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Analysis Proximate of *Nerita costata* and *Nerita maxima* Collected from Hutumuri and Latuhalat Beaches in Ambon, Maluku, Indonesia

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ABSTRACT

Nerita sp. is a type of gastropod that is commonly consumed by the people of Ambon Island, especially in the villages of Hutumuri and Latuhalat, and has the potential to be an alternative food source. However, its nutritional content has not been studied in detail. This research aims to analyze the proximate content, including moisture, ash, protein, fat, carbohydrates, and fiber, in Nerita maxima and Nerita costata from both locations. The study used a descriptive approach with random sampling techniques from the waters of Hutumuri Beach and Latuhalat Beach. Proximate analysis was conducted in the laboratory using the standard AOAC (Association of Official Analytical Chemists) methods.The analysis results show that at Hutumuri Beach, Nerita costata has a moisture content of 79.24%, ash 1.18%, protein 12.80%, fat 1.79%, carbohydrates 2.16%, and fiber 0.18%. Meanwhile, Nerita maxima has a moisture content of 81.30%, ash 1.10%, protein 13.90%, fat 1.72%, carbohydrates 1.66%, and fiber 0.19%. At Latuhalat Beach, Nerita costata has a moisture content of 76.80%, ash 1.48%, protein 17.02%, fat 2.75%, carbohydrates 1.49%, and fiber 0.20%. Whereas, Nerita maxima has a moisture content of 78.31%, ash 1.44%, protein 15.47%, fat 2.90%, carbohydrates 1.51%, and fiber 0.23%This research shows that Nerita costata and Nerita maxima from the waters of Latuhalat have higher protein and fat content compared to those from Hutumuri. This indicates that the more fertile and rocky water environment of Latuhalat supports better nutritional value, making these two species potential alternative food sources for the community.

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INTRODUCTION

Nerita costata and *Nerita maxima* are gastropod species that exhibit relatively high morphological diversity. This diversity is closely related to their polymorphic nature, in which a single species can display a wide range of shell colors, shapes, and surface ornamentations (Lukan, 2024). Such variations make shell characteristics an important taxonomic feature for species identification and classification within the genus *Nerita*. Hardiyanti et al. (2011) stated that shell coloration and ornamentation patterns can be effectively used to distinguish groups of *Nerita* sp., thereby supporting ecological and systematic studies of this genus. Ecologically, *Nerita* sp. play a crucial role in coastal and mangrove ecosystems. They function as primary consumers that feed on algae and organic detritus, thereby contributing to nutrient cycling and energy flow within the food web (Sujatmiko et al., 2020). Their presence helps maintain the balance of microalgal populations on rocky and coral substrates, which in turn supports the stability of coastal ecosystems. As part of the benthic community, *Nerita* spp. also serve as prey for higher trophic level organisms, emphasizing their importance in sustaining marine biodiversity.

In addition to their ecological significance, *Nerita costata* and *Nerita maxima* possess considerable economic and socio-cultural value. Their shells are widely used as raw materials for handicrafts and decorative items, while their meat is consumed as a source of animal protein by coastal communities (Liline et al., 2020). In Ambon, these gastropods are locally known as *bia* and are commonly consumed as an alternative protein source in addition to fish. They are especially important during the wave season, when fishing activities are limited and fish availability decreases. The organisms are usually collected during low tide, a traditional activity known locally as *bameti* (Liline et al., 2020). The waters of Hutumuri Beach are characterized by substrates composed of coral, sandy coral, and rocky areas, which provide suitable habitats for various gastropod species. The local community of Hutumuri Village actively utilizes several types of gastropods as food resources (Mornaten & Kilay, 2022). Similarly, Latuhalat Beach is dominated by rocky coral substrates that support a rich diversity of marine organisms, including *Nerita costata* and *Nerita maxima* (Salmanu et al., 2021). These gastropods are abundantly found in the intertidal zone and are widely harvested by local residents for daily consumption, thereby contributing to household food security and the diversification of marine-based food resources (Supusepa, 2018).

