Growth performance of carrageenan-producing seaweeds of Kappaphycus and Eucheuma in Sumbawa

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Submission date: 10-Dec-2021 03:32PM (UTC+0700)
Submission ID: 1726419970
File name: 42_Growth_performance_of_carrageenan.pdf (628.57K)
Word count: 1898
Character count: 9568

Growth performance of carrageenan-producing seaweeds of *Kappaphycus* and *Eucheuma* in Sumbawa

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Abstract

This research purpose is to address growth performance of carrageenan-producing seaweeds of *Kappaphycus* and *Eucheuma*. The research was conducted in coastal area of Kaung Island, Buer sub-district, Sumbawa Regency from August to September 2012. Importance of *Eucheuma*/*Kappaphycus* spp. for Indonesian economy and farmer livelihood are main source of hydrocolloids and main source of income. West Nusa Tenggara is one of the production center for *Eucheuma*/*Kappaphycus* in Indonesia. The method used for this study was planting seaweed using long-line system involving 25 farmers. The species planted were *Kappaphycus alvarezii* Tembalang, *Kappaphycus alvarezii* Maumere, *Kappaphycus striatum* and *Eucheuma spinosum*. The growth of *Eucheuma* spp was measured every 7 days until harvesting time which is 45 days. Initial seed weight was 100 g and the number of seeds perline were 200. Purphoses sampling done by 5 samples per line for analysis of fresh weight, dry weight, carragenan content and incident disease.The result of this research shows that the increase in weight *Kappaphycus alvarezii* Tembalang is 0,82 grams/day, *Kappaphycus alvarezii* Maumere is 0,06 grams/day, whereas that of *Kappaphycus striatum* is 0,97 grams/day and *Eucheuma spinosum* is 5,59 grams/day. It can be concluded that *K. alvarezii, K. striatum a*nd *E. spinosum* can grow in Kaung, *E. spinosum* is more adaptable to Kaung ecology, and can be grown throughout the year.

Keyword: cultivation, long line, fresh weigth, dry weight, adaptable.

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Introduction

The development if seaweed cultivation to improve community's prosperity in NTB is supported by economic potency and large cultivation area. As an illustration, data of economy survey in 2010 show that seaweed farmer revenue in NTB ranged from Rp. 26.538.000 to Rp. 60.458.500 per year, in which the potency of cultivation area reached 25.206 hectares (Pemda NTB, 2011). However, the use of this area just reached 44% with total production of dry seaweed was 221.047 tonnes (Pemda NTB, 2011).

Economically, seaweed cultivation is one of productive businesses within coastal area which brings benefit. Besides accelerating seaweed harvest time (30 to 50 days) and cultivation that does not need a complex maintenance, seaweed (*Eucheuma*/*Kappaphycus*) cultivation in NTB is also an important source of livelihoods that improves community's revenue along the coastal area. This is because the cultivation of seaweed can bring revenue which is 26 to 60 million rupiahs per year and it depends on cultivation method used and the total area of cultivation.

In the other hand, dry seaweed production in NTB just reached 220,000 tonnes, and this value is less than the potency of production which is more than 1 million tonnes per year (Pemda NTB, 2011). Seaweed is not only an important source of alternative livelihood for farmers, but also a source of hydrocolloid used in many industries. Some of these industries are pharmacy, food, paint, and cosmetic that uses carrageenan as one of raw materials.

According to those facts, the local government of NTB has taken strategic steps including extension and intensification of seaweed cultivation in order to improve seaweed production in NTB and increase locally-generated revenue. This effort also aims to grow economic business which is productive that benefits coastal community that generally has low income. From the perspective of NTB, extension of seaweed cultivation directed to Sumbawa Island has a big potency because of the extent of potential area that has not been used which is more than 50% out of 20.200 hectares of potential area for seaweed cultivation in Sumbawa Island. Kaung Island is a potential area to develop cultivation of many species of seaweed such as Kappaphycus and Eucheuma. According to this fact, there is a need of a research to address the growth of and carrageenan from *Kappaphycus and Eucheuma* cultivated in marine area of Kaung Island.

