.05$) from the treatment of A culture medium.

The growth rate of biomass in C culture medium was higher than in B culture medium, and the A culture medium was the lowest. From the initial phase of planting, it was observed a continuously gradual increase in biomass until the 28th day of the final phase. The C culture medium Showed the fastest growth and in biomass as well, whereas the B and A culture media showed a slower growth and their biomass were low. It was suggested that the combination of growth media (Urea: ZA: TSP) with the good concentration could increase the growth of *G. latifolium* offesting on well- fast-growing *holdfast* and many branches *thallus*. According to Widyawati *et al*. (2019), the nitrogen element in Urea can accelerate *thallus* growth. While the nitrogen element in ZA fertilizer can accelerate plant growth and increase protein content. Meanwhile according to Wahyurini (2014), element nitrogen in Urea fertilizer and element phosphate in TSP fertilizer will greatly affect the growth rate of seaweed.

Phosphate content in culture media is an important component of stimulating *thallus* growth, accelerating and strengthening the growth of young plants into mature plants. Phosphate causes the high growth rate so that the weight of the biomass becomes high (Lingga and Marsono, 2007). According to Prakoeswa *et al*. (2009), the use of appropriate growth regulators in the media helps *thallus* and organs of seaweed grow, while in the media without the addition of growth regulators, the growth could be very stunted and may not even grow at all.

Survival Rate

The results of survival observations showed that *G. latifolium* in C culture media treatment was the highest of 100±0%, followed by 99.67±0.58% in B culture medium and the lowest was in (A) culture medium of 98.67±2.31% (Figure 2). ANOVA results showed that the combination of Urea, ZA, and TSP fertilizers between treatments showed no significant difference ($P> 0.05$) to the increase of *G. latifolium* biomass.

Survival rate in this study showed, that in the culture media C was the highest, compared to culture media B, and the lowest was in culture media A. Based on the beginning of planting until the 14th day, the survival of *G. latifolium* was, stable; it was continued until days 21st to 28th when the growth decreased due to the death. This decrease of survival rate can be seen on the higher of the standard deviation, and the value of the data is far from the mean survival in *G. latifolium*. Seaweed with morphological changes in the color of pale white stems, on lead stems rather red color that

causes the stems to become soft and broken. The death of explants may due to the ability of explant adaptation when explaining hormones in different nutritional compositions when excess nutrient composition will divert interactions that can activate explants (Fadel *et al*., 2013).

The survival rate in C culture medium is considered to be higher because the application of fertilizer concentration is fit with the need for the development of seaweed growth cells. Seaweed requires nutrients for growth and survival (Mukhlis *et al*., 2016). Urea is a single type of fertilizer which nitrogen function accelerates *thallus* growth (Stiaji *et al*., 2012). According to Muarif *et al*. (2017) to maintain the survival of seaweed, adequate nutrition is required for the formation of new tissue or of shoots to stay alive. Essentially a lot of nitrogen is needed by seaweed as an energy supplier in the process of photosynthesis (Kushartono *et al*., 2009). Meanwhile, the lowest survival rate on A culture medium was thought to be the high composition of culture media resulting in death. According to Mulyaningrum *et al*. (2014), media inhibition factors is, if main elements of micronutrients were in excessive amounts and become toxic. When the amounts of B was too high, it ends to high mortality. The utilization of micronutrients by explants is too high, resulting in high mortality. According to Wahyurini (2014), too many doses of fertilizer (Urea and TSP) given will cause growth to be stunted and seaweed undergoes have a morphological changes including the color of pale white stems, on lead stems rather red which causes the stems to become soft and broken.

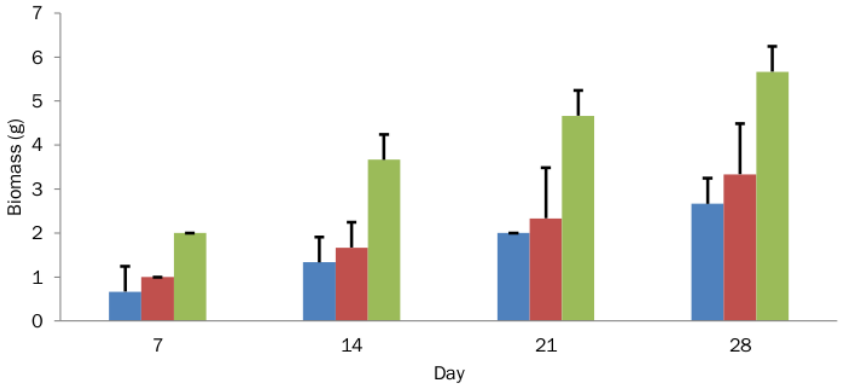

Figure 1. The average weight growth rate of *G. latifolium* cultured in different media
Note. ■ = (A) urea, ZA, TSP (100:50:50) %; . ■ = (B) urea, ZA, TSP (75:75:50) %; . ■ = (C) urea, ZA, TSP (75:50:75) %

