

TESTING OF PROTEIN CONTENT, WATER CONTENT AND ORGANOLEPTIC QUALITY OF BLOOD SEA CUCUMBER (*Holothuria Edulis*) WITH DIFFERENT OVENING TEMPERATURES

Pengujian Kadar Air, Protein dan Mutu Organoleptik Teripang Darah (*Holothuria edulis*) dengan Suhu Pengovenan yang Berbeda

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(Received July 8th 2026; Accepted August 11th 2026)

ABSTRACT

Sea cucumber is one of the marine organisms with high economic value, often used as food and in traditional medicine. Sea cucumbers are marine animals that are easily damaged, so they require post-harvest processing to extend their shelf life. One preservation method commonly used is drying. This study aims to determine the moisture content, protein content, and organoleptic quality of dried blood sea cucumber (*Holothuria edulis*) at different oven temperatures. The research used a descriptive quantitative approach with oven drying at five temperature treatments: P1 (50°C), P2 (60°C), P3 (70°C), P4 (80°C), and P5 (90°C), with each treatment replicated three times. The parameters observed included moisture content, protein content, and organoleptic tests of appearance, aroma, and texture by 25 untrained panelists. The collected data were analyzed by calculating the average value for each testing parameter. The results revealed that increasing the oven temperature consistently reduced the moisture content, reaching a range of 1.44% to 1.10%, and increased the protein content from 12.06% to 17.63%. The organoleptic evaluation indicated that a temperature of 90°C produced the highest scores for appearance, aroma, and texture. Overall, the treatment using a drying temperature of 90°C (P5) provided the highest values for all tested parameters and is recommended as the best treatment in the processing of dried blood sea cucumber to obtain good physical quality, protein content, and moisture content.

Keywords: Drying, Organoleptic, Protein, Sea cucumbers, Water content

ABSTRAK

Teripang merupakan salah satu biota laut bernilai ekonomi tinggi yang sering dijadikan sebagai bahan pangan dan obat tradisional. Teripang termasuk hewan laut yang mudah rusak sehingga memerlukan pengolahan pascapanen untuk memperpanjang masa simpan. Salah satu metode pengawetan yang sering digunakan adalah pengeringan. Penelitian ini bertujuan menguji kadar air, protein dan mutu organoleptik teripang darah (*Holothuria edulis*) kering pada suhu pengovenan yang berbeda. Penelitian ini menggunakan pendekatan deskriptif

kuantitatif dengan metode pengeringan oven pada lima perlakuan suhu P1 (50°C), P2 (60°C), P3 (70°C), P4 (80°C), dan P5 (90°C), dimana setiap perlakuan diulang sebanyak tiga kali. Parameter yang diamati meliputi kadar air, protein serta uji organoleptik terhadap kenampakan, aroma, dan tekstur oleh 25 panelis tidak terlatih. Data yang diperoleh dianalisis dengan menghitung nilai rata-rata dari setiap parameter pengujian. Hasil penelitian menunjukkan bahwa peningkatan suhu oven secara konsisten menurunkan nilai kadar air hingga mencapai kisaran 1,44% menjadi 1,10% dan meningkatkan kadar protein dari 12,06% menjadi 17,63%. Penilaian organoleptik menunjukkan bahwa suhu 90°C memberikan skor tertinggi pada aspek kenampakan, aroma, dan tekstur. Perlakuan 5 dengan suhu pengeringan 90°C secara keseluruhan merupakan perlakuan dengan nilai tertinggi untuk semua parameter pengujian dan dapat direkomendasikan sebagai perlakuan terbaik dalam proses pengolahan teripang darah kering untuk memperoleh mutu fisik dan kandungan protein serta kadar air yang baik.