Material and Methods

The method used for this study was planting seaweed using long-line system involving 25 farmers. The species planted were *Kappaphycus alvarezii* Tembalang, *Kappaphycus alvarezii* Maumere, *Kappaphycus striatum* and *Eucheuma spinosum*. The growth of *Eucheuma* spp was measured every 7 days until harvesting time which is 45 days. Initial seed weight was 100 g and the number of seeds per line were 200. Purphoses sampling done by 5 samples per line for analysis of fresh weight, dry weight, carragenan content and incident disease.

Seaweed was planted from August to September 2012. The seed used was introduced from seed bed in Gerupuk Bay area and Mid-Lombok Regency. Data of weight increase was calculated using following formulas:

Increase of weight = weight on t (time) – initial weight

Growth rate (% per day) = ((ln W_t *- ln* W_o*)/ t) x 100*

Analysis of carrageenan was done by extracting seaweed, cooked with pressure on temperature of 100ºC for 2 to 3 hours until seaweed turned into a gel, with alcohol. The analysis of carrageenan was done in Immunology Lab, Faculty of Math and Sciences, Universitas Mataram.

Results and discussion

The result of measurement of four 4 seaweed species cultivated on four ropes on this study is shown on the table 1.

Table 1. Average weight of seaweed (g) cultivated between August and September 2012.

No.	Species	Day-							
		0	7	14	21	28	35	42	49
1.	*E. cottonii (tembalang)*	100	146	178	207	156	112	130	140
2.	*E. cottonii* (maumere)	100	148	166	120	103	82	99	103
3.	*E. spinosum*	100	146	178	213	262	300	337	374
4.	*E. striatum* (sacol)	100	146	179	210	169	126	138	148

Weighing was done for each clump with 180 times of repeat per unit

According to the data, decreasing weight is experienced by *E. cottonii* Tembalang, *E. cottonii* Maumere, and *E. striatum*. This condition generally happens on day 28. The decreasing weight is caused by *ice ice* disease that caused seaweed thallus to break. The data of weight increase shows that *E. Spinosum* production reaches 74 Kg per 100 m^2.

Seaweed species of *E. spinosum* constantly experiences increasing weight although this species is attacked by *ice ice* disease. *Eucheuma spinosum* also has the highest growth compared with other species of seaweed. The data also show that there are some seaweed clumps from species of *E.* cottonii tembalang and maumere, and *E.striatum* gone because of *ice ice* attack.

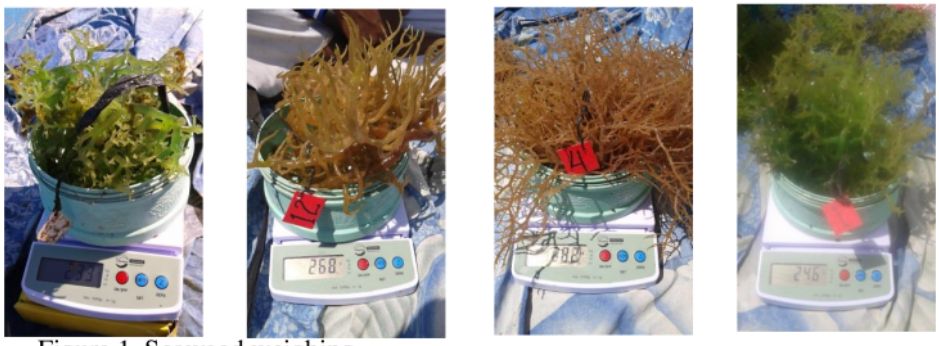

Figure 1. Seaweed weighing

Following are the ratio between wet and dry weights of each seaweed species on different planting days. Sample was taken from ropes for research purpose. Drying was done on the top of *para-para* for 3 days.

Table 2. The ratio between wet and dry weights of seaweed.

