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DECLINE IN FRESHNESS OF SKIPJACK TUNA ALONG THE DISTRIBUTION CHAIN FROM LANDING SITES TO LOCAL CONSUMERS IN TERNATE

PENURUNAN KESEGARAN IKAN CAKALANG SELAMA DISTRIBUSI DARI TEMPAT PENDARATAN IKAN KE KONSUMEN LOKAL DI TERNATE

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ABSTRACT

Proper handling of fish is a key factor influencing the success of fresh fish distribution and trade. However, in practice, handling procedures are often inadequately implemented by fishermen, resulting in reduced fish quality and price. To address this issue, a study was conducted at the Dufa-dufa Fish Landing, Ternate City (North Maluku) to assess the distribution and quality of fresh skipjack tuna (*Katsuwonus pelamis*). The distribution of fresh skipjack tuna is extensive, reaching all regions of the city through various fish distribution nodes. While fishermen have endeavored to maintain the freshness, quality degradation was observed along the distribution chain. Sensory tests were conducted at each stage of the distribution process, from landing to the final consumers, assessing organoleptic attributes such as eyes, gills, and body texture. The results showed that the values differ at each node and tended to decline. The Kruskal-Wallis analysis indicated a significant difference in organoleptic values between the eyes, gills, and body texture of skipjack tuna at each distribution node ($P < 0.05$). These findings suggested that the freshness of skipjack tuna may decline during the distribution process.

Keywords: distribution, Dufa-dufa Fish Landing, organoleptic, skipjacks

ABSTRAK

Penanganan ikan yang efektif merupakan faktor krusial dalam keberhasilan distribusi dan perdagangan ikan segar. Akan tetapi, dalam praktiknya, nelayan sering mengabaikan prosedur penanganan ikan, yang berakibat pada penurunan kualitas produk dan penurunan harga. Sebuah penelitian dilakukan di Pendaratan Ikan Dufa-dufa, Kota Ternate (Maluku Utara) untuk mengatasi kesenjangan pengetahuan ini. Tujuan penelitian ini adalah untuk menilai distribusi dan kualitas ikan cakalang (*Katsuwonus pelamis*) segar. Distribusi ikan cakalang sangat luas, menjangkau semua wilayah kota melalui berbagai simpul distribusi ikan. Nelayan telah melakukan upaya mempertahankan kesegaran ikan cakalang pada setiap simpul jalur distribusinya. Uji sensoris dilakukan pada setiap rute distribusi ikan cakalang, dari pendaratan hingga konsumen akhir, dan nilai organoleptik ikan, termasuk mata, insang, dan tekstur tubuh, ditemukan berbeda pada setiap simpul dan cenderung menurun. Analisis Kruskal-Wallis menunjukkan perbedaan yang signifikan secara statistik dalam nilai organoleptik antara mata, insang, dan tekstur tubuh ikan cakalang di setiap simpul distribusi ($P < 0,05$). Temuan ini menunjukkan bahwa kesegaran ikan cakalang menurun selama proses distribusi.

Kata kunci: cakalang, distribusi, organoleptik, PPI Dufa-dufa

INTRODUCTION

The fisheries sector is a vital resource for the community and a primary driver of the national economy. Ternate City, located in North Maluku Province, is a notable city with considerable fisheries resource potential. The area of Ternate City's waters is larger than the area of its land. The city's total area encompasses 5,709.58 km^2, with a land area of 162.03 km^2 and an extensive water area of 5,547.55 km^2. This vast expanse of water, a distinguishing characteristic of Ternate City, has the potential to contribute to the city's fisheries resources (Hidayat *et al.* 2023). The fisheries sector plays a pivotal role in supporting the economic growth of the Ternate City community. The fisheries sector is the most significant contributor to the Ternate City economy, with a promising potential for the provision of fisheries products (Assagaf *et al.* 2020).

Notably, pelagic fish represent a significant portion of the total catch in Ternate City, highlighting the diversity and abundance of its fisheries. Skipjack tuna is a predominant commodity in the city's fishing industry. This assertion is further substantiated by Hidayat's (2023) findings, which reveal that the production of skipjack tuna in the period spanning from 2017 to 2021 accounted for 2.97%. The Dufa-dufa Fish Landing in Ternate City is a port that is frequently utilized as a landing site for fish in Ternate City. According to Irham *et al.* (2019), Dufa-dufa is among the ports designated for skipjack tuna landing. Ensuring the quality of these fish is paramount, and proper handling techniques must be employed to maintain their integrity until they reach the end consumer. As the primary site for fish landing, the strategic function of the landing site must ensure the equitable distribution of fish and maintain optimal pricing for consumers (Sihotang *et al.* 2024).