Kata kunci: Kadar Air, Organoleptik, Pengeringan, Protein, Teripang

INTRODUCTION

Sea cucumbers are marine organisms of high economic value, frequently utilized as food and in traditional medicine. Dried sea cucumber products are in high demand in both local and international markets, particularly in China and Southeast Asia (Nurlaila *et al.*, 2016). The "blood" sea cucumber (*Holothuria edulis*) is a marine commodity of high economic value due to its nutritional content, especially protein (Rahmawati *et al.*, 2020; Dasilva *et al.*, 2025). According to Rahman and Sari (2020) and Bordbar *et al.* (2011), this species contains protein, collagen, and bioactive compounds that are beneficial to health. Sea cucumbers are highly perishable after capture, necessitating post-harvest processing to extend their shelf life. Drying is a commonly used preservation method; it aims to reduce the material's moisture content to prevent spoilage caused by microbial growth. According to Winarno (2004), high moisture content can accelerate food spoilage. Oven drying is considered an efficient method capable of producing goods with low, uniform moisture content in less time compared to conventional drying techniques (Purnomo *et al.*, 2020; Nurjanah *et al.*, 2021).

Drying temperature plays a crucial role in determining the final product quality. If the temperature is too low, the drying process becomes inefficient and may allow for microbial growth. Conversely, excessively high temperatures can degrade nutritional content—particularly protein, which is a primary component of sea cucumbers. Therefore, selecting the appropriate temperature during oven drying is vital for preserving the nutritional value and sensory quality of the final product. In this regard, Riansyah *et al.* (2013) noted that an optimal drying temperature can achieve low moisture content without significantly reducing protein levels. Moisture content, protein content, and organoleptic qualities—such as appearance, aroma, and texture—serve as critical indicators for assessing the success of the drying process. Organoleptic quality determines consumer acceptance of the final product; consequently, organoleptic testing is a vital component in evaluating the quality of dried sea cucumber products.

Given the importance of maintaining the quality of "blood" sea cucumbers (*Holothuria edulis*) regarding moisture content, protein levels, and organoleptic properties, this study was conducted. The research aimed to analyze these parameters in sea cucumbers dried in an oven at various temperatures. The findings are expected to serve as a reference for standardizing sea cucumber processing in a manner that is practical, efficient, and yields high added value for the fishery processing industry.

RESEARCH METHODS

Place and Time

This research was conducted from May to June 2025 at the Marine Product Processing Technology Applied Laboratory and the Basic Laboratory of Palu Polytechnic, as well as the Laboratory of the Faculty of Mathematics and Natural Sciences at Tadulako University, Palu.

Tools and Materials

The equipment used in this study for processing dried sea cucumbers included a digital scale, a steamer, a draining rack, a basin, a spoon, a tray, a gas stove, and a drying oven. Testing equipment included glassware, a porcelain crucible, tongs, a centrifuge, a spectrophotometer, and a shaker. The primary material used in the study was fresh blood sea cucumbers (**Holothuria leucospilota**) obtained from the coastal waters of Rerang Village, Damsol District, Donggala Regency; the sea cucumbers were relatively uniform in size and alive at the time of processing.

Research Methods

This study was a laboratory experiment employing a quantitative descriptive approach. The treatments consisted of varying oven drying temperatures—specifically (P1) 50°C, (P2) 60°C, (P3) 70°C, (P4) 80°C, and (P5) 90°C—applied for a duration of six hours. Each treatment was replicated four times. The parameters observed included moisture content, protein content, and organoleptic quality (appearance, odor, and texture). The data obtained were analyzed using quantitative descriptive methods by calculating the mean values for each drying temperature; these were then compared narratively to identify trends regarding the treatments' effects on product quality. The organoleptic assessment utilized a Randomized Block Design (RBD) with five main treatments and four replications, resulting in 20 experimental samples to enhance data validity.

Research Design

This study was a laboratory experiment employing a quantitative descriptive approach (Raysa & Yusra, 2024). The treatments involved varying oven-drying temperatures—specifically 50°C (P1), 60°C (P2), 70°C (P3), 80°C (P4), and 90°C (P5)—with a drying duration of 6 hours. Each treatment was replicated three times. The parameters observed included moisture content, protein content, and organoleptic quality (appearance, aroma, and texture) as assessed by 25 untrained panelists. Data obtained from each test parameter were analyzed by calculating the mean values.

