POST-HARVEST QUALITY PROFILE OF DRIED SEAWEED (*KAPPAPHYCUS ALVAREZII*) IN PASI KOLAGA DISTRICT, MUNA REGENCY, SOUTHEAST SULAWESI, INDONESIA

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Abstract: *Kappaphycus alvarezii* is a leading commodity of aquaculture in Southeast Sulawesi, especially in Pasi Kolaga District, Muna Regency, which is the largest seaweed producing area in the province. Although it has high economic potential, its post-harvest quality is still not well documented. This study aims to examine the post-harvest quality of dried seaweed. *Kappaphycus alvarezii* through sensory, chemical, and physical evaluation. A quantitative approach was used with purposive sampling, involving three samples from different farmers with large stocks. Quality testing followed the Indonesian National Standard (SNI) 2690:2015 and 8169:2015 and was analyzed descriptively. Sensory analysis showed an average appearance score of 8.0 (slightly less clean, bright, species-specific) and a texture score of 7.5 (unevenly dry, tough, not easily broken), both meeting the minimum SNI standard of 7. Chemical analysis found an average moisture content of 35.50% and a CAW value of 46.82%, both of which did not meet the SNI standard (maximum moisture content of 30% and minimum CAW of 50%). Physical testing showed an average coarse impurity of 7.05%, exceeding the 3% limit. Other values were: foreign matter 0.22%, sand 0.85%, salt 10.80%, and total impurity 10.67%. These results indicate that the post-harvest quality of seaweed has not fully met national standards, especially in chemical and physical aspects.

1 Introduction

Optimizing marine potential sustainably, maintaining marine ecosystems, and improving the welfare of coastal communities are the goals of the blue economy that has been pushed by the government to date. Among the sectors that continue to be developed is the aquaculture sector such as seaweed cultivation [1]. Seaweed cultivation has a strategic role because it contributes to increasing economic growth, improving community welfare, and providing ecosystem benefits such as carbon absorption and nutrient recycling in the ocean [2]. In addition, seaweed is also the main source of income for thousands of small-scale farmers in Indonesia because seaweed cultivation requires relatively low capital and production inputs compared to other coastal aquaculture activities [3]. Indonesia currently occupies the top position as the main producer of seaweed that produces carrageenan, especially *Kappaphycus alvarezii* (known in the industry as “cottoni”) [4].

Southeast Sulawesi, especially Muna Regency, is one of the areas with potential for development in the marine economic sector, including seaweed cultivation [4]. It was recorded that in 2022, Muna Regency had produced 112,441,463 tons with a value of IDR 390,101,719,000 of seaweed and seawed production was the highest in Southeast Sulawesi province [5].

One of the areas that produces seaweed in Muna Regency is Pasi Kolaga district. This district is mostly inhabited by people whose main occupation is as fishermen. The most numerous aquaculture fishermen are seaweed aquaculture fishermen, so that Pasikolaga district is one of the central areas for seaweed production in Muna Regency [6]. The type of seaweed developed is *Kappaphycus alvarezii* which can genetically grow well in tropical areas (Figure 1). This type of seaweed is the main source of carrageenan which is widely used in the food and non-food industries, making it attractive to the international market [7]. Bioactive compounds obtained from seaweed have great potential to become key components in the food, nutraceutical, and pharmaceutical industries [8]. Typical compounds in seaweed—such as polysaccharides, polyphenols, and certain pigments—show antioxidant, antimicrobial, and antiviral activities that have great potential to improve human health [9].

The main product produced from seaweed cultivation in Pasikolaga district is mostly still in the form of dried seaweed. Dried seaweed is obtained from fresh seaweed that is 35-45 days old after planting which is dried by drying it for 3-5 days under the hot sun. After going through the process of sailing, the dried seaweed is usually sold directly to collectors and then to larger-scale processing factories, most of which are located in big cities in Indonesia.

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Figure 1. Seaweed *Kappaphycus alvarezii* cultivated (source: researcher's documentation, 2024)

The processing of seaweed into certain products is greatly influenced by the quality of the available seaweed. This is closely related to the issue of food security, where seaweed that meets SNI standards ideally has a better price compared to seaweed that does not meet the Indonesian National Standard (SNI). Furthermore, the post-harvest process is a critical stage that determines the quality of the final product [10]. Dried seaweed that meets SNI standards will be easier to process into various products and semi-products, because it does not require additional mechanisms and time to adjust, because it has been in accordance with the basic material standards before processing.