Despite their frequent utilization as food, information regarding the nutritional value of *Nerita costata* and *Nerita maxima* remains limited, and most local communities are not yet fully aware of the nutritional benefits provided by these gastropods. Nutritional composition, particularly proximate composition, is a fundamental indicator of food quality, as it describes the levels of moisture, protein, fat, ash, and carbohydrates that determine the nutritional and energy value of food materials (Tuaputty et al., 2023). Proximate analysis is therefore essential to evaluate the potential of these gastropods as alternative protein sources for coastal communities. Furthermore, knowledge of the proximate composition of *Nerita costata* and *Nerita maxima* can serve as a scientific basis for promoting their sustainable utilization and conservation. By understanding their nutritional content, these species can be better integrated into local food security programs and small-scale fisheries development. This information may also support the development of value-added products derived from gastropods, thereby increasing their economic potential (Rumahlatu et al., 2017). Therefore, it is necessary to determine and compare the proximate composition of *Nerita costata* and *Nerita maxima* collected from the waters of Hutumuri Beach and Latuhalat Beach. The results of this study are expected to provide scientific data on their nutritional value, enhance public awareness of their benefits, and contribute to the sustainable management of coastal biological resources in Ambon, Maluku, Indonesia.

MATERIALS AND METHOD

The sampling process was carried out during low tide to facilitate the collection of *Nerita costata* and *Nerita maxima* from the intertidal zone. Specimens were manually collected from rocky and coral substrates using simple collection tools and placed in labeled containers according to species and sampling location. Each sample was washed with clean seawater to remove adhering debris, sand, and epiphytes. The collected samples were then transported to the laboratory under cooled conditions to maintain their freshness and prevent biochemical degradation prior to analysis. In the laboratory, the samples were identified morphologically based on shell characteristics, including shape, color, and ornamentation, to ensure accurate species determination. The edible portions were separated from the shells, washed with distilled water, and homogenized to obtain uniform sample material. Homogenization was necessary to ensure that the proximate analysis results accurately represented the

overall chemical composition of each species. The prepared samples were then stored at low temperature until further analysis was conducted.

Proximate analysis was performed following standard procedures established by the Association of Official Analytical Chemists (AOAC, 2005). Moisture content was determined by oven-drying the samples at a constant temperature until a stable weight was achieved. Ash content was measured by incinerating the samples in a muffle furnace to obtain the total mineral residue. Crude protein content was analyzed using the Kjeldahl method, which determines total nitrogen content and converts it to protein using an appropriate conversion factor. Crude fat content was determined using a Soxhlet extraction method with organic solvents, while crude fiber content was analyzed through acid and alkaline digestion. All analyses were conducted in triplicate to ensure accuracy and reliability of the data. The results were expressed as percentages based on wet weight or dry weight, depending on the analytical parameter. Replication was applied to minimize experimental errors and improve the validity of the findings. The mean values and standard deviations were calculated to describe the variation in proximate composition between species and sampling locations.

The data obtained from the proximate analysis were then analyzed descriptively and comparatively to identify differences in nutritional composition between *Nerita costata* and *Nerita maxima* as well as between samples collected from Hutumuri Beach and Latuhalat Beach. This comparative approach was important to evaluate the influence of habitat conditions on the chemical composition of the gastropods and to assess their potential as alternative food resources. Furthermore, the results of this study are expected to provide baseline data that can be used for further nutritional evaluation and development of marine-based food products. The proximate composition data may also serve as scientific support for promoting *Nerita* spp. as locally available and nutritionally valuable marine resources. In addition, these findings can contribute to sustainable coastal resource management by encouraging the utilization of underexploited marine organisms in a responsible and environmentally friendly manner.