Research Procedure

This research procedure includes a series of stages, starting from sample collection and preparation, boiling, drying using an oven at various temperatures, to analysis of water content, protein content, and organoleptic testing of the final product. Each stage is carried out systematically in the laboratory to obtain accurate data in assessing the effect of drying temperature on the physical and chemical quality of blood sea cucumbers (*Holothuria edulis*).

Sample Collection and Preparation

Fresh **Holothuria edulis** (pinkfish/red-bellied sea cucumber) were obtained from local fishermen in the coastal area of Rerang Village, Donggala Regency, and subsequently transported to the laboratory in a fresh state using plastic bags containing salt. The samples consisted of sea cucumbers that were relatively uniform in size and physically intact. The specimens were washed under running water to remove mucus, debris, and sand; the viscera were then removed, followed by a final thorough washing.

Boiling Process

After cleaning, the sea cucumbers are boiled in a steamer filled with clean water for 15–30 minutes. Boiling is done using a gas stove until the flesh becomes firmer and the color of the sea cucumbers darkens slightly. The boiling process aims to kill initial microorganisms, remove excess fishy odor, and speed up the drying process. After boiling, the sea cucumbers

are drained using a drainer and allowed to reach room temperature (Nurlaila, 2016 and Hanifaturahmah *et al.*, 2024).

Drying Process

The sea cucumber samples were then divided into five drying temperature treatment groups: 50°C (P1), 60°C (P2), 70°C (P3), 80°C (P4), and 90°C (P5), with a uniform drying time of 6 hours. Drying was carried out using a temperature-controlled oven. During the drying process, the samples were arranged evenly in a cup so that hot air evenly reached the entire surface. After that, the samples were cooled at room temperature for 30 minutes (Nurlaila, 2016).

Moisture Content Test

Water content was analyzed using the oven drying method at 105°C. Approximately 2 grams of the dried sample was weighed and placed in a porcelain cup. The cup containing the sample was placed in an oven for approximately 6 hours until a constant weight was reached. After that, the cup was removed and cooled in a desiccator, then reweighed. Water content was calculated based on the difference in weight before and after drying (Sudarmadji *et al.*, 1997; AOAC, 2005).

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

Description:

- A : The weight of the empty cup is expressed in grams
- B : The weight of the dish + the initial sample is expressed in grams
- C : The weight of the dish + the dry sample is expressed in grams.

Protein Test

Protein content determination was performed using the Biuret method, following the procedure described by Sudarmadji *et al.* (1997). A 1 g sample was weighed and placed into an Erlenmeyer flask, to which 25 mL of distilled water and 5 mL of 1 M NaOH were added. The mixture was heated in a water bath for 15 minutes and agitated until homogeneous for 2–3 hours. The sample was cooled and centrifuged at 5000 rpm for 45 minutes to obtain a clear filtrate. A 1 mL aliquot of the filtrate was mixed with 3 mL of Biuret reagent. The mixture was allowed to stand for 30 minutes, after which its absorbance was measured using a UV-Vis spectrophotometer at the wavelength of maximum absorbance to calculate the protein content.

$$\text{Kadar Protein (\%)} = \frac{\left(\frac{X}{1000}\right) \times Y \times Fp}{W} 100\%$$

Description:

- X = BSA concentration of the sample (ppm)
- Y = volume (L)
- Fp= dilution factor (if any)
- W= sample weight (g)

Organoleptic Test

Attributes such as color, odor/aroma, and texture are evaluated by trained or untrained panelists using descriptive scales or structured scoring (Lawless & Heymann, 2010). The organoleptic testing is based on the sea cucumber organoleptic assessment score sheet specified in the Indonesian National Standard (SNI) 01-2346-2006, as presented in Table 1 below:

Table 1. Sea cucumber organoleptic assessment score sheet based on Indonesian National

Standard (SNI) 01-2346-2006

Specification	Value
Appearance / Feature	
The incision has healed well, and the outer skin is neat and attractive	9
The incision site has healed well, though the external skin closure is somewhat untidy	7
Slightly open split mark; outer cover somewhat untidy	5
Wide, gaping split; outer skin is somewhat untidy	3
The cut is wide open, and the outer skin is ragged	1
Smell	
Very specific sea cucumbers	9
Sea cucumber species	7
Sea cucumber—not specific enough	5
A bit musty	3
Musty	1
Texture	
Hard, dense, compact, and clay	9
Hard, dense, slightly compact, and clay	7
not hard enough, not dense, lacking compactness	5
A bit soft and lacks firmness	3
Soft and lacking cohesion	1

RESULT

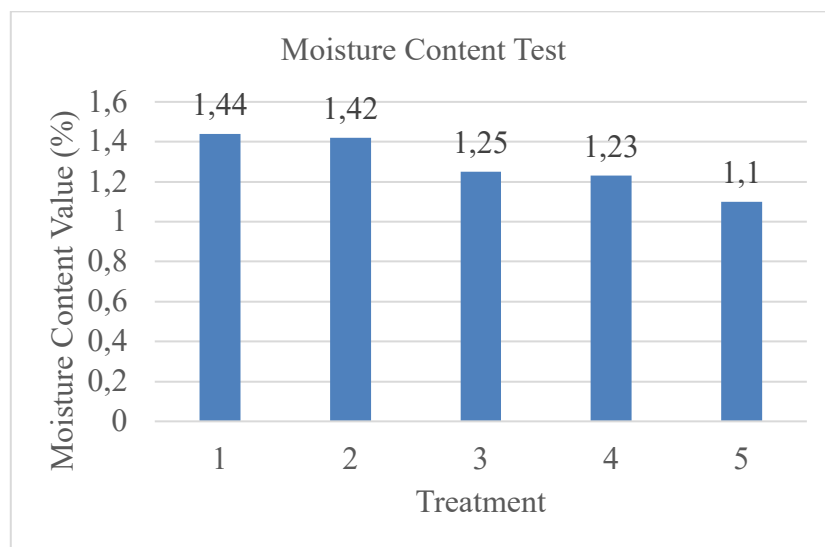


Figure 1. Water content in each treatment

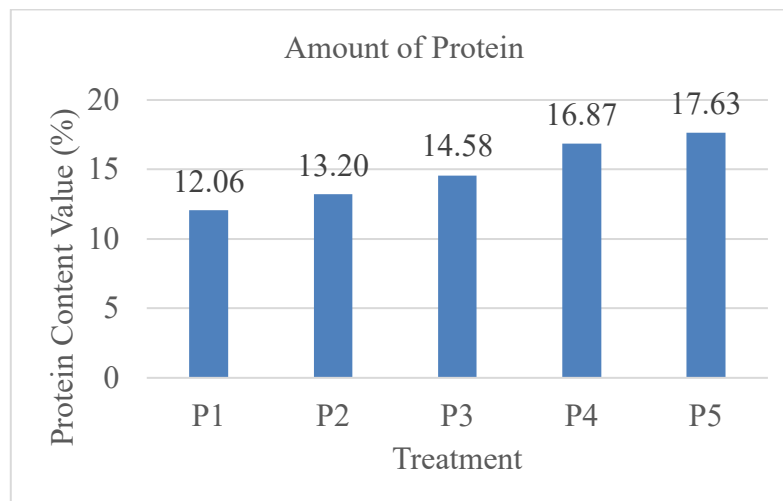


Figure 2. Protein levels for each treatment

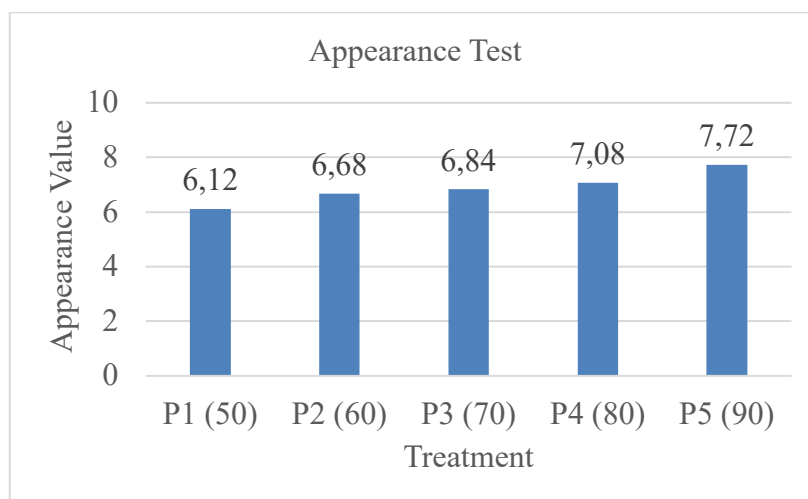


Figure 3. Organoleptic test scores for appearance

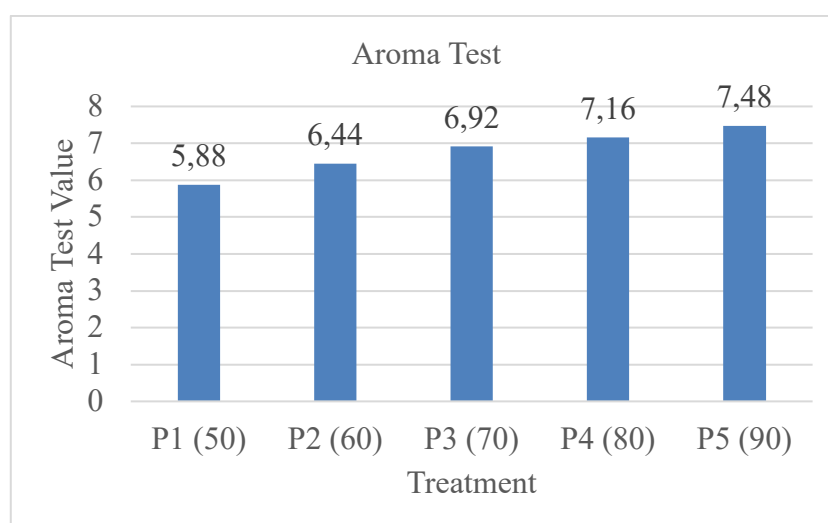


Figure 4. Organoleptic test scores for aroma

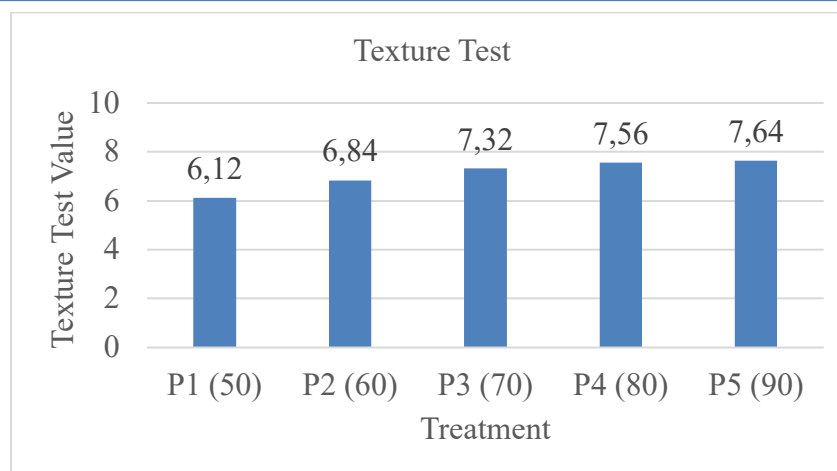


Figure 5. Organoleptic test values for texture

DISCUSSION

Moisture Content Analysis

Measurements of the moisture content in red sea cucumbers (*Holothuria edulis**) showed a decrease in moisture levels as the oven drying temperature increased. The average moisture content for each treatment is shown in Figure 1. The highest moisture content was observed in treatment P1 (50°C) at 1.44%, while the lowest was in treatment P5 (90°C) at 1.10%. This reduction in moisture content occurred because higher temperatures accelerate the evaporation of free water from the sea cucumber tissue. As the temperature rises, the energy available to evaporate water increases, resulting in a lower final moisture content in the dried product. This decrease demonstrates the effectiveness of high temperatures in reducing moisture content, a crucial factor for extending the shelf life of red sea cucumbers. According to Litaay *et al.