Maintaining fish quality is crucial to prevent spoilage. Freshness is crucial for maintaining fish quality and preventing the onset of bacterial contamination, which can lead to spoilage (Wijaya *et al.* 2024; Garcia *et al.* 2017). Maintaining fish quality is crucial as consumers expect products to have a pleasant aroma, taste, and texture (Warm *et al.* 2000). Consequently, implementing rigorous quality control and safety measures for raw materials is paramount. Consequently, implementing rigorous quality control and safety measures for raw materials is paramount.

The quality of fish is contingent on the handling method implemented from the ship to the distribution process (Purnomo *et al.* 2023; Nurani *et al.* 2023; Kurniadi *et al.* 2024). After being landed at the port, the fish must be handled immediately and properly to maintain its freshness. The fish must undergo a cold treatment before being distributed to various locations and end consumers. A cold chain, initiated at the ship and spanning unloading, distribution, and delivery to the market, is instrumental in preserving product quality (Purnomo *et al.* 2023). The cold chain is a critical component of the supply chain, contributing to maintaining the quality of the fish (Hidayat *et al.* 2023). The Ministry of Marine Affairs and Fisheries has issued a policy contained in the Regulation of the Minister of Marine Affairs and Fisheries Number 7/PERMEN-KP/2019 concerning the Requirements and Procedures for Issuing Certificates of Good Fish Handling Methods. This Ministerial Decree aims to serve as a reference for fisheries actors in maintaining fish quality. Quality is crucial because it can guarantee the selling price. Ensuring good fish quality can enhance consumer confidence and stabilize prices (Afiyah *et al.* 2019). Continued decline in quality will hurt the community. If this trend persists, it will harm the fisheries industry, entrepreneurs, and consumers. Quality is important because it can guarantee the selling price. Good fish quality can increase consumer confidence and stabilize prices (Afiyah *et al.* 2019). If the decline in quality continues to occur, it will be detrimental to the community. If this is allowed to continue, it will have an impact on the fisheries industry, entrepreneurs, and consumers.

The process of fish distribution from the fishing port to the end consumer typically involves multiple distribution nodes. Each of these nodes will provide different treatment depending on the perpetrator. Poor handling during distribution can compromise the quality of the fish. To address this challenge, a comprehensive fish distribution study has been conducted in Ternate City to ensure the fish reaches the end consumer in optimal condition. The primary objective of this study is to assess the quality level of skipjack tuna landed at the Dufa-dufa Fish Landing in Ternate City, from the moment of landing to the final market in Ternate City.

METHODS

This study was conducted at the Dufa-dufa Fish Landing in Ternate City from October to November 2022. The data collected in this study included the distribution stages of skipjack tuna and the organoleptic value of the fish in each distribution process, as well as the handling of fish in each distribution process. The respondents in this study were distribution actors, including fishermen, implementers, traders, or dibo-dibo, and small traders.

The collection of data concerning the handling of fish in each distribution process was conducted through direct observation and interviews with respondents. Information regarding handling practices was collected through open-ended inquiries and subsequently documented. In addition to conducting interviews, quality tests were carried out on skipjack tuna in each distribution stage by measuring organoleptic values. Organoleptic testing was carried out using sensory tests or the five senses (Erungan *et al.* 2005). Organoleptic testing was carried out using sensory tests or the five senses (Erungan *et al.* 2005). The utilization of organoleptic testing as a primary method for evaluating the freshness of fish is predominantly driven by its practicality and the fact that it is a widely accepted approach. Kim *et al.* (2023) stated that freshness indicators can be used for determining the quality of fish products quickly and non-destructively by reflecting the freshness and spoilage degree of fish products during storage. The procedure is expeditious, uncomplicated, and does not necessitate the utilization of advanced laboratory equipment. It can serve as an immediate indicator of consumer acceptance of the product. Organoleptic testing employs the five human senses to evaluate the fish's appearance (eyes, gills, mucus), odor, and texture. These attributes are critical indicators of freshness and are rapidly perceived by humans. In this study, the tuna was evaluated based on several parameters, including its visual appearance, gill structure, and texture.