RESULTS AND DISCUSSION

The coastal waters of Hutumuri and Latuhalat beaches are characterized by diverse substrates, including coral, sandy coral, and rocky substrates. The dominant substrate types in the research area are sandy coral and rocky coral. These substrate conditions create a suitable habitat for various marine organisms, particularly gastropods such as *Nerita costata* and *Nerita maxima*, which commonly attach themselves to coral surfaces and rocks, especially dead coral. The presence of sandy and rocky coral substrates plays an important role in supporting biodiversity in the intertidal zone (Purwasih, 2021). These substrates provide shelter, attachment surfaces, and feeding grounds for many benthic organisms. Gastropods from the genus *Nerita* are well adapted to such environments due to their strong muscular foot, which allows them to firmly adhere to hard substrates and resist wave action. This adaptation enables them to survive in dynamic coastal conditions with high water movement and exposure during low tide. *Nerita costata* and *Nerita maxima* are typically found in areas with good water circulation and moderate wave exposure, where algae grow abundantly on coral and rock surfaces. These algae serve as their primary food source. By grazing on algae, these gastropods contribute to maintaining ecological balance, preventing excessive algal growth that could otherwise inhibit coral recruitment and reduce habitat quality for other marine organisms (Lukas, 2024).

Furthermore, the distribution and abundance of *Nerita* species can be used as bioindicators of environmental conditions in coastal ecosystems. Their presence reflects the availability of suitable substrates and relatively stable environmental conditions (Mujiono, 2016). Changes in their population density may indicate disturbances such as pollution, coastal development, or habitat degradation. Therefore, the coastal ecosystems of Hutumuri and Latuhalat beaches, with their dominant sandy and rocky coral substrates, provide an ideal habitat for *Nerita costata* and *Nerita maxima* (Pratiwi, 2024). Studying these gastropods not only enhances our understanding of species–habitat relationships but also offers valuable insights into the ecological health and sustainability of the coastal environment. The results of the proximate analysis can be seen in table 1 below.

Table 1. Proximate Analysis Results for Nerita costata and Nerita maxima

Location	Type	Proximate Components					
		moisture content %	Ash content %	Protein %	Fat%	Carbohydrate %	Fiber %
Hutumuri Beach	1. *N. costata*	79,24	1,18	12,80	1,79	2,16	0,18
	2. *N. maxima*	81,30	1,10	13,90	1,72	1,66	0,19
Latuhalat Beach	1. *N. costata*	76,80	1,48	17,02	2,75	1,49	0,20
	2. *N. maxima*	78,31	1,44	15,47	2,90	1,51	0,23

1. Moisture content. Moisture content is one of the important parameters to determine the quality and shelf life of a food product. The results of this study show that the moisture content of Nerita costata and Nerita maxima is higher at Hutumuri Beach and Latuhalat Beach, with environmental factors such as high temperatures and salinity fluctuations affecting these results. According to SNI 01-2715-1996, the maximum moisture content for marine food products such as fish meal is 10%. The results of this study indicate that the moisture content of Nerita costata and Nerita maxima at both beaches exceeds that standard. This is consistent with the study by Pratiwi et al. (2024), which recorded low moisture content in Nerita sp. in the mangrove habitat of the Nibung River at 15.55% due to environmental moisture stability.

2. Ash content. Ash content serves as a parameter to indicate the presence of inorganic materials (minerals) in a given material or product. According to SNI 01-2715-1996, the maximum ash content for food products is 20%, and this study shows that the ash content of Nerita costata and Nerita maxima is still below that limit. Lukas et al. (2024) found low ash content (0.31%) in Nerita undulata on Lemukutan Island, indicating that drier coral-based environments tend to reduce mineral content. Consumption of Nerita costata and Nerita maxima can contribute to mineral needs. The ash content in Nerita costata and Nerita maxima is influenced by environmental conditions, particularly substrate and food availability. Stable and nutrient-rich environments such as Latuhalat Beach support high mineral content, while less stable environments like Hutumuri Beach yield lower ash content.

