Quality of *Eucheuma cottonii* seaweed cultivated in Lampung waters

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**Abstract.** This study was aimed to observe the quality of *Eucheuma cottonii* dried seaweed produced from seaweed farmers in Lampung, especially in its main production centers namely sub-district Ketapang, south Lampung. Seaweed was taken from three locations namely Ruguk, Legundi and Tri Dharma Yoga Village. The parameters observed were included seaweed moisture content, clean anhydrous weed (CAW), ash content, yield, and the quality of carrageenan produced. The results showed that seaweed moisture content ranged from 21.71 to 33.48%, CAW 37.53-40.72%, ash content 33.68-43.08%, and carrageenan yield 11.35-13.57%. From the results of the observation it was concluded that the quality of seaweed from Legundi Village was the best compared to other villages.

**Keywords:** carrageenan, *Eucheuma cottonii*, Lampung, seaweed

1. **Introduction**

*E. cottonii* is a seaweed producing carrageenan that is commonly used as raw material for carrageenan industries. Carrageenan used as additives for the food, beverage, cosmetics, pharmaceutical, paint, textile, and other industries. Besides being used as a food source, *E. cottonii* is also used as a producer of growth hormone that is often used for organic fertilizers (Sedayu et al 2013). Therefore the demand for this type of seaweed increases by 5-10% every year both to meet the needs of the seaweed industry in the country and for export. At present, Indonesia is the largest producer of *E. cottonii* seaweed in the world. This is supported by the development of seaweed cultivation technology that can be done with various techniques (Failu et al 2016, Soenardjo 211).

The price of seaweed on the market is very determined by the quality of seaweed. The quality of dried seaweed is regulated in Indonesian National Standards or Standar Nasional Indonesia (SNI). Seaweed must meet the standards issued by SNI 2690-2015, especially for the type of *Eucheuma* sp. seaweed has moisture content must be less than 30%, and clean anhydrous weed (CAW) minimum is 50%. To get good quality seaweed, seaweed handling techniques must be considered since harvesting, drying, packaging, and storage.
Lampung is one of the main producers of seaweed *E. cottonii* in Sumatra, and most of this seaweed was produced by sub-districts of Ketapang. This area is the main producer of *E. cottonii* seaweed in Sumatra which is used as a source of seeds and as a source of raw material for the seaweed processing industry. The three main *E. cottonii* producers in Ketapang are Ruguk, Legundi and Tri Dharma Yoga villages. Different location characteristics between the three locations are thought to affect the quality of seaweed produced. Therefore this study aims to determine the quality of *E. cottonii* seaweed produced from Lampung, especially Ketapang sub-district as the main producer area, and further looking at the differences in the quality of seaweed between the three villages.

2. Materials and methods

2.1. Materials
Seaweed samples were taken from three locations namely Ruguk, Legundi and Tri Dharma Yoga Villages at Ketapang sub-districts. dried seaweeds were collected from seaweed farmers, then packaged in plastic bags and closed tightly to be taken to chemical and processing products laboratories at BBRP2BKP Jakarta to observe the quality.

2.2. Methods
The parameters observed were included seaweed moisture content, clean anhydrous weed (CAW), ash content, yield, and the quality of carrageenan produced. During the research, interviews were also conducted with farmers about how to handle post-harvest and sale of seaweed products. Analysis of moisture and ash content were carried out using gravimetric method according to the method SNI 01-2354.2-2006. Clean anhydrous weed was analyzed using gravimetric method according to the method SNI 8168-2015. Carrageenan yields are analyzed according to the procedure SNI 2354.12-2013. To see the significant difference in the quality of seaweed between the three locations, analysis of variant (ANOVA) test was conducted and continued with the least significant difference (LSD) test with the SPSS program.

3. Results and discussion

From observations in the field, it appears that post-harvest handling of *E. cottonii* seaweed at the farmer level includes harvesting from the sea, washing with seawater, releasing from straps, cleaning of material and other grasses that attach, drying and packaging. The quality of dried seaweed from all three locations varies, this is related to sources and post-harvest methods at the farm level. The way farmers deal with seaweed has a huge influence on the quality of the produced seaweed.

3.1. Moisture content
The moisture content of seaweed is a parameter that shows the level of seaweed dryness and is closely related to the quality of seaweed during storage and distribution Moisture content of dried seaweed from three locations were varied from 21.71±0.44 to 33.48±0.73% (figure 1). Statistical tests showed that the seaweed of the three locations had significantly different moisture content (P<0.05). The highest moisture content found in seaweed from Tri Dharma Yoga Village, while the lowest is obtained from Legundi Village. If compared to the Indonesian standard quality for dry seaweed which requires a maximum moisture content of 30% (SNI 2690-2015), it can be seen that the quality of seaweed from Legundi and Ruguk villages has met the requirements, while the origin of Tri Dharma Yoga still does not meet.

The moisture content of seaweed is very closely related to the drying technique carried out by farmers. The high water content indicates that the drying process is still not optimal or the drying time is lacking. Some farmers tend to dry the seaweed in a short time to reduce the loss of seaweed weights produced. This will actually have an impact on the low price of seaweed because traders will assess the low
seaweed that is still less dry. Tamaheang et al (2017) report that if drying is done correctly, with sunlight for 24 hours it is possible to produce seaweed moisture content 13.75%.

