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MORPHOLOGICAL IDENTIFICATION OF SEA CUCUMBER AND PROXIMATE ANALYSIS OF THE HABITAT SUBSTRATE OF MUDY SEA CUCUMBER ON MOLOSING ISLAND AND BIAU BEACH BOLAANG MONGONDOW REGENCY

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Abstract

Sea Cucumbers belong to the phylum Echinodermata, class Holothuroidea. These creatures are commonly found in areas near coral reefs, sandy waters, seaweed, seagrass beds, and muddy sands. This research aims to identify the various species of Sea Cucumbers in the waters around Molosing Island and Biau Beach, Bolaang Mongondow Regency. Furthermore, the research seeks to determine the nutritional content of the muddy substrate where Sea Cucumbers reside. The study involves observing the form, colour, and patterns (morphology) of Sea Cucumbers and testing the nutritional content of their muddy habitat substrate using proximate analysis with the SNI by difference method. The identification results of the form, colour, and patterns of Sea Cucumbers at Molosing Island and Biau Beach, Bolaang Mongondow Regency, reveal three species of Sea Cucumbers from different genera: Holothuturia and Stichopus. One species on Molosing Island is *Holothuria leucospilota*, while two on Biau Beach are *Stichopus horrens* and *Stichopus vastus*. Proximate analysis of the muddy habitat substrate of Sea Cucumbers includes the following parameters: ash content, protein content, crude fiber content, and fat content.

Keywords: sea cucumbers, proximate analysis, substrate, Molosing Island, Biau Beach, morphology

INTRODUCTION

Indonesia is one of the world's largest archipelagic countries, encompassing 17,504 islands with a coastline stretching over 95,181 km, ranking as the second-longest coastline globally. The country's maritime area spans approximately 5.8 million km² (71% of Indonesia's total area) (Ministry of Marine Affairs and Fisheries, 2019), endowing it with a substantial and diverse array of biological resources in its marine and terrestrial realms. This wealth of biodiversity has led to Indonesia being recognized as a Mega Biodiversity nation. The oceanic potential, drawing the interest of foreign tourists due to its high economic value and rich nutritional content, includes marine organisms such as the sea cucumber, also known as "sea cucumber," "tea fish," and "sea ginseng". Sea cucumbers belong to the phylum Echinodermata, class

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
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Holothuroidea. These creatures are commonly found in areas near coral reefs, sandy waters, seaweed, seagrass beds, and muddy sands (Oktamalia *et al.,* 2016). Generally, sea cucumbers have elongated, cylindrical bodies resembling cucumbers of varying sizes. For instance, *Holothuria atra* can reach up to 60 cm long and weigh 2 kg (Sadili, 2015). They possess a mouth (anterior) surrounded by tentacles, while the opposite side features an anus (posterior). Sea cucumbers have soft bodies, and their skin can be smooth, warty, or spiky (Rukyah, 2006; Elfidasari *et al.,* 2012).

Sea cucumbers hold significant economic potential due to their diverse and beneficial nutritional content, which can serve as a source of animal protein, wound healing, and anti-inflammatory properties (Elfidasari *et al.,* 2012). As stated by Janakiram (2015), sea cucumber extracts contain bioactive compounds with antioxidant activity, such as triterpene glycosides, which can inhibit the formation of free radicals in the body, potentially preventing degenerative diseases like heart disease and cancer. Sea cucumbers are a high-value fishery commodity with solid potential for international markets. Indonesia is one of the world's largest exporters (Herliany *et al.,* 2016; Virgin, 2020). According to data from Brown *et al.* (2010), Indonesia holds the top position among 38 exporting countries, with a total percentage of 12%. Most processed sea cucumber products exported from Indonesia are dried and smoked sea cucumbers.

Substrate selection plays a crucial role in the proliferation of sea cucumbers, as they function ecologically as deposit and suspension feeders. Sea cucumbers process the substrate in their environment as a food source and provide sustenance for predatory marine organisms in their vicinity (Darsono, 2007). The substrate and water medium significantly influence the breeding and growth of sea cucumbers (Agusta *et al.,* 2012).

If managed and developed effectively, the diverse wealth of natural resources plays a pivotal role in environmental conservation and tourism advancement. Molosing Island and Biau Beach in Bolaang Mongondow Regency are regions with the potential to be developed as tourist destinations due to their abundant biological resources and easy accessibility. The natural resources found on Molosing Island and Biau Beach encompass coral reefs, mangroves, flora, and fauna, including sea cucumbers. These resources underline the potential for sustainable tourism and ecosystem preservation.