Samples of skipjack tuna were collected using a purposive sampling technique. A total of thirty fish samples were collected at each distribution point. To obtain an overview of changes in fish quality at each distribution point, the fish were coded or tagged with a string, then followed from landing and distribution to the final market. The organoleptic testing procedure employed in this study adhered to the standards outlined in SNI 2346-2011, which delineates Guidelines for Organoleptic Testing and/or Sensory Testing. A total of six panelists were assigned to assess the condition of the fish at three fish distribution points. The data obtained from the assessment sheets were subsequently tabulated. Subsequently, the tabulated data were subjected to calculation to determine the mode value, which was then employed as the ultimate assessment score. This value was then employed to construct a bar chart, which was used to compare fish freshness values between distribution points.

The data analysis employed in this study was a quantitative analysis derived from the results of organoleptic tests on each channel. Subsequently, a non-parametric test, or Kruskal-Wallis, was conducted to ascertain alterations in fish quality at each fish distribution node. Non-parametric statistical tests, as defined by Walpole (1995), are tests of the similarity of several middle values in the analysis of variance (H) with the following formula (Sugiyono 2017):

$$H = \frac{12}{N(N+1)} \sum_{t=1}^{k} \frac{Rt^2}{n_t} - 3(N+1)$$

Description:
N = All number of data
k = Many locations of research
R_t = Number of ranks at each location
n_t = Number of data for each location
t = Data per location

To further analyze the quality of skipjack tuna across different distribution nodes, the Kruskal-Wallis test was employed. The application of this statistical test yielded a p-value less than 0.05, indicating a statistically significant difference in the average organoleptic value between the distribution nodes. Conversely, a p-value greater than 0.05 suggests that the average organoleptic value is equivalent between the distribution nodes.

RESULTS AND DISCUSSION

Distribution flow of skipjack tuna

The fishing port is the epicenter of fishing activities and the economy. According to Lubis (2012), fishing ports play a pivotal role in marine fisheries, functioning as the

nexus of the economy, from the preparatory stages of fishing, shipping, and fish storage to the distribution process that reaches consumers. The fish storage port in Dufa-dufa, Ternate City, utilizes four distribution routes, involving fishermen, implementers, traders, or "dibo-dibo", and small traders. Fishermen, in their capacity as producers, engage in fishing activities, which are subsequently sold by implementers who fulfill the role of monitoring market prices and determining selling prices. These implementers also oversee the management of fishing operations. In line with this, Hidayat (2023) asserts that implementers are tasked with monitoring market prices and determining selling prices, in addition to regulating the operational management of fishing operations.

Marketing activities for skipjack tuna catches at the Dufa-dufa Fish Landing in Ternate City were carried out at the Dufa-dufa Fish Landing pier and not in the designated storage area. However, the results of the most recent interview with the manager of the Dufa-dufa Fish Landing - Regional Fisheries Port Management Office Region III indicate that the utilization of fish storage areas will be optimized in 2023. Marketing activities for skipjack tuna were conducted at the Dufa-dufa fish announcement in Ternate City, where the catch was sold by the implementer as a marketing channel involving distribution actors at the Dufa-dufa Fish Landing. In the context of distribution, fishermen or producers frequently employ intermediaries to facilitate the dissemination of their products (Ekayani *et al.* 2019). Fishermen, in their capacity as producers, also play a role in selling the catch (Kotler 1992). This phenomenon has also been documented by Kakati and Chakraborty (2017), who observed that producers frequently employ intermediaries as distributors within the distribution process. This intermediary function serves as an independent conduit between producers and end consumers.

Quality of skipjack tuna in distribution stages

An organoleptic test of skipjack tuna was conducted at the Dufa-dufa Fish Landing in Ternate City, which was subsequently distributed to the consumer market in Ternate City. The sensory evaluation revealed a decline in quality across all distribution lines, as indicated by the assessment parameters of eyes, gills, and muscles (Figure 1).

The results of the organoleptic test of skipjack tuna eyes on each distribution stage from landing to the consumer market in Ternate City revealed a decline in quality. The organoleptic test of the fish eyes on each distribution stage obtained a value of 8, then it was 7 in distribution, and then it was 6 in marketing in the consumer market (Figure 2). The condition of the skipjack tuna's eyes at the time of landing was included in the very fresh criteria with a range of values (8-9). This observation was substantiated by the condition of the convex eyeballs, transparent corneas, and pupils. Conversely, at the time of distribution, the organoleptic value of 7 was classified as fresh, as indicated by the condition of the skipjack tuna eyes, which were observed to be flat, the cornea exhibited slight cloudiness, the pupil was grayish, and the eyes were shiny. In the context of marketing, the organoleptic value was designated as 6, categorizing the specimen as less fresh. This classification was attributed to the sunken eyeballs, cloudy corneas, and grayish pupils.

