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Analysis of Seagrass Nutritional Content of *Enhalus acoroides* (L.F.) Royle at Jelok Kete Beach, Jerowaru District, East Lombok, Indonesia

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Abstract. Enhalus *acoroides* (L.F) Royle seagrass is one type of seagrass that has an important ecological role in maintaining the balance of coastal ecosystems. However, research on the nutritional content of seagrass is still very limited, especially in the East Lombok region. This study aims to analyze the nutritional content of *Enhalus acoroides* (L.F) Royle seagrass fruit growing on Jelok Kete Beach, Batu Nampar, Jerowaru District, East Lombok. This study uses a descriptive quantitative approach. The method used includes sampling seagrass fruits at the research site and analyzing the laboratory to determine the nutritional content such as ash content, water content, carbohydrates, proteins, fats, and vitamins. The results showed that the fruit of *Enhalus acoroides* (L.F) Royle has a nutritional content of 11% water content, 50% ash content, 7.87% protein, 10% fat, 21.2% carbohydrates, 7.74% vitamin c, and 2.67% chlorophyll-a levels.

Keywords: *Enhalus acoroides*, nutritional content, leaf, seagrass bed

INTRODUCTION

Seagrass plants are flowering marine plants (*angiosperm*) and includes monocot plants (*Monocot*) that have true roots, leaves, and fruits. It usually grows in sunny and nutrient-rich coastal areas because it gets its supply from land and sea (Kaya, 2017) Seagrass plants can grow in all coastal areas in Indonesia, including in the coastal area of Lombok, one of them. Seagrass plants are plants that have a vital role in the marine ecosystem, because seagrass functions as a primary producer and forms a habitat that supports life for surrounding organisms and seagrass can reduce the speed of currents. Seagrass is also a shelter and foraging for small invertebrates and fish. In addition to having an ecological role, seagrass also has a function as a source of food and traditional medicines that are suitable for consumption by the community because the seagrass contains nutrients such as carbohydrates, proteins, and fats, and can produce primary and secondary metabolites (Jalaludin et al., 2020). However, seagrass is not so popular and related information is not so popular and information related to the nutritional content of the fruit is not widely available.

Seagrass plants have about 50 species that grow in shallow ocean areas with muddy and sandy bottoms around the world, but in Indonesia there are only 13 types of seagrass plants that belong to 2 families, namely *Hydrocharitacea* and *Potamogetonaceae* of the 13 types of seagrass spread in Indonesia, one of them is the seagrass type *Enhalus acoroides* (L.F.) Royle which is often used by the community. This type of seagrass is able to survive and spread widely, especially on smooth and muddy surfaces. Seagrass *Enhalus acoroides* (L.F.) Royle It can be used as a source of food, especially the fruit, but its management has not been utilized optimally (Awang et al., 2018).

Jelok Kete Beach is located in Batu Nampar Village, Jerowaru District, East Lombok, providing the local community with good fishing opportunities and is a sizable fishing spot. This is mainly due to the presence of seagrass *Enhalus acoroides* (L.F.) Royle on the beach. This type of seagrass is very important as a food source for fish and contributes to the richness of marine ecosystems. Coastal communities often use various parts of *Enhalus acoroides* (L.F.) seagrass Royle, especially its fruits and seeds, as a food source.

Nutrient content in seagrass of *Enhalus acoroides* (L.F.) Royle is important to know because it can provide valuable information about the nutritional value contained in it and help in formulating a balanced diet that is beneficial to health. In addition, information related to the nutritional content of seagrass fruit can support efforts to develop seagrass fruit-based food products or supplements. This study aims to analyze the nutritional content of *Enhalus acoroides* (L.F) Royle seagrass fruit growing on Jelok Kete Beach, Batu Nampar, Jerowaru District, East Lombok.

RESEARCH METHODS

Time and Location Research

Seagrass fruit sample *Enhalus acoroides* (L.F.) Royle was taken in the waters of Jelok Kete beach, Batu Nampar Village, Jerowaru District, East Lombok on April 4, 2024. The samples that have been collected are then cleaned from sand or mud attached to the fruit, and put in clean plastic to be stored in a cooler before being analyzed in the Integrated Laboratory of Universitas Islam Negeri Mataram.