Proximate analysis is a chemical analysis method used to identify the nutritional content of feed or food material. The proximate analysis assesses several components: moisture content, organic matter (ash), protein, fat, and crude fiber (Samosir, 2010; Mikdarullah *et al.,* 2020).

RESEARCH METHODS

Research time and location

This research was conducted from March to May 2023. The research was carried out at Molosing Island and Biau Beach, Lolak District, Bolaang Mongondow Regency. Proximate analysis was performed at the Ministry of Research, Technology, and Higher Education, Universitas Brawijaya, Faculty of Animal Husbandry, and Nutritional and Animal Feed Science Department.

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

Figure 1. Sea Cucumber Collection Locations A. Molosing Island, B. Biau Beach

Research Methodology

Sea cucumber samples were collected using purposive sampling (sampling of what is found) on Molosing Island and Biau Beach, Bolaang Mongondow Regency. The sea cucumber samples were collected during both morning and evening hours when the tide was low. Sea cucumbers and their habitat substrates were collected and placed in labelled containers.

Research Procedure

Sea cucumber samples obtained from the waters around Molosing Island and Biau Beach, Bolaang Mongondow Regency, were thoroughly washed with water. Subsequently, they were identified by species using references such as Sadili's book from 2015 ("Pedoman Umum Identifikasi dan Monitoring Populasi Teripang") and the internet-based program "The Taxonomicon" for taxonomical identification. The identification process in this research was based on the body's shape, colour, and patterns. Furthermore, the sea cucumber habitat substrate samples were subjected to proximate analysis using the SNI 01-2891-1992 by difference method.

Data Analysis

Ash Content

$$\%\ Ash\ content = \frac{(W2 - Wo)}{(W1 - \mathrm{Wo})} x100\%$$

Descrition :
Wo = empty crucible mass
W1 = crucible mass + sample before drying (combustion)
W2 = crucible mass + sample after drying (combustion)
Fat Content

$$\%\ Fat\ content = \frac{W3 - W2}{W1} x\ 100\%$$

Description :
W1 = sample weight (g)
W2 = empty fat flask weight (g)

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

W3 = fat flask weight + extracted fat weight (g)

Protein Content

$$\%\ Protein\ content = \frac{(V_1 - V_2) \times N \times 14 \times fp \times 100\%}{W}$$

Description:
V1 = volume of HCl for sample titration
V2 = volume of HCl for blank titration
N = standard HCl normality
14 = atomic mass of nitrogen
Fp = conversion factor for general food protein: 6.25
W = sample weight

Crude Fiber Content

$$\%\ Crude\ fiber\ content = \frac{berat\ residu\ (garam)}{berat\ sampel\ (gram)} x100\%$$

RESULTS AND DISCUSSION

Morphological Identification

Three samples of sea cucumber species were discovered from the sampling conducted around the waters of Molosing Island and Biau Beach in Bolaang Mongondow Regency. One sea cucumber was found around Molosing Island, and two around Biau Beach. The results of morphological identification, which encompassed body shape, colour, and patterns of the sea cucumber species, yielded three distinct species from two different genera: Holothuria and Stichopus. The sea cucumber species in Molosing Island waters was identified as *Holothuria leucospilota*. In contrast, the two sea cucumber species found near Biau Beach were identified as *Stichopus horrens* and *Stichopus vatus*.

The first sea cucumber species found near Molosing Island is *Holothuria leucospilota*, commonly known as the black sea cucumber or black sap sea cucumber. Sihaloho's (2020) study mentioned that this sea cucumber is commercially referred to as the white threadfish. This species is easily recognizable and commonly found due to its habitat in seagrass beds and coral reefs. It has a reddish-black body colour adorned with small papillae or tubercles all over its body, although, at first glance, the overall colour appears black. This sea cucumber weighs 576 grams, measures 27 cm in length, and has a width of 8 cm (Figure 2).