No.	Seaweed	Weight measurement (g)											
		Day 28			Day 35			Day 42			Day 49		
		W	D	D/W	W	D	D/W	W	D	D/W	W	D	W/D
1	*E. cottonii (tembalang)*	156	20	0.12	112	15	0.13	130	13	0.1	140	13	0.09
2	*E.cottonii* (maumere)	103	14	0.13	82	11	0.13	99	9	0.09	103	9	0.08
3	*E.spinosum*	262	42	0.16	300	49	0.16	337	54	0.16	374	60	0.16
4	*E. striatum* (sacol)	169	21	0.12	126	17	0.13	138	16	0.11	148	15	0.10

Weighing was done for each clump with 180 times of repeat per unit

According to table above, it can be seen that the highest ratio between wet and dry weights is experienced by *E. spinosum*. The ratio between wet and dry weights can represent water content in seaweed. The higher the ratio, the lower water content in seaweed, a fact which means that the higher dry seaweed production.

The result of measurement of seaweed sample done in Immunology Lab, Faculty of Match and Sciences, Universitas Mataram is shown on following figure 2.

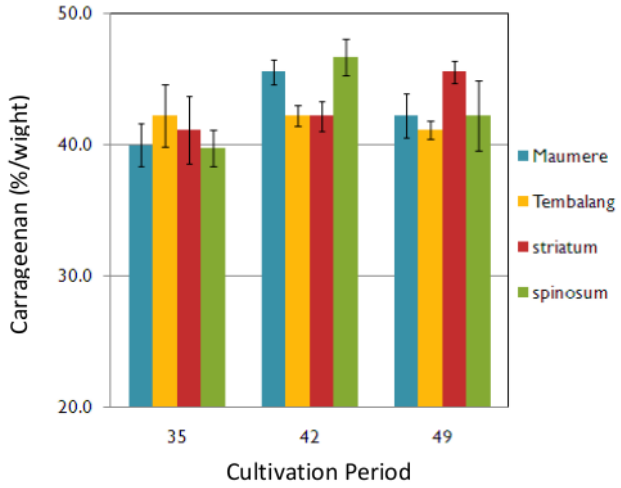

Figure 2. Percentage of Carrageenan in many Species and Cultivation Periods

The content of seaweed carrageenan in *E. spinosum* and *K. alvarezzi* strain maumere cultivated for 42 days tends to be higher compared with that of cultivated for 35 and 49 days, whereas the carrageenan content in *E. striatum* tends to increase gradually until day 49 of cultivation. Carrageenan content of *K. alvarezzi* (tembalang) tend to be stabile on the three cultivation periods.

Conclusion

*K. alvarezii, K. striatum a*nd *E. spinosum* can grow in Kaung. *E. spinosum* is more adaptable to Kaung ecology, and can be grown throughout the year.

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Table 2. Percentage of sperm motility following treatment with different Noni (*morinda citrifolia*) extract level after cooling.

Time of cooling (h)	Noni extractlevels (%)	Mean ± *SD*
0	0	69.00 ± 2.11[b]
	10	73.00 ± 3.50 [a]
	20	68.00 ± 4.22[b]
	30	67.50 ± 4.25[b]
24	0	62.00 ± 4.22[a]
	10	64.50 ± 3.69[a]
	20	56.00 ± 3.94 [b]
	30	53.50 ± 2.42 [b]
48	0	52.00 ± 2.58 [a]
	10	54.00 ± 3.94 [a]
	20	43.50 ± 2.42 [b]
	30	42.00 ± 2.58 [b]

[a, b] highly significant different (P<0.01).

Discussion

The results showed that the level of Noni (*morinda citrifolia*) extract had very significant effect (P<0.01) on sperm motility percentage in 0, 24 and 48 h of cooling. Levels 10% Noni (*morinda citrifolia*) extract produced the highest percentage of motility of spermatozoa, followed by the level of 0%, 20%, and 30% Noni (*morinda citrifolia*) extracts. Sperm motility decreased gradually as the duration of cooling. The longer the cooling the lower the sperm motility and viability. Decrease in the percentage of sperm motility after cooling is due to fewer sperm that have sufficient energy reserves to be used to move, as long as the cooling sperm remain metabolic activity. Exogenous substrates during cooling required for mitochondrial ATP availability is limited. Secondary metabolites materials required for energy and buffer as well as antioxidants to protect sperm from damage due to the accumulation of CO_2, lactic acid and free radicals (Kaeoket et.al., 2011; Tavilani et. al., 2008). It can be concluded that thebestNoni (*morinda citrifolia*) extract level for resulting optimal sperm motility was 10%.

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