The large amount of seaweed produced in Muna Regency can be the basis for international interest in Indonesia. However, there is no post-harvest quality data on seaweed produced by seaweed farmers in Pasikolaga District, so it is important to conduct this research with the aim of mapping the post-harvest quality profile of seaweed *Kappaphycus alvarezii produced* by farmers in Pasikolaga District based on sensory, chemical and physical parameters, then comparing them with SNI standards.

(drying)

(temporary storage)

(packing process into sacks)

(product transportation process)

Figure 2: Post-harvest handling process **(**source: researcher documentation, 2024)

2 Research methods

2.1 Study Area and Data Collection

This research was conducted in October-December 2024. The location was in Pasi Kolaga District, Muna Regency, Southeast Sulawesi Province. Sampling was conducted by purposive sampling on seaweed farmers by taking 3 seaweed samples from 3 different seaweed farmer points and having abundant stock. In addition, surveys and interviews were conducted to determine the post-harvest handling process carried out by farmers. The seaweed was put in Polypropylene plastic for preparation in the laboratory. Quality testing was carried out in the basic laboratory of Muhammadiyah University of Kendari.

2.2 Observation Parameters and Data Analysis

After taking seaweed samples, it was continued with laboratory tests with reference to SNI 2690:2015 and SNI 8169:2015[11][12]. Based on these standards, there are several parameters that must be met so that dried seaweed can be said to be of good quality, namely :

Sensory test to assess the appearance and texture using a scale of 1–9, where the scale that complies with SNI is at least 7. Sensory analysis of dried seaweed was carried out by and 25 panelists by filling out the dried seaweed sensory assessment sheet as can be seen in Table 1 below :

Table 1. Sensory Assessment Sheet for Dried Seaweed (SNI 2690 : 2015)

Specification	Mark	Sample Code				
		1	2	3	4	5
1. Appearance						
- Clean, bright colors specific to type	9					
- Slightly less clean, less bright color, specific species	7					
- Less clean, the color is a bit dull specific to the species	5					
- Dirty, species specific color, dull	3					

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-	Dirty, spesies specific color, very dull	1
2. Texture		
-	Evenly dry, tough and not easily broken	9
-	Drying is uneven, tough and not easy to break	7
-	Moist, clay is quite easy to break	5
-	Easy to break	3
-	Easy to break	1

Chemical test includes : water content, minimum 30%. Water content above this threshold increases the risk of microbial growth and decreased carrageenan quality. Clean Anhydrous Weed (CAW), which is the net dry weight after all water and soluble impurities have been removed; its value is at least 50% to ensure high carrageenan yield and efficient processing.

$$Water\ Content = \frac{B-C}{B-A}\ x\ 100\%$$

Information:
A = weight of empty glass (g)
B = weight of cup + initial sample (g)
C = weight of cup + dry sample (g)

$$CAW\ (\%) = \frac{Wd-Wa}{Wo}\ x\ 100\%$$

Information:
Wo = Initial weight of seaweed (g)
Wa = Weight of dry aluminum foil container (g)
Wd = Dry weight of seaweed and container (g)

Physical contamination limited by impurities parameters. There are two types of impurities, namely coarse impurities and total impurities. SNI stipulates that coarse impurities must not exceed 3% by weight. While the limit for total impurities has not yet been set as a standard value.
Coarse impurities are impurities found outside the seaweed thallus and can be separated manually.

$$Percentage\ of\ impurities\ (\%) = \frac{Wd}{Wo}\ x\ 100\ \%$$

Information:
Wo = weight of sample used for analysis (g)
Wd = weight of dirt and other foreign matter (g)
Total impurities are all dirt found on the surface or salt in the seaweed thallus.

$$Total\ impurities\ (\%) = Foreign\ matter\ level\ (\%) + salt\ level\ (\%) + sand\ level\ (\%)$$

$$Foreign\ matter\ level\ (\%) = \frac{Wa}{W}\ x\ 100\%$$

Information:
Wa = weight of foreign matter on seaweed (g)
W = weight of sample used for analysis (g)

$$Salt\ level\ (\%) = \frac{V\ x\ N\ x\ 58{,}5\ x\ Fp}{W}\ x\ 100\%$$

Information:
V = Volume $AgNO3_3$used for titration (ml)
N = Normality of $AgNO_3$used for titration (mol/G)
Fp = Dilution factor
W = weight of sample used for analysis (mg)

$$Sand\ Level\ (\%) = \frac{Ws}{W}\ x\ 100\ \%$$

Information:
Ws = weight of sand that has been dried (g)
W = weight of sample used for analysis (g)
Sample testing from 3 different points was carried out with 3 repetitions. The research data were analyzed through simple statistics and described descriptively.