Figure 2. *Holothuria leucospilota* in the waters of Molosing Island

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

The second species of sea cucumber found near Biau Beach is *Stichopus horrens*. This type of sea cucumber has a small body size with large, spine-like protrusions covering the entire upper surface of its body, while the lower part is flat. However, this sea cucumber has a fragile body texture that easily breaks when outside its habitat. Its body colour is dark green, sometimes appearing black, with reddish-orange papillae (spines) (Nurwidodo *et al*., 2018). The discovered sea cucumber weighs 97 grams, has a length of 17 cm, and a width of 6 cm (Figure 3).

Figure 3. *Stichopus horrens* in the Waters of Biau Beach

The third species of sea cucumber found around the waters of Molosing Island is *Stichopus vastus*, commonly known as the gamat sea cucumber. According to Sadili (2015), this type of sea cucumber has a shape resembling a square, a hard and rigid body texture, and a flat underside. The body wall of this sea cucumber easily disintegrates when outside of seawater. Its body colour is yellowish-green with black spots, and the underside is lighter. This sea cucumber weighs 880 grams, measures 27 cm in length, and has a width of 13 cm (Figure 4).

Figure 4. Stichopus vastus in the Waters of Biau Beach

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

Various species of sea cucumbers were found based on the research conducted in the waters of Molosing Island and Biau Beach, Bolaang Mongondow Regency. Among these species are *Holothuria leucospilota* from the genus Holothuria, *Stichopus horrens*, and *Stichopus vastus* from the genus Stichopus. According to the report by Nurwidodo and colleagues in 2018, sea cucumbers from the Holothuriidae and Stichopodidae families can inhabit various substrates. These substrates include mud, sandy mud, sand, muddy sand, rocky beach pebbles, dead corals, coral fragments, and coral boulders. The surrounding substrate conditions heavily influence sea cucumber life. Due to their limited and slow movement and the absence of chewing or cutting tools, sea cucumbers are generally categorized as deposit feeders. Hence, environmental conditions such as seawater quality and sediment or substrate characteristics significantly affect sea cucumber survival. Around Molosing Island, the environment is marked by green vegetation, trees, and large rocks. The island features a substrate of white sandy beaches supported by coral reefs and seagrass beds. The temperature in this area ranges from 28 to 34 °C, the salinity is around 25 ppt, and the water pH is approximately 7.36. Meanwhile, Biau Beach is an environment rich in mangrove forests with a substrate of muddy sand, including coral fragments. The temperature at Biau Beach ranges from 28 to 34 °C, the salinity is around 20 ppt, and the water pH is approximately 6.91.

Sea cucumbers generally inhabit ecosystems with clean coral reefs, minimal pollution, and relatively calm waters. Good water-quality conditions are also crucial. The ideal habitat for sea cucumbers includes seawater salinity between 29 and 33%, a pH range of 6.5–8.5, water clarity around 50–150 cm, oxygen levels in the water between 4 and 8 ppm, and seawater temperature between 20°C and 25°C (Wibowo *et al.*, 1997).

Proximate Analysis

Nutrient component testing within the muddy substrate habitat of sea cucumbers was conducted using the proximate analysis method, considering parameters such as ash content, protein, crude fiber, and fat. The results of the proximate analysis on the muddy substrate habitat of sea cucumbers have been detailed in Table 1.

Table 1. Proximate Analysis Results of Muddy Substrate Habitat for Sea Cucumbers

Sample Receipt Date	No	Material Code	Food Substance Content				
			Dry Material (%)	Ash Content (%)	Crude Protein (%)	Crude Fiber (%)	Crude Fat (%)
17-05-2023	1	Sea Cucumber Substrate A	99,02	94,94	0,24	6,18	0,17
	2	Sea Cucumber Substrate B	97,64	95,42	0,50	2,86	0,45
	3	Sea Cucumber Substrate C	98,80	95,39	0,39	5,13	0,18

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

Sea Cucumber Substrate A	=	Habitat Substrate of the Sea Cucumber Species *Holothutia leucospilota* (Sandy Substrate, Molosing Island)
Sea Cucumber Substrate B	=	Habitat Substrate of *Stichopus horrens* Sea Cucumber (Silty Sand Substrate, Biau Beach)
Sea Cucumber Substrate C	=	Habitat Substrate of *Stichopus vastus* Sea Cucumber (Silty Sand Substrate and Dead Coral Fragments, Biau Beach)

The nutritional components within the muddy substrate habitat of sea cucumbers are presented in Table 1, considering the parameters of ash content, protein, crude fiber, and fat. Ash content refers to the mineral residue generated through combustion or high-temperature heating treatment. In food, ash content is determined by measuring the remaining mineral content after completely burning organic matter. To ascertain the mineral content of a food substance, the initial step involves the destruction or breakdown of the material being tested. This process typically involves two methods: dry ashing and wet digestion, which are chosen based on the characteristics of the organic components within the tested material (Yenrina, 2015). In the ash content analysis of the muddy substrate habitat for sea cucumbers, dried substrates were used and prepared by exposure to sunlight. This resulted in ash content measurements for three substrate types: substrate A with 94.94% ash content, substrate B with 95.42% ash content, and substrate C with 95.39% ash content.