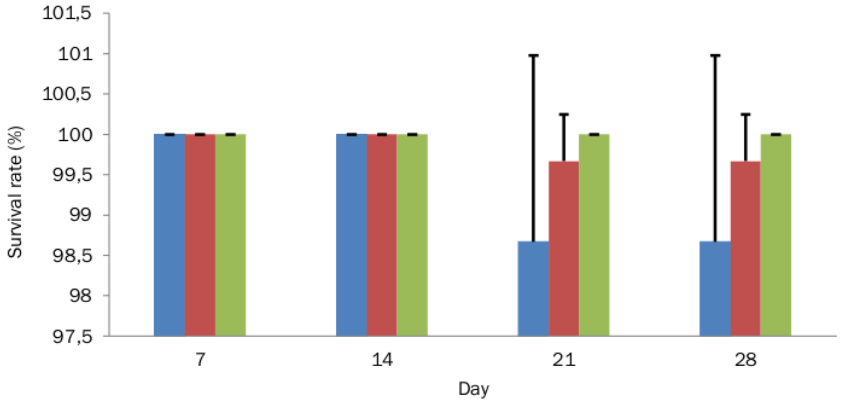

Figure 2. The average survival rate of *G. latifolium* seaweed cultured in different media
Note. ■ = (A) urea, ZA, TSP (100:50:50) %; . ■ = (B) urea, ZA, TSP (75:75:50) %; . ■ = (C) urea, ZA, TSP (75:50:75) %

The results of temperature measurements demonstrated that from the beginning of planting until the harvest time there were no significant fluctuations, the values were ranging from 29-30 °C. Temperature measurements showed that the temperature in the study water media was suitable for the growth of *G. latifolium*. As stated by Aslan (1998), good temperatures for seaweed growth ranged from 26-33 °C. The requirements for cultivation, good water temperature for seaweed growth is 24-30 °C (Sulma and Manoppo, 2008). The result of pH measurements is pH 7, meaning, that the pH on the media is still within the normal range for the growth of *G. latifolium* cells. According to Kordi and Tancung (2007), cultivation will work well at pH 6.5 - 9.0. Meanwhile, according to Mudeng *et al*. (2015), the optimum pH required for seaweed cultivation is 6.5 - 8.5. All algae with a pH ranging from 6.8 to 9.6 can still live and grow (Ain *et al*., 2014; Burdames and Ngangi, 2014). The degree of acidity (pH) affects the level of water fertility. Acidic waters will be less productive. At low pH (high acidity) the dissolved oxygen content will decrease, so oxygen consumption decreases (Afandi *et al*., 2015). Salinity results on *G. latifolium* indicates conditions that support growth. Based on these results it can be seen that salinity of 30-33 ppt support growth of *G. latifolium*. According to Guo *et al*. (2014), the optimal range of salinity for seaweed growth is 25-33 ppt. Seaweed will growth slowly if the salinity is too low (<15 ppt) or too high (> 35 ppt), from the salinity range following its living conditions it can cause interference on osmoregulation process that occurs in cells and physiological seaweed (Choi *et al*., 2010).

Conclusion

The best growth rate in culture media C with a concentration of 75% Urea: 50% ZA: 75% TSP (2 g. L^{-1}). The biomass growth rate on different culture media showed that the highest *G. latifolium* biomass increased in C culture medium treatment 5.67± 0.58 g, followed by B culture medium 3.33± 1.15 g, and the lastly, the lowest A culture medium 2.67±0.058 g and The survival observations showed that *G. latifolium* seaweed in the highest C culture media treatment was 100±0%, followed by 99.67±0.58% in B culture medium and the lowest was in (A) culture medium of 98.67±2.31%.

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Domestication of Red Seaweed (Gelidium latifolium) in Different Culture Media

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6