Tools and Materials

The tools used are oven, erlenmeyer 125 mL, analytical scale, erlenmeyer 250 mL, porcelain cup, fat flask, detergent, filter paper, kiln, fat-free cotton, soxhlet flask, Bunsen, lash kjeldahl, distillation device, oven, erlenmeyer 125 mL, analytical scale, and erlenmeyer 250 mL. The materials used are HgO 40 mg, K_2SO_4 1.9 mg, H_2SO_4 2 mL, Aquades, HBO_3 solution (boric acid) 5 mL, indicator (methyl red – methylene blue), pp indicator, HCl solution 0.02 N 25 mL, and NaOH solution andhexane soluble.

Research Methods

The approach used in this study is quantitative. A quantitative approach is research that is based on specific numerical data that is analyzed using statistics to answer problems. This type of research is descriptive research. Descriptive research is a method to study an existing object without providing any treatment.

Working Procedure

Moisture Content Analysis

Seagrass water content *Enhalus acoroides* (L.F.) Royle was analyzed in an oven using the gravimetry method by drying the sample first at 110 °C for 5 hours. Then, weigh 5 grams of dry samples and place them in a porcelain cup that has a stable weight. Heat a porcelain cup containing the sample in the oven at 100-105 °C for 6 hours. After heating, the sample is cooled in a desiccant and reweighed (Warsidah et al., 2023).

$$\text{Kadar Air (\%)} = \frac{(B\text{-}A)\text{-}(C\text{-}A)}{D} \times 100\%$$

Where:
A : cup weight (g)
B : cup weight + sample (before in oven) (g)
C : cup weight + sample (once in the oven) (g)
D: sample weight (g)

Ash Content Analysis

Analysis of ash content in seagrass fruit samples *Enhalus acoroides* (L.F.) Royle uses the gravimetry method with a kiln tool starting with the preparation of the ashing dish. First, the ashing cup is dried in the oven at 105°C for one hour, then cooled in a desiccator for 15 minutes, and weighed until it reaches a stable weight. Next, a sample of 5 grams is put into an ashing cup and heated over a bunsen flame until it does not produce smoke. After that, the sample is fed into the frying kiln at 600°C for one hour, followed by weighing until it reaches a constant weight (Warsidah et al., 2023).

$$\text{Kadar Abu } (\%) = \frac{(B\text{-}A)\text{-}(C\text{-}A)}{D} \times 100\%$$

Where:
A : cup weight (g)
B : cup weight + sample (before in oven) (g)
C : cup weight + sample (once in the oven) (g)
D: sample weight (g)

Protein Content Analysis
Destruction Stage

In the destruction stage, the sample is weighed 1 g and placed in a 100 mL Kjedhal flask. Then 2 g of selenium mixture and 25 mL of concentrated H_2SO_4 are added. Heat over an electric heater or burner flame until boiling and the solution turns greenish (for 2 hours).

Distillation Stage

The results of the destruction obtained are then cooled, then diluted and put into a 100 ml measuring flask and adjusted to the line mark. Then pipette 5 mL of the solution and put it into the distiller. After that, 5 ml of 40% NaOH is added along with a few drops of PP indicator. Next, it is distilled for approximately 10 minutes, as a container used 10 mL of 2% boric acid solution that has been mixed with the PP indicator. Then rinse the coolant end with distilled water. The last stage is to add 10 drops of methylred indicator.

Titration stage

Titration with HCl 0.01 N solution, then the blank is determined. Determination of blanks. The determination of blanks has the same procedure as sample titration, but the analysis is carried out without samples.

$$\text{Protein Level } (\%) = \frac{(A\text{-}B) \times N\ HCl \times 14}{\text{mg of sampel}} \times 100\%$$

Where:

A	: Sample Titration (ML)
B	: Empty titration (ML)
Conversion Factors	: 6.25

Fat Content Analysis

Fat content was analyzed using the Soxhlet extraction method. Starting with the fat pumpkin which will be used in the oven for 15 minutes at a temperature of 100-105 ºC. Next, the fat pumpkin is cooled in a desiccant to remove moisture and weighed. The sample was weighed as much as 2 g. Then it is wrapped in filter paper, covered with fat-free cotton and put into a soxhlet that has been connected with a fat gourd. The sample has previously been ovened and the weight is known. The hexane solvent is poured until the sample is submerged and reflux or extraction is carried out for 5-6 hours or until the fat solvent that descends on the sample is clear in color. Fat solvents that have been used, distilled, and stored. The fat extract present in the fat pumpkin is dried in an oven at 100-105 ºC for 1 hour. The fat pumpkin is cooled in a desiccant and weighed. The stage of drying the fat pumpkin is repeated until a constant weight is obtained (Pargiyanti, 2019).

$$\text{Fat} = (\%) = \frac{(C\text{-}A)}{B} \times 100\%$$

Where:
A = Weight of empty pumpkin (grams)
B = sample weight (grams)
C = weight of the spherical base flask and extracted fat (grams)

Carbohydrate Rate

The carbohydrate content is determined by the separation method, which is calculated by adding the measured moisture content, protein content, fat content and ash content. Carbohydrate content is analyzed based on the results of water, protein, fat and ash using the following formula (Warsidah et al., 2023):

$$\text{Carbohydrates} = 100\% - (\%\text{water} + \%\text{protein} + \%\text{fat} + \%\text{ash})$$

Vitamin C Level Analysis

Raw Solution Manufacturing

Vitamin C 100 ppm Ascorbic acid is weighed as much as 5mg then put into a 50mL measuring flask and dissolved with aquadest to the limit mark.

Calibration Curve Creation

A 100 ppm C solution was pipetted into test tubes of 3 mL, 5 mL, 7 mL, 9 mL, and 11 mL, respectively, 25 mL of aquadest was added to the limit mark and homogenized, so that concentrations of 3 ppm, 5 ppm, 7 ppm, 9 ppm, and 11 ppm were obtained.

Determination of Maximum Wavelength of Vitamin C Solution

Concentration solution was taken from the calibration curve solution and then put into the curvette, then measured at a wavelength of 200-400nm using an aquadest blank.

Solution Measurement Calibration Curve

The absorbance of each solution was measured with a calibration curve of 3 ppm, 5 ppm, 7 ppm, 9 ppm, and 11 ppm and then put into the cuvette, then the absorbance was measured at the maximum wavelength obtained. After that, a calibration curve is made and a linear regression equation is calculated from the data obtained.

Determination of Vitamin C Levels of Seagrass *Enhalus Acoroides*

Weighing samples 1, 2 and 3 each as much as 5 grams of sample filters, after which the filtrate is inserted into a 100ml measuring flask, Aquadest is added until the limit mark, then homogenized. The determination of vitamin C levels in samples is carried out by inserting the sample solution into a curvette and measuring Next, absorbance is measured at the maximum wavelength obtained and then the vitamin C level is calculated by incorporating the absorbance value into the linear regression equation.

Data analysis was carried out by absorbance of the sample to the calibration curve using the liner regression equation This equation was used to calculate the vitamin C level in the sample.

$$Y=aX+b$$

Where:
a = Regression settings
Y = Sample Absobantion
X = Sample concentration
b = Coefficient of regression

Chlorophyll-a Level Analysis

The seagrass samples obtained were weighed using a digital scale of 3 grams of seagrass fruits. Then the seagrass leaves are crushed using mortar and then put into a test tube. After inserting, an Acetone solution of 10-15 ml per sample bottle is added, then the sample is put into the refrigerator for 24 hours. Measurements are made with a spectrophotometer by entering the wavelength (absorbance value) on a spectrophotometer with wavelengths of 664, 647, 630 nm (Rosang & Wagey, 2016). Chlorophyll-a data analysis uses the following formula:

$$\text{Chlorophyll-a} = 11.85.\ E664 - 1.54.\ E647 - 0.08.\ E630$$

Where:
E664 = Absorbance value at wavelength 664 nm
E647 = Absorbance value at wavelength 647 nm
E630 = Absorbance value at wavelength 630 nm

RESULTS AND DISCUSSION

Overview of the Research Location

Jelok Kete Beach is a beach located in the south of Lombok Island, precisely in Tembere Hamlet, Batu Nampar Village, Jerowaru District, East Lombok which is located at the coordinate point -8.827708,116.421710. This beach has a beautiful view so the local village government has made it a tourist attraction. Jelok Kete Beach is also a place where seagrass lives *Enhalus acoroides* (L.F.) Royle which is usually used by the surrounding community as a source of food so that with the existence of Seagrass *Enhalus acoroides* (L.F.) Royle makes this beach has great fisheries potential, therefore many surrounding communities take advantage of this potential as their livelihood.