Figure 1. Organoleptic assessment process at each stage of distribution (A) Landing, (B) Distribution, (C) Consumer.

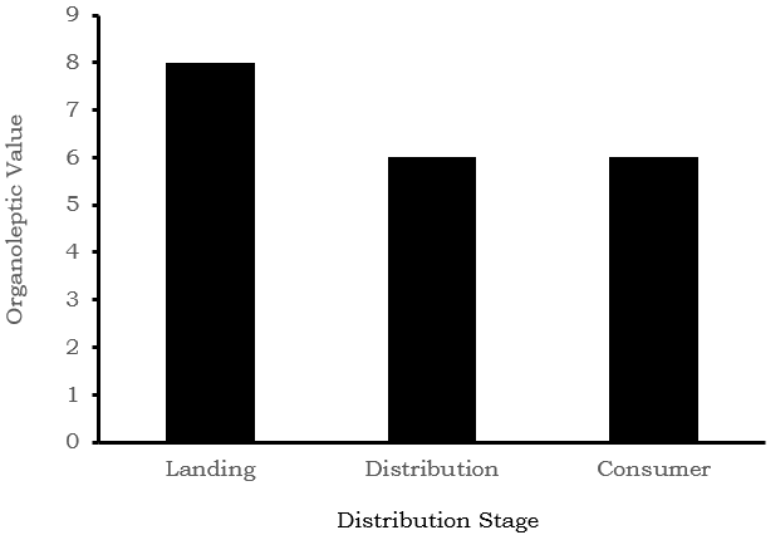

Figure 2. Organoleptic value of skipjack tuna eyes in each distribution stage.

The organoleptic test value of skipjack tuna in each distribution stage decreased, with the organoleptic test value of the gills of skipjack tuna at landing being 8, decreasing to 7 at distribution, and further decreasing to 6 at the consumer market stage (Figure 3). This finding indicates that at the time of landing, the condition of the fish gills is still classified as very fresh, with a range of values from 8 to 9. This observation was evident in the dark red or bright color of the gills and the presence of minimal mucus. Furthermore, during the distribution process, the condition of the skipjack tuna enters the category of still fresh, with a range of values 7-8. This condition can be proven by the pink gills with a minimal amount of mucus and a transparent appearance. Conversely, at the time of marketing, skipjack tuna is considered not fresh (range: 6-7) due to its light brown or grayish gills.

In a manner analogous to the two organoleptic parameters and the preceding distribution stages, the organoleptic test value of skipjack tuna texture in each distribution stage also decreased. The landing value was recorded at 8, the distribution value at 7, and the marketing value in the consumer market at 6 (Figure 4). At the time of landing, skipjack tuna gills exhibited a fresh condition with a value range of 8-9, and at the time of distribution, they were still classified as fresh with a value range of 7-8. Conversely, when assessing the marketing stage, the value range is 6-7, categorizing this condition as “not fresh”.

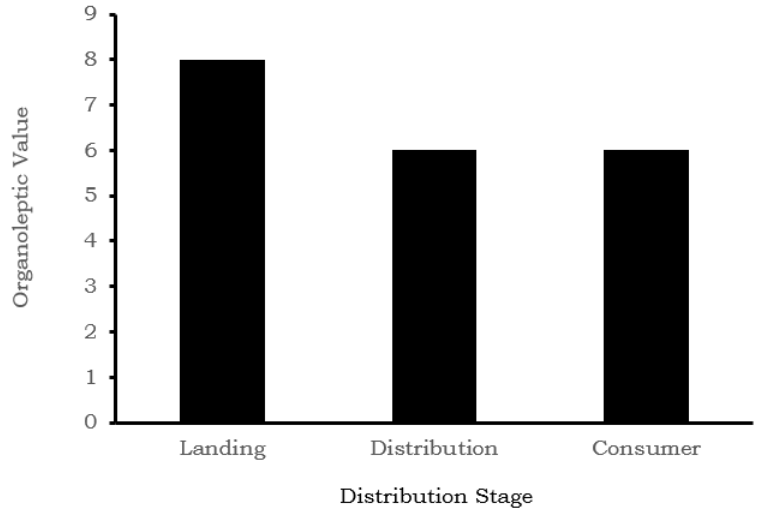

Figure 3. Organoleptic value of skipjack tuna gills in each distribution stage.