3. Protein. Protein is a very important nutrient for the body because besides having a function as fuel for the body, it also serves as a building and regulating substance (Purwasih & Faturohman, 2021). According to SNI 01-2715-1996, the minimum protein content for seafood is 65%. The results of this study show that the protein content of Nerita costata and Nerita maxima is still below that standard, but remains sufficiently high to be used as a source of protein. Pratiwi et al. (2024) reported a protein content of 6.6% in Nerita sp. found in the mangroves of the Nibung River, which is lower compared to this study, as the mangrove environment may provide a more limited nitrogen source. Salmanu et al. (2021) noted a very high protein content in Turbo chrysostomus at Latuhalat (58.38%), indicating that rocky substrates rich in algae greatly support protein synthesis. Likewise, Lukas et al. (2024) reported a high protein content (57.84%) in Nerita undulata from Lemukutan Island, this emphasizes that rocky habitats with abundant food availability increase the protein levels in Nerita costata and Nerita maxima.

4. Carbohydrate. Carbohydrates in food materials play an important role in determining the characteristics of food, including taste, color, texture, and others. Leasa (2022) states that the high or low levels of carbohydrates, by difference, are influenced by the high or low values of other nutritional compositions such as fat content, protein, water content, and ash content. The carbohydrate content in Nerita costata and Nerita maxima in this study is lower compared to the levels reported by Pratiwi et al. (2024) in mangrove habitats (59.1%), which are rich in organic detritus as an energy source. Salmanu et al. (2021) found low carbohydrate levels (2.99%) in Turbo chrysostomus in Latuhalat. The low carbohydrate levels in Latuhalat indicate that energy in rocky habitats is stored more as fat or protein than as carbohydrates.

5. Fat. Fat is one of the essential substances that the body needs and is a more effective source of energy for the body (Abdulah et al., 2017). According to SNI 01-2715-1996, the maximum fat content for food ingredients is

8%. The results of this study show that the fat content of Nerita costata and Nerita maxima is still well below this limit, making them low-fat food sources. Pratiwi et al., (2024) recorded very low fat content (0.64%) in Nerita sp. in mangroves, while Salmanu et al., (2021) recorded a fat content of 2.21% in Turbo chrysostomus in Latuhalat, and Lukas et al., (2024) noted a fat content of 1.44% in Nerita undulata from Lemukutan Island. These results indicate that the rocky habitat of Latuhalat, rich in food, supports higher fat accumulation compared to the drier mangrove or coral environments.

6. Fiber content. Crude fiber is a part of food that cannot be hydrolyzed by chemical substances, where the substances used to determine the crude fiber content are Sulfuric Acid (H2SO4) and Sodium Hydroxide (NaOH) (Hardiyanti & Nisah, 2019). According to SNI 01-2715-1996, the maximum fiber content for marine food is 3%. The results of this study indicate that the fiber content of Nerita sp is still within the limit of the SNI.

CONCLUSION

Based on the results and discussion of this research, it can be concluded that: In the waters of Hutumuri Beach, Nerita costata has a water content of 79.24%, ash content of 1.18%, protein of 12.80%, fat of 1.79%, carbohydrates of 2.16%, and fiber of 0.18%. Meanwhile, Nerita maxima in the same location contains a water content of 81.30%, ash content of 1.10%, protein of 13.90%, fat of 1.72%, carbohydrates of 1.66%, and fiber of 0.19%. In the waters of Latuhalat Beach, Nerita costata has a water content of 76.80%, ash content of 1.48%, protein of 17.02%, fat of 2.75%, carbohydrates of 1.49%, and fiber of 0.20%. Meanwhile, Nerita maxima at this location has a water content of 78.31%, ash content of 1.44%, protein of 15.47%, fat of 2.90%, carbohydrates of 1.51%, and fiber of 0.23%.

AUTHORS CONTRIBUTION

Rafdin, Liline, and Salmanu. designed and conducted the research, analysed and interpretation the data and wrote the draft of manuscript.

CONFLICT OF INTEREST

The authors declare no conflicts of interest and take full responsibility for the content of the article, including any implications of AI-generated art.

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