* (2022), a reduction in moisture content can also result from the boiling process, which causes the release and evaporation of water from the substrate. Winarno (2004) stated that the purpose of drying is to reduce moisture content to a safe level, thereby preventing microbial growth and spoilage. Furthermore, the Indonesian National Standard (SNI 2732.1-2009) specifies that the maximum moisture content for dried sea cucumber products should be below 20%; thus, all treatments in this study met the quality requirements for effective drying.

The consistent reduction in moisture content also indicates that a six-hour drying period was effective in lowering water content, particularly at temperatures of 80–90°C. Treatment P5 (90°C) yielded the lowest moisture content (1.10%), suggesting that this temperature is optimal for the drying process without compromising the physical integrity of the product.

Protein Content Analysis

Protein content analysis of the red sea cucumber (*Holothuria edulis**) across five different drying temperatures (Figure 2) shows an increase in protein values as the drying temperature rises. The lowest protein value was observed in treatment P1 (50°C) at 12.06%, while the highest was in P5 (90°C) at 17.63%. This increase in protein content indicates a rise in the proportion of protein within the material; this is attributed to the reduction of moisture content during the drying process, which leads to a higher concentration of solid components, including protein. Higher drying temperatures result in greater moisture loss, thereby increasing the concentration of protein within the dried material.

This finding aligns with Winarno (2004), who explained that during drying—particularly thermal drying—moisture content decreases drastically; consequently, non-volatile nutrients such as protein become more dominant in the chemical composition of the

