Physical and chemical water...

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Physical and chemical water condition in and around the area of seaweed “Lahe” (Caulerpa Sp.) growth

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Abstract. Lahe (local name of Sangihe) is the type of seaweed Caulerpa Sp, can be classified as green seaweed. Lahe grows naturally in the coastal waters of Batunderang Island and other areas in Sangihe Regency. Until about 40years ago, lahe was consumed by the Sangihe community. Formerly lahe was traded in several traditional markets. At present, the community only knows lahe through the Sangihe culinary exhibition. Our team conducts research on the potential and optimization of lahe as a functional food ingredient and medicine. The initial stage of the study was to measure, analyze and evaluate the physical and the chemical condition of the waters where lahe grows in the waters of the village of Batunderang. This article describes the physical and chemical condition of water. Analysis of physical and chemical condition of water can explain the ecological conditions that guarantee the growth of lahe, and its relation to productivity. The results of the analysis of physical and chemical conditions can also be used as references for ecological monitoring and lahe cultivation. Measurements are made in five positions that are determined based on ecological conditions variation. At each position, measurements were taken on four depth variations: 15 cm, 50 cm, 100 cm, and 200 cm below the surface. Measurements are carried out on the full moon, where the tide fluctuation is maximum. From the measurement data, we describe daily changes of: direction and velocity of currents, temperature of sea water and the temperature of air above the sea surface

1. Introduction

Seaweed is a coastal water commodity whose the usefulness has been widely developed. Seaweed grows in the tidal area. Seaweed grows (sticks) to solid substrates such as rocks, dead corals, or tree trunks [1,2]. Seaweed is distinguished as Chlorophyceae (green algae or green seaweed), Phaeophyceae (brown algae or brown seaweed) and Rhodophyceae (red algae or red seaweed) [1]. The type of seaweed studied here is grape seaweed (Caulerpa Sp.). This type of seaweed is included in the classification of Chlorophyceae or green algae . According to de Oliveiraet et al.[3], the percentage of the presence of green seaweed is only about 13%. The isolation of bioactive metabolites from green seaweed is kahalide F, which is currently being studied for cancer treatment. According to McClintock & Baker in de Oliveira et al.[3], the most representative substance of green seaweed (Phylum Chlorophyta) is an isoprenoid derivative, acetogenins, amino acid derivatives, carbohydrates and shikimate derivatives

Seaweed is used as a functional food because it is rich in certain fats, minerals and vitamins, Seaweed contains bioactive ingredients such as polysaccharides, proteins, and polyphenols. The potential for seaweed utilization in the medical field is to cure cancer [4], to overcome oxidative stress and inflammation, allergies [5], diabetes [6], platelets [7], obesity [8], lipidemia [9] and hypertension [10]. Kahalide F, which is isolated from green seaweed by the Spanish biopharmaceutical company, can be

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produced as an antitumor drink (entering the Phase II clinical trial). The research also found that green seaweed can suppress cancer cell growth by lysosomal induction and cell membrane permiabilization [11]. The results of research by Fini et al.[12], prove that raw seaweed foods have a stronger effect on cancer cell death than ingredients that have been made into compounds. Another use of seaweed extract is the bioplastic material. Polysaccharides produced from seaweed extract are environmentally friendly bioplastics that can have high prices[1].

Physical and chemical factors are interactive with the physiology of seaweed. Light and nutrient interactions determine the carbon ratio that affects the growth of seaweed [13]. Turbidity of water affects the penetration of light and subsequently affects photosynthesis and seaweed growth [14,3]. The density of seaweed "canopy" affects the temperature of the water and the intensity of light penetrates below the surface, thus affecting photosynthesis and cellular metabolism below the surface [15]. Solid seaweed can affect the speed of inflow by up to 25%. The interactive effect between the physiological conditions of seaweed and the physics and chemistry of water causes the conditions in the seaweed area to differ significantly from the surrounding area [15]. The interaction of physical conditions and chemistry with seaweed physiology is important information for seaweed cultivation [16].

This article describes the physical and chemical conditions of water at the location of lahe growth. Physical variables measured and analyzed include: air temperature and humidity, air-water thermal interactions on the water surface, water temperature and current velocity. Seawater chemical variables studied include: salinity, pH and dissolved oxygen (DO), Survey was carried out for one day with a two-hour measurement interval. The results of the study describe the ecological conditions, physiology of lahe, and the physical and chemical conditions of sea water where lahe thrives naturally. The type of seaweed studied is grape seaweed (Caulerpa Sp.) - Figure-1) which is in the local language Sangihe called as Lahe. The physiological conditions of the lahe studied were the length of the lahe chain, the size of the meristem and the diameter of the stem (thallus). The chemical composition of lahe studied was: water content, protein content, fat content, carbohydrate, crude fiber and ash. The results of the analysis describe daily changes in physical variables for lahe growth naturally in the coastal waters of Lapango District, Sangihe Regency.