3.2. Ash content
Seaweed ash content from Lampung varies from 33.68±1.38 to 43.08±2.43% (table 1). The results of statistical tests show that there were significant differences between seaweed from Ruguk and other locations (P< 0.05). The high level of seaweed ash is not beneficial because it can cause high levels of carrageenan ash produced. Another disadvantage of the high ash content of seaweed is the need for an extra washing effort to clean seaweed before the carrageenan extraction process. Research Harun et al (2013) showed that the levels of carrageenan ash from the waters of the Tihenggo Village, Gorontalo City range from 14.62 to 18.41%. Indonesia's national standards for the quality of carrageenan require ash content between 15-40% (SNI 8391-1-2017).

From this study, it was seen that the ash content of dried seaweed from Lampung was still quite high. The high ash content indicates that there are still high levels of inorganic impurities such as sand or the high mineral content in seaweed. This is partly due to washing using seawater that is not clean enough and there is soil or sand contamination during the drying process.

![Figure 1. The moisture content of E. cottonii seaweed from Ketapang sub-district, South Lampung.](image)

**Table 1. Ash content of dried E. Cottonii from Ketapang sub-district.**

| Origin of Seaweed | Ash content (%) |
|-------------------|----------------|
| Ruguk             | 43.08±2.43\(^a\) |
| Legundi           | 36.30±2.65\(^b\) |
| Tri Dharma Yoga   | 33.68±1.38\(^b\) |

* the same letter shows not significantly different

3.3. Clean anhydrous weed
Clean anhydrous weed (CAW) is a parameter that shows the level of cleanliness of dried seaweed. The higher the CAW value, the cleaner and drier the seaweed will be, which will have an impact on the higher total dry weight available and carrageenan yield. CAW is one of the parameters required in the Indonesian national standard (SNI) for the quality and safety of dried seaweed products, with a minimum value of 50%.

The results of the study showed that clean anhydrous weed (CAW) seaweed from all three locations ranged from 37.53±1.15 to 40.72±4.23% (figure 2). From this study, it can be seen that the CAW value
of dried seaweed from the three locations still does not meet the SNI quality requirements. The low value of CAW is caused by poor post-harvest handling at the farm level such as nonoptimal process of washing, cleaning, and drying of seaweed. This is also evident from the high ash and moisture content of seaweed (figure 1 and table 1).

3.4. Carrageenan yield
Carrageenan yield is a quite important parameter because it determines the price of seaweed used as raw material for the carrageenan industry. The yield of carrageenan is very much determined by the quality of dried seaweed, and is influenced by the quality of planted seaweed used, harvest age, location and method of cultivation, depth of plantation, planting season, water quality, and post-harvest handling of seaweed and (Asni 2015, Failu et al 2016, Harun et al 2013, Kushartono et al 2009, Nur et al 2016 and Soenardjo 2011).

The results showed that carrageenan yield of these seaweed were ranging between 11.35±0.35 to 13.58±0.39%. There was a statistically significant difference in the yield of carrageenan from seaweed from the three locations, where the yield of carrageenan from legundi village was lower than that of other villages (P<0.05). In general, the yield of carrageenan from the three villages seaweed is still low compared to the results of other studies. Ega et al (2016), reported that carrageenan yield of E. cottonii seaweed extracted with different alkaline treatments ranging from 34.43 to 45.26%. Failu et al (2016) reported that yield of carrageenan from Kappaphycus alvarezii seaweed that cultivated using net-basket method was 46.76%. Harun et al (2013) reported the yield of carrageenan from Kappaphycus alvarezii seaweed with a different harvest age was varied from 23.01-30.63%.

Table 2. Carrageenan Yield of dried E. cottonii from Ketapang sub-district.

| Origin of Seaweed | Carrageenan Yield (%) |
|-------------------|-----------------------|
| Ruguk             | 13.47±0.43a           |
| Legundi           | 11.35±0.35b           |
| Tri Dharma Yoga   | 13.58±0.39b           |

* the same letter shows not significantly different

The low carrageenan yield obtained from seaweed from these villages is due to the still less optimal process of cleaning and drying seaweed. The high water content and impurities are seen from the low CAW value cause the low yield produced. The low quality of seaweed causes low prices received by
farmers. So far, farmers sell their seaweed to seaweed traders or distributors, and the price depends on the quality of seaweed produced.

![Diagram of seaweed marketing system](image)

**Figure 3.** *E. cottonii* seaweed marketing system in Lampung.

3.5. *Marketing chain of seaweed and quality improvement by seaweed traders/distributors*

From interviews with seaweed farmers and traders, seaweed marketing in Lampung is generally through the chain of farmers, small traders, big traders or distributors and industry or exporters (figure 3). The quality of seaweed produced by farmers sometimes does not meet the quality requirements for the carrageenan industry or seaweed exporter, so the role of big traders/distributors is very important to improve the quality of seaweed. Seaweed quality improvement is generally carried out at big traders/distributor before being sent to industry or exporters. At the level of small traders, generally there is no improvement in the quality of seaweed that occurs. Small traders only collect seaweed from farmers, temporarily store it and send it to wholesalers.

The low quality of seaweed at the farm level is partly due to the farmers' lack of understanding of the quality of dried seaweed. In addition, some aquaculture conditions such as high turbidity of seawater and lack of washing processes also cause large amounts of impurities when drying seaweed. Another factor that causes low quality is a short drying process because farmers want to quickly sell their products to get money.

Improving the quality of seaweed at the level of wholesalers/distributors is generally done by cleaning dried seaweed from impurities that stick to it such as sand, soil, salt, and other impurities. Then the seaweed is dried again for several hours until the water content meets the industry/exporter requirements. seaweed is then packaged in sack packs, pressed and stored in the warehouse to wait for delivery to the industry or exporter. In conclusion, seaweed Legundi Village was high quality compared to other village.

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