Environmental parameters

The results of measuring environmental parameters at Jelok Kete Beach are as follows in Table 1.

Table 1. Environmental Parameter Measurement Results

No.	Day	Environmental Parameters			
		Salinity	Ph	Temperature	TDS
1.	Day 1	40 ppm	8.11	31.5 °C	6.460 ppm
2.	Day 2	40 ppm	8.08	31.2 °C	6.500 ppm
3.	Day 3	40 ppm	8.12	32.2 °C	6.510 ppm
Average		40 ppm	8.10	31.6 °C	6.490 ppm

Based on Table 1, the environmental parameter values during sampling were stable because there were no significant changes, with an average salinity value of 40 ppm, an average pH value of 8.10, and an average temperature value of 31.6 °C and the average TDS value of 6,490 ppm.

The environmental parameters measured in this study are used as supporting parameters for the productivity of seagrass fruit nutritional content. The supporting parameters measured consist of salinity, pH, temperature and average TDS value. The salinity of seawater when sampling has an average value of 40 ppm and meets the seawater salinity standard, which is > 33 ppm so that with this salinity level seagrass *Enhalus acoroides* (L.F.) Royle can grow well and productivity is also good so that the fruit produced is good and the nutritional content produced is also optimal for human consumption (Arief, 2019).

The pH of seawater in this study has an average value of 8.10, meeting the seawater pH standard, which is > 8.1. pH affects the nutritional content of seagrass fruit *Enhalus acoroides* (L.F.) Royle is the protein level because pH affects the ionization state of amino acid residues that make up proteins, so if the pH is high, the protein content is also high because the protein content cannot dissolve in a high pH (Gupita & Rahayuni, 2012).

The temperature in this study has an average value of 31.6 °C and meets the standard seawater temperature > 30 °C. The average temperature is optimal for the growth of *Enhalus seagrass* (L.F.) Royle. In addition, temperature also greatly affects the nutritional content of the fruit of *Enhalus acoroides* (L.F.) seagrass Royle is like vitamin levels because with the optimum temperature fertilization will also be optimal.

TDS (*Total Dissolved Solid*) is a the amount of dissolved solids in the form of organic ions, compounds, and colloids in water. The seawater TDS in this study has an average value of 6,490 categorized as seawater is still good because the average range of seawater TDS in Indonesia is 12,000-36,000. with the average TDS if *Enhalus acoroides* (L.F.) Royle can grow well because it has not been indicated to be polluted so that the productivity of the plant is also good (Khairunnas & Gusman, 2018).

Nutritional Content

Results of analysis of the nutritional content of seagrass fruit *Enhalus acoroides* at Jelok Kete Beach are as follows in Table 2.

Table 2. Results of Analysis of Nutritional Content of Seagrass *Enhalus acoroides*

No.	Nutritional Content	Value
1	Moisture content	11%
2	Ash content	50%
3	Fat content	10%
4	Protein Content	7,87%
5	Carbohydrate Rate	21,2%
6	Vitamin C Levels	7,74%
7	Chlorophyll a Levels	2,67%

Based on Table 2, the highest value of the nutritional content of seagrass fruit was ash content with a value of 50%, while the lowest value was vitamin c with a value of 7.74%.

Moisture Content

Moisture content is the amount of water contained in a food product or food ingredient. Determination of moisture content serves to determine the quality of a foodstuff, in this case seagrass *Enhalus acoroides* (L.F.) Royle Based on the results of research that has been carried out, the water content value of seagrass fruit *Enhalusacoroides* (L.F.) Royle, which is 11%, is categorized as low when compared to the Warsidah (2017) research which results in the water content value of seagrass *Enhalus acoroides* (L.F.) Royle 87% (Warsidah et al., 2023). The low moisture content in seagrass fruits is influenced by a long drying process because the longer the drying process, the less moisture content there is. Ordinary water content is associated with the stability index, especially during food storage, so that seagrass *Enhalus acoroides* (L.F.) Royle with this moisture content value can last for a long time if stored for a long time, besides that the moisture content value can inhibit the growth of bacteria, mold, and yeast because it is not moist (Kaya, 2017).