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3 Results and Discussion

3.1 Sensory Test

Sensory testing of dried seaweed was conducted to obtain a comprehensive picture of its visual appearance and textural characteristics. This procedure serves as an initial stage of quality assessment, where panelists utilize all five senses—especially sight and touch—to evaluate and provide an objective impression of the quality of dried seaweed products before further testing. Table 2 shows the results of sensory testing on dried seaweed (*Kappaphycus alvarezii*) which is cultivated by farmers.

Table 2. Results of Seaweed Sensory Tests (*Kappaphycus alvarezii*)

Dried seaweed	Sensory Test Parameters	
	Appearance	Texture
I	8.2	8,0
II	8.1	7,5
III	7.6	7,0
Average	8.0	7,5

Referring to the sensory test data presented in Table 2, the appearance aspect of dried seaweed obtained an average score of 8.0. This score indicates that visually the product still displays a slightly unclean impression, bright colors, and slightly obscured specific characteristics of the type. However, this figure of 8.0 is within the range of quality requirements listed in SNI2690:2015, so that the product is still considered worthy from the perspective of external appearance. In other words, although the panelists noted a slight deficiency in terms of appearance, the dried seaweed was considered to have met the minimum quality limit standardized by SNI, namely 7 (slightly less clean, less bright color, specific species).

In terms of texture parameters, dried seaweed achieved an average score of 7.5. These results indicate that the dry surface is less even, when stretched it still shows a pliable nature so that it is not easily broken. This characteristic, although not ideal for some consumers who want higher dryness, is still in accordance with the texture quality criteria according to SNI2690:2015. This means that from the SNI assessment perspective, the physical structure of the dried seaweed has met the required specifications, so it is suitable for marketing or use as a further raw material. The sensory characteristics of seaweed in Pasi Kolaga are generally better compared to other locations in Southeast Sulawesi, for example in South Konawe Regency [13].

3.2 Chemical Test

This chemical test consists of testing the water content and Clean Anhdryous Weed (CAW) content. Water content is an indicator of food quality. The higher the water content, the greater the chance of chemical reactions, microbial growth, texture damage, so that the product degrades faster.

Table 3. Chemical Parameters of Dried seaweed (*Kappaphycus alvarezii*)

Dried seaweed	**Chemical Parameters (%)**	
	Water level	**CAW**
I	31.90	50.64
II	31.30	44.51
III	43.50	45.32
Average	**35.50**	**46.82**

The test results showed an average water content of 35.50%, exceeding the maximum limit of 30% set in SNI 2690:2015. This discrepancy is thought to be due to the lack of effective and consistent implementation of post-harvest procedures—especially drying techniques—at the farmer level. The drying phase is a critical point in determining final quality: temperature, drying time, thickness of the layer, and air circulation must be controlled so that water can evaporate to a safe level [14]. In addition, inadequate storage methods also contributed; hygroscopic salt crystals on the surface of seaweed easily absorb water vapor from humid environments, causing the water content to rise again after the drying process is complete [15]. Without adequate technical guidance and drying facilities, it is difficult to expect products to meet the SNI threshold.

The second parameter, CAW, is used to assess the level of physical cleanliness—namely, how much of the weight fraction of dried seaweed is truly free from inorganic contaminants such as sand and coral debris or other organic contaminants in the form of different seaweed species. SNI 2690 : 2015 requires a minimum CAW value of 50% for a product to be considered suitable. However, the test results showed an average of only 46.8%, indicating that the dirt fraction in the sample was still high. Low CAW has implications not only for decreasing visual quality and economic value, but can also block the hydrocolloid extraction process due to the presence of insoluble foreign particles.