dried product. Hanifaturrahmah *et al.* (2024) stated that drying sea cucumbers at high temperatures yields lower moisture content and relatively higher protein content due to the increased concentration of solid components within the tissue. The study results indicate that the maximum temperature employed (90°C) still resulted in increased protein content; this is supported by research from Rahman & Wahyuni (2020), which found that drying sea cucumbers at temperatures up to 90°C effectively preserves protein content without causing significant damage to the protein structure.

Organoleptic Test

Appearance

Organoleptic test results regarding the appearance of blood sea cucumbers (**Holothuria leucospilota**) showed an increase in average scores as the drying temperature rose. The average appearance scores for temperatures ranging from 50°C to 90°C are presented in Figure 3. The results indicate that the oven temperature treatment influenced the visual quality of the dried product. The highest appearance score was obtained with treatment P5 (90°C), averaging 7.72, while the lowest was observed with treatment P1 (50°C), averaging 6.12.

Increasing the oven temperature contributed to changes in color, tissue density, and surface cleanliness. Higher temperatures tended to produce products with well-closed incision marks, resulting in a more visually appealing appearance. This aligns with Suwantoro (2014), who stated that visual aspects—such as color, shape, and surface cleanliness—significantly influence consumer acceptance of dried fishery products.

The notable results at 90°C are likely due to more optimal water evaporation at this temperature, allowing the incision marks to close more tightly and creating a compact, attractive product surface. According to Meilgaard *et al.* (2007), appearance constitutes the consumer's first impression and is influenced by processing treatments such as heating, drying, and other post-harvest procedures.