In addition, moisture content has a strong relationship with water activity in foodstuffs, which has an impact on shelf life. The high or low water activity will affect the storage duration and quality of foodstuffs. The lower the water activity, the longer the food can survive (Leviana & Paramita, 2017).

Ash content

Ash content is a mixture of inorganic components or minerals found in a food. Based on the results of the research that has been carried out, the value of seagrass ash content *Enhalus acoroides* (L.F.) Royle, which is 50%, is categorized as very high compared to the research research Kaya (2017) which showed the results of tilia with seagrass ash content of 0.51% and

Warsidah (2024) which showed that the value of seagrass ash content was 0.76%, but when compared to the research Setyawati et al., (2007), showed that the value of seagrass ash was 68.14%, the value of the research results was categorized as moderate. Differences in proximate values in seagrass (such as water, protein, fat, ash, and carbohydrates) can be caused by several factors, including the aquatic environment in which the seagrass grows, the availability of nutrients, the part of the seagrass analyzed, and the season. Season plays an important role because in winter, seagrass proximate values tend to be lower compared to spring and summer. These factors affect the nutrient content and chemical composition of seagrass, which can then vary depending on environmental conditions and time of year (Coria-Monter & Durán-Campos, 2015).

The longer the drying process lasts, the higher the ash content in the material will increase. This happens because more water content is evaporated during drying, so the minerals remaining in the material become more concentrated, and the ash content which is a representation of the amount of these minerals will be higher (Patin et al., 2018)

Fat Content

Fat is a parameter that is often measured when analyzing nutrient content. Based on the results of the research on the value of fat content contained in seagrass *Enhalus acoroides* (L.F.) Royle, which is 10% categorized as high compared to fruit *Enhalus* acoroides from the waters of Samboang Beach obtained a fat content of 0.66% reported by Warsidah (2023). The difference in fat content is influenced by geographical conditions affecting the parameters of the aquatic environment and the nutrient content of a marine biota. The value of fat content from seagrass positively corresponds to the season, namely summer, the value of fat content is greater compared to the transition season (Pradheeba et al., 2011).

Fats have the potential to suffer damage due to chemical processes, one of which is autooxidation. Autooxidation occurs when oxygen in the air or in waters reacts with unsaturated fatty acids which are the building blocks of fats. This process is greatly affected by the high temperature and intensity of sunlight, which can lead to the burning of the thallus (the body part of the plant such as seagrass) and interfere with its health. In other words, extreme environmental conditions such as intense heat and sunlight can accelerate the breakdown of fats in seagrass, which in turn can negatively impact the health and ecological function of those seagrasses (Arfah & Patty, 2016).

High levels of seagrass fat *Enhalus acoroides* (L.F.) Royle It is not harmful to health because it is in seagrass *Enhalus acoroides* (L.F.) Royle has a greater content of unsaturated fatty acids compared to saturated fatty acids. This higher content of unsaturated fatty acids makes seagrass healthier and more beneficial if consumed. Unsaturated fatty acids are better for health than saturated fatty acids, as they can help lower the risk of heart disease and maintain cholesterol balance in the body (Tahril et al., 2009).

Protein Content

Protein is an important food substance for the body because in addition to functioning as fuel in the body, it also functions as a building and regulating substance. Based on the results of seagrass fruit research *Enhalus acoroides* (L.F.) Royle's protein content value of 7.78% is categorized as low when compared to the results of the study Coria-Monter and Durán-Campos (2015) crude protein value of seagrass *Enhalus acoroides* by 13.8% (Coria-Monter & Durán-Campos, 2015). The high and low protein contained in seagrass fruit is related to the content of the biaoactive components contained by the seagrass. In addition, the protein content is also related to the water content of a food, when the water content is smaller or reduced, the protein value will increase and vice versa (Yolanda et al., 2023).