2. Method

This research was conducted in coastal waters in front of Dolosang sub-village of Batunderang Village, Sangihe District. The stages of the research activities include: (1) identification of ecological features, the boundaries of lahe area and the growth conditions of lahe, (2) determination of measurement positions (based on ecological features and physiology of lahe), (3) variable measurements of water physics and chemistry and lahe samples. Based on the results of the identification of ecological features and growth, five physical and chemical variable measurement locations were determined. The measurement position is presented in the scheme (Figure-1). Positions 1, 2 and 3 are perpendicular to the coastline, while positions 4, 2 and 5 are parallel to the coastline. Positions 4 and 5 are the border of the lahe growth area. Position-1 is located around the mangrove roots, while position 3 is located on the inside of the coral reef. The research location is fully covered by coral reefs that stretch between two headlands. Tidal inlet and outlet of sea water are through positions 4 and 5.

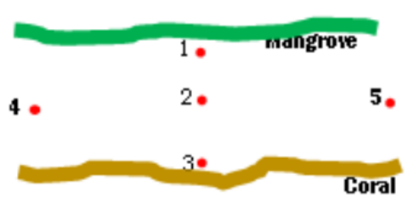

Figure-1. Measurement position

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3. Research Result

3.1. Description of weather, ecological, and physiological conditions
Survey activities and identification of measurement positions were carried out on July 26, 2018. Measuring the physical and chemical variables of water and sampling were carried out on July 27-29, 2018. Five days before measurement and at the time of measurement, it didn't rain. Measurements are carried out during the full moon where tidal fluctuations are highest. The research location in Peraoiran Panati Dolosang, shows the ecosystem of lahe growth from the front of the mangrove forest, sea grass to the inside of the coral reef. At this location there is no river flow. Fresh water that enters the growth area of lahe is only in the form of fresh water seepage through small rock slits and sand. The research location in the Dolosang coast waters shows the lahe ecosystem starting from the front boundary of the mangrove forest, sea grass beds to the inside of the coral reef. At this location there is no river flow. Fresh water that enters the growth area of lahe is only in the form of fresh water seepage through small rock slits and sand. Based on the ecological conditions five measurement positions were determined (Figure-2). The ecological and physiological data of are presented in Table-1

Table 1. Ecological and physiological condition of natural growth of lahe (C*aulerpa* Sp.)

Position	Physiological condition according to position				Ecological condition accdording to pos.		
	chain length (cm)	thallus diameter (mm)	Meristem diameter (mm)	Density (av.) (gr/ml)	Maximum depth (m)	Max current velocity (m/sec)	Max water temperature (°C)
1	220	2.2 – 2.8	2.8 – 3.2	0.56	5.6	1.2	28.2
2	240	2.2 – 3.0	2.8 – 3.3	0.55	6.2	1.5	30.6
3	48	1.2 – 2.0	2.6 – 3.0	0.88	5.0	2.5	32.4
4	220	2.1 – 2.7	2.6 – 3.2	0.56	4.6	2.4	31.2
5	210	2.1 – 2.6	2.6 – 3.1	0.57	4.8	2.3	31.4

Note: maximum depth data is measured at highest position of sea surface.

Table-1 shows that the physiological data of lahe differed significantly between position-3 (inner border of coral reefs) with other positions. The length of the lahe chain that rests entirely on the reef is only 48 cm. In other positions where the base of the lahe is attached to coral or coral fragments and at the base of the field, the end of the chain is more than 2 meters long. The size of the thallus and meristem of lahe that sticks in the coral reef are smaller than the oyhrt position. The density of lahe that attached to coral reefs, is higher than the other positions. This is related to thallus and meristem which are more solid for lahe attached on the coral reefs, compared to the other position. The physiological differences between the positions indicate differences in ecological conditions (current velocity and water temperature) and other variables such as nutrition, pH, DO etc. This requires further research.

3.2. Description of chemical condition of water and lahe composition
Chemical condition of water and lahe, measured in location are include salinity, pH and dissolved oxygen. Data of chemical water condition of five measurement positions are presented in Table-2

Table 2. Chemical condition of water at the measurement position

Chemical variable	Quantity of chemical variable according to position				
	1	2	3	4	5
Salinity (ppt)	0.002	0,003	0.004	0.003	0.003
PH	8.20	8,17	8,12	8.18	8.18
Dissolved oxygen (ppm)	6,18	6,12	6.10	6.14	6.16

Table-2 shows that the chemical properties of seawater samples show the difference between position-3 and other positions. pH and DO water samples taken from position 3 are lower than other positions. Salinity of water samples taken from position 3 is higher than from other positions. This difference is relatively small. The difference of the water properties between these positions can be presumed to be related to ecological differences and physiological differences in the table presented in Table-1

Chemical composition of lahe samples taken from five positions are presented in Table-3. The data in Table-3 did not show a significant difference in the chemical composition of the lahe samples taken from five positions.

Table 3. Chemical composition of lahe

Chemical variable	Quantity of chemical component of lahe according to position				
	1	2	3	4	5
Water (%)	43,42	43,13	40,25	42,82	42,78
fat (%)	0,68	0,70	0,72	0,66	0,64
Protein (%)	6,16	6,20	6,42	6,00	6,08
Ash (%)	14,2	13,6	11,8	13,2	13,2
Carbohydrate	45,20	45,32	45,44	44,88	44,80

The chemical composition data of lahe samples from did not show significant differences between position

3.3 Temperature and humidity above sea surface

Air temperature and humidity are ecological factors that influence the life under the water surface. Thermal energy transfer between air and water determines the daily change of thermal energy below the water surface [17]. Microclimate variables are very sensitive to changes of ecosystems and environment, so that microclimate data is needed in monitoring and evaluating the condition of ecosystems and the environment [18]. Daily fluctuations of air temperature and humidity above sea surface are presented in Figure-2 and Figure-3 respectively.

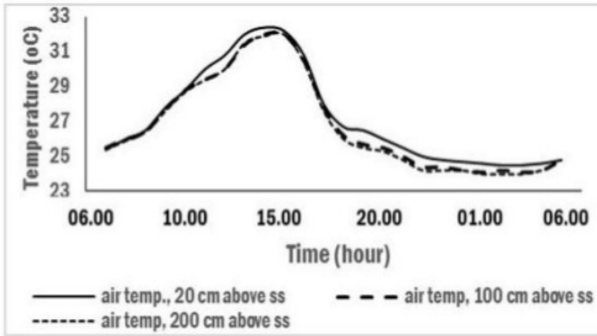

Figure-2. Air temperature at 30 cm, 100 cm and 200 cm above sea surface

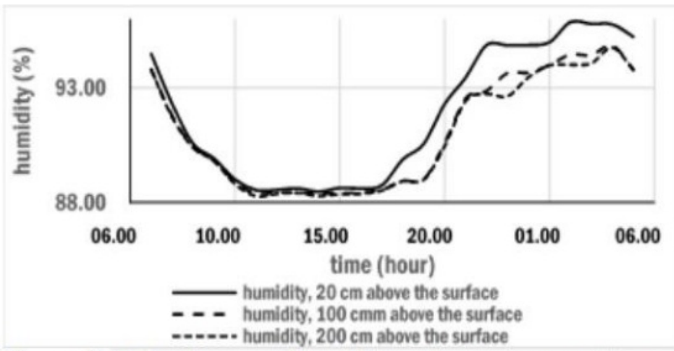

Figure-3. Daily changes of humidity at the various position above the sea surface

Figure-2 shows the daily changes of air temperature above the lahe growth area at three variations of height: 20 cm, 100 cm and 200 cm. Changes and quantities of air temperature at altitudes of 100 cm and 200 cm, are the same throughout the day. At night between the hours of 18.30 - 05.00, the air temperature at an altitude of 20 cm is higher than the temperature at an altitude of 100 cm and 200 cm, This phenomenon is related to the release of energy from the mass of water into the air [19]. This phenomenon is also indicated by the changes of humidity that higher at night air for position near the water surface (Figure-3).

4. Discussion

Ecological features that is the presence of two headlands and coral reefs that protect the area of lahe growth, and the surface of the lower lahe area controls the magnitude and pattern of daily changes in physical and chemical variables. The presence of headlands and coral reefs reduces the influence of waves and currents so that the current velocity and wave energy in the area of lahe growth becomes low. The hogher seabed surface in inlet and outlet position compared to the area of lahe growth, causes a low current velocity and accumulated nutrients which ensures the growth of the lahe naturally. The supply of fresh water through gravel and sand cracks supplies fresh water and nutrients, so as to control the temperature and salinity that are ideal for lime growth.

5. Conclusion

Ecological features of the growth area of lahe control the magnitude and daily changes of physical and chemical variables that are ideal for lahe growth.

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