Low-temperature treatments (such as P1 and P2) resulted in products with paler colors and uneven surfaces due to suboptimal drying. Products with such characteristics tended to receive lower scores from panelists because they appeared less attractive. Overall, the data indicate that an oven temperature of 90°C yielded the best results regarding visual appearance; therefore, it is recommended for use in the drying process of blood sea cucumbers.

Aroma

Organoleptic test results regarding aroma indicate that panelists preferred Treatment 5, in which the sea cucumbers were dried at the highest temperature. Figure 4 illustrates the average aroma scores for temperatures ranging from 50°C to 90°C. The aroma scores for oven-dried blood sea cucumbers showed distinct variations across the temperature treatments. The lowest score was observed in Treatment P1 (50°C) with an average of 5.88, while the highest was obtained in Treatment P5 (90°C) with an average of 7.48. Treatments P4 and P5 yielded the highest scores compared to the others, reflecting the characteristic sea cucumber aroma compliant with SNI 01-2346-2006 standards.

The increase in aroma scores at high temperatures (80–90°C) suggests that drying at these temperatures effectively reduces the fishy or musty odors often associated with incompletely processed seafood. This is attributed to the evaporation of undesirable volatile compounds, as well as the inactivation of enzymes and spoilage microorganisms responsible for generating unpleasant odors. According to Winarno (2004), the aroma of food products is significantly influenced by volatile compounds formed or lost during processing stages such as heating and drying. Treatments P4 and P5 exhibited superior aroma scores because the optimal drying process evaporated the components causing fishy and musty odors while successfully developing the characteristic sea cucumber aroma.

Thus, the 90°C oven drying treatment produced the best aroma, as it maximized the

reduction of fishy odors and imparted a characteristic scent preferred by the panelists. These results confirm that high-temperature drying is effective in enhancing the organoleptic aroma quality of dried blood sea cucumbers.

Texture

Data from the organoleptic testing regarding the average texture score of the red-bellied sea cucumber (*Holothuria edulis**) are presented in Figure 5. The highest texture score was obtained with treatment P5 (90°C), with an average score of 7.64, while the lowest score was observed in treatment P1 (50°C), with an average of 6.12. This indicates that increasing the oven drying temperature affects the texture quality of the final product. According to the Indonesian National Standard (SNI) 01-2346-2006, the optimal organoleptic texture score is 9, characterized by a texture that is hard, dense, compact, and tough.

Higher oven temperatures tend to produce a texture that is more compact, dense, and firm rather than soft or mushy. This occurs because, at high temperatures, water within the sea cucumber tissue evaporates more completely, causing the tissue structure to shrink in a stable manner and become more resistant to pressure. Conversely, at low temperatures, drying proceeds slowly; consequently, the texture does not form optimally, and the product tends to be softer and less dense.

According to Suwanto (2014), the texture of dried products—such as fishery commodities—is influenced by the extent of water loss and the protein coagulation process during heating. Furthermore, Winarno (2004) states that texture is influenced by water content and the distribution of collagen or structural proteins within animal tissue. At high temperatures, collagen undergoes denaturation, which can enhance tissue compactness. Thus, treatment P5 (90°C) yielded the best results regarding texture, as evidenced by the highest average score from the panelists. This temperature facilitates the formation of a dense, firm texture consistent with the characteristics of high-quality dried sea cucumber.

CONCLUSION

The research results indicate that oven drying temperature affects the moisture content, protein content, and organoleptic quality of blood sea cucumbers. As the drying temperature increases, moisture content decreases, whereas protein content and organoleptic scores tend to increase. A temperature of 90°C yielded the lowest moisture content (1.10%) and the highest protein content (17.63%). Furthermore, this temperature resulted in the highest scores for the appearance, aroma, and texture of the dried sea cucumbers. Thus, treatment P5—involving drying at 90°C for 6 hours—was the optimal treatment for producing high-quality dried blood sea cucumbers in terms of moisture content, protein content, and organoleptic quality.

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