Protein content is a complex molecule that plays a vital role in growth and is an energy source. Determining protein content using the Kjeldahl method (1999) (as explained in Yenrina, 2015) involves three main stages: digestion, distillation, and titration. Based on the proximate analysis results of the muddy substrate habitat for sea cucumbers, it is revealed that substrate A has a protein content of 0.24, substrate B has a protein content of 0.50, and substrate C has a protein content of 0.39. From these results, it can be inferred that the muddy substrate habitat originating from sea cucumbers contains a crude protein content.

Crude fiber consists of remnants of food components, including cellulose and lignin, making it an indigestible plant component for the human digestive system (Yenrina, 2015). Sea cucumbers fall into the category of marine animals with omnivorous feeding patterns, consuming various types of food (Rampai, 2019). They convert the surrounding material into a source of energy or nutrition, contributing to the abundance of nutrients within their bodies. Therefore, it is not surprising that sea cucumbers possess diverse essential nutrients. The data from the proximate analysis of the muddy substrate habitat for sea cucumbers reveals that substrate A has a value of 6.18, substrate B has a value of 2.86, and substrate C has a value of 5.13 for crude fiber content. This demonstrates that sea cucumbers' muddy substrate habitat contains crude fiber.

Fat is one of the food components that contains essential nutrients in the diet, serving as an energy source and having other physiological roles (Rampai, 2019). Based on the data from the proximate analysis of the muddy substrate habitat for sea cucumbers, the values for substrate A are 0.17, substrate B is 0.45, and substrate C is 0.18 for fat content. This indicates that the muddy habitat where sea

indonesian.biodivers.j.
Vol. 4, No. 3, Dec 2023
ISSN : 2722-2659

cucumbers live has a high-fat content.

The proximate analysis results of the muddy substrate habitat samples of sea cucumbers from Location A (Molosing Island) and Locations B and C (Biau Beach) indicate that the nutritional content, measured by parameters such as ash content, protein content, crude fiber content, and fat content of the collected samples, shows that the nutritional content of samples from substrates B and C is higher compared to samples from substrate A. This could be due to organic matter and microorganisms that serve as food sources for sea cucumbers. Additionally, the population of sea cucumbers living in substrates B and C is more abundant than in substrate A. Rampai (2019) explains that sea cucumbers utilize three food sources: detritus, plankton, and organic material mixed in mud or sand. The substrate habitat where sea cucumbers live is crucial in their growth and distribution. Sea cucumbers can live on the substrate surface (epifauna), be embedded in sediments or sand (infauna), or hide in coral or rock crevices. The underlying water substrate, such as sand, mud, and coral debris, becomes a suitable habitat for sea cucumbers due to the presence of organic matter, which serves as their primary food source (Rampai, 2019). According to Martoyo *et al*. (2007), the ideal growth conditions for sea cucumbers are within the range of 24–30 °C for temperature, 28–32 ppt for salinity, 6.5–8.5 for water pH, 4–8 ppm for dissolved oxygen, 0.3–0.5 m/s for current velocity, and water clarity between 50–150 cm.

CONCLUSION

The results of the research conducted at Molosing Island and Biau Beach in Bolaang Mongondow Regency reveal the presence of three species of sea cucumbers suspected to belong to different genera. Around the waters of Molosing Island, the identified species is believed to be *Holothuria leucospilota* from the family Holothuriidae. In contrast, at Biau Beach, the identified species are *Stichopus horrens* and *Stichopus vastus* from the family Stichopodidae. Proximate analysis involving the measurement of parameters such as ash, protein, crude fibre, and fat content has been conducted. The habitat substrate, or bottom layer of the waters, significantly impacts the development, growth, and distribution patterns of sea cucumbers.

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