The low CAW value, similar to the finding of excess water content, again reveals the problem upstream: the lack of integration of sorting, washing, and drying procedures according to quality guidelines.Farmers often dry seaweed on sandy soil with inadequate substrate, thus increasing the chance of recontamination. Lack of training on "*best handling practices*" post-harvest and lack of access to communal-scale drying infrastructure widen the quality gap. Interventions in the form of intensive extension programs, provision of tiered drying racks, and implementation of quality inspections at collection points will greatly help increase CAW while reducing water

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content, so that Indonesian dried seaweed products can compete in the global market by fully meeting the SNI 2690:2015 standard.

3.3 Physical Contamination

Impurities are defined as all unwanted materials—including plastic fragments, shells, coral debris, sand, and even other seaweed species—included in the product. The standard distinguishes between two important categories. Coarse impurities adhere to the outer surface of the thallus and are relatively easy to remove manually through sorting. In contrast, total impurities include all impurities, including dissolved salts and microscopic particles embedded in the inner tissues of the seaweed, and require more intensive handling [12]. Understanding this distinction is crucial because control strategies are not the same. Visual sorting is effective for coarse impurities, while reducing total impurities requires repeated washing and controlled drying.

Table 4. Impurity Parameters of Dried Seaweed (*Kappaphycus alvarezii*)

Dried seaweed (*Kappaphycus alvarezii)*	Foreign matter level (%) (A)	Sand level (%) (B)	Salt level (%) (C)	Coarse Impurities (%)	Total Impurities (%) (A+B+C)
I	0.16	1.07	71.08	7.08	72.31
II	0.33	0.73	76.01	8.88	77.07
III	0.17	0.76	75.72	5.20	76.65
Average	**0.22**	**0,85**	**74.27**	**7.05**	**75.34**

SNI 2690:2015 standardizes that the maximum coarse impurities content is 3%. While for total impurities, SNI has not yet set a detailed standard threshold for salt, sand, or total foreign matter content in dried seaweed. However, the principle of food quality is clear: the fewer non-seaweed contaminants, the higher the quality, economic value, and safety of the product. In other words, purity is the main indicator appreciated by the seaweed processing industry.

The analysis results in Table 7 show an average of 7.05% coarse impurities, far exceeding the maximum limit of 3% standardized by SNI 2690:2015. This discrepancy indicates weak post-harvest practices in the field. Direct drying on tarpaulins on the ground, brief washing, and minimal visual inspection cause sand, coral debris, and other types of seaweed to remain carried to the final stage [16].

To improve the situation, comprehensive interventions are needed. Technical training for farmers on repeated wet-dry sorting, use of raised drying racks or nets, and washing using pressurized fresh water are effective initial steps. On the downstream side, strengthening the quality system based on *Good Aquaculture Practices* (GAP) and random inspections at collection points will force the supply chain to prioritize cleanliness upstream. Implementing simple technologies—such as ergonomic sorting tables and clean air blowers—can significantly reduce coarse impurities, in the end the 3% standard becomes easily achievable.

4 Conclusion and Recommendations

4.1 Conclusions

1. Dried seaweed *Kappaphycus alvarezii* from Pasi Kolaga district achieved an appearance score of 8 and a texture score of 7.5—both within the SNI 2690:2015 requirement range of at least 7: appearance (slightly less clean, color less bright, specific species), texture (unevenly dry, tough, not easily broken)
2. Chemical parameters have not met SNI. The average water content of 35.5% exceeds the limit of 30%, Clean Anhydrous Weet (CAW) 46.8%, below the minimum requirement of 50%. This indicates that the product is not pure enough for high-quality processing industry.
3. The impurity levels have not met the SNI standard. The average coarse impurities reached 7.05%, more than double the maximum threshold of 3% according to SNI 2690:2015. Total impurities (75.34%)

4.2 Recommendations

1. Post-harvest improvement at the farmer level. Layered sorting (wet and dry) to separate sand, coral, and other species before drying. Lifting drying on clean racks/nets with tarpaulin bases that are regularly cleaned to reduce sand contamination. Re-washing with pressurized fresh water before final drying to reduce dissolved salts.
2. Optimizing drying with a layer thickness of <5 cm, turning the material periodically. Applying closed storage in sacks or warehouses to prevent moisture reabsorption.

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