Protein levels in marine biota ecosystems, such as seagrass, are influenced by the movement of currents and the intensity of sunlight that can penetrate into the ecosystem. Ocean currents play a role in delivering nutrients needed for the photosynthesis process. In the presence of sufficient exposure to sunlight, photosynthesis can proceed well, producing carbohydrates and precursor compounds necessary for protein formation. Thus, the interaction between ocean currents and sunlight is crucial in determining protein levels in the ecosystem (Chrismadha et al., 2006).

Carbohydrate Rate

Carbohydrates are food components that act as the main source of energy in the human body, carbohydrates also have an important role in determining the characteristics of food ingredients, such as taste, color, texture and others. Based on the results of the research on the value of carbohydrate levels in seagrass *Enhalus acoroides* (L.F.) Royle is as big as 21.2% is categorized as high when compared to the results of Warsidah (2017) research of 10.38%. The high level of carbohydrates is influenced by the calculation of *by difference* Influenced by the content of other nutrients, the lower the other nutrients, the higher the carbohydrate content will also be, on the contrary, the higher the other nutrient components, the lower the carbohydrate content. The nutritional components that affect the amount of carbohydrate content are the content of protein, fat, water, and ash (Ferdinand, 2014). In addition, the high and low carbohydrate levels are influenced by the carbohydrate content in food is highly dependent on the level of brightness or intensity of the sun to optimize the occurrence of photosynthesis that produces carbohydrates (Warsidah et al., 2023). Based on the carbohydrate value of seagrass fruit *Enhalus acoroides* (L.F.) Royle can be consumed as a substitute for rice because the difference in carbohydrate values contained in rice is not much different.

Vitamin C Levels

Vitamin C (arboric acid) is a vitamin that is water-soluble, acidic and odorless. Vitamin C plays a role in healing wounds, teeth, capillary membranes, canker sores and maintaining healthy teeth and gums. Vitamin C is found naturally in a variety of vegetables, fruits and plants (Bougatef et al., 2010). Based on the results of research on vitamin C levels in seagrass *Enhalus acoroides* (L.F.) Royle 7.74% or 7.74mg/100g is categorized as low compared to tomatoes which have a vitamin C level of 21.29 mg/100g (Sari et al., 2021). The high and low levels of vitamin c are influenced by the type of fruit so that each type of fruit and each region has different levels of vitamin c. In addition, the difference in vitamin c levels is also influenced by internal and external factors.

Internal factors that affect the difference in vitamin c levels are genetic factors that are able to affect taste, smell, chemical composition, nutritional value and production ability. While external factors are environmental factors that include sunlight because sunlight affects a lot of the combination of nutrients in photosynthetic tissues so that plants that receive a lot of sunlight will have more vitamin c content and vice versa. Temperature can also affect vitamin c levels in plants because with the optimum temperature fertilization will also be optimal (Cresna et al., 2014). In addition, it also affects vitamin c levels because the lower the altitude of the place, the higher the intensity of sunlight and the higher the temperature of the sun, the more easily the vitamin c is oxidized so that if the altitude is low, the vitamin c level is also low (Fatchurrozak, 2013).

Chlorophyll-a Levels

Chlorophyll-a is the most abundant type of chlorophyll-a in plants that plays an important role in the photosynthesis process. Chlorophyll-A is generally found in plant leaves, but chlorophyll-A is also found in all parts of the plant such as in fruits (Nio Song & Banyo, 2011). Based on the results of the study, the level of chlorophyll-a in seagrass fruit of 2.67% is categorized as low when compared to kiwi fruit which has a chlorophyll-a level of 10.24 ppm (Inggrid & Santoso, 2014). The high or low level of chlorophyll-a in plants is the age of the plant, the level of other pigments that are more dominant in the fruit or the presence of adaptation factors in a plant. In addition, the content of chlorophyll-a levels is affected by sunlight because the more sunlight is captured, the more chlorophyll-a levels will also increase, and vice versa (Gupita & Rahayuni, 2012).

CONCLUSION

Based on the results and discussion, it was concluded that the seagrass fruit *Enhalus acoroides* (L.F.) Royle at Jelok Kete Beach, Batu Nampar, Jerowaru contains a moisture content of 11%, ash content of 50%, protein of 7.87%, fat of 10%, carbohydrates of 21.2% and vitamin c of 7.74% and chlorophyll-a content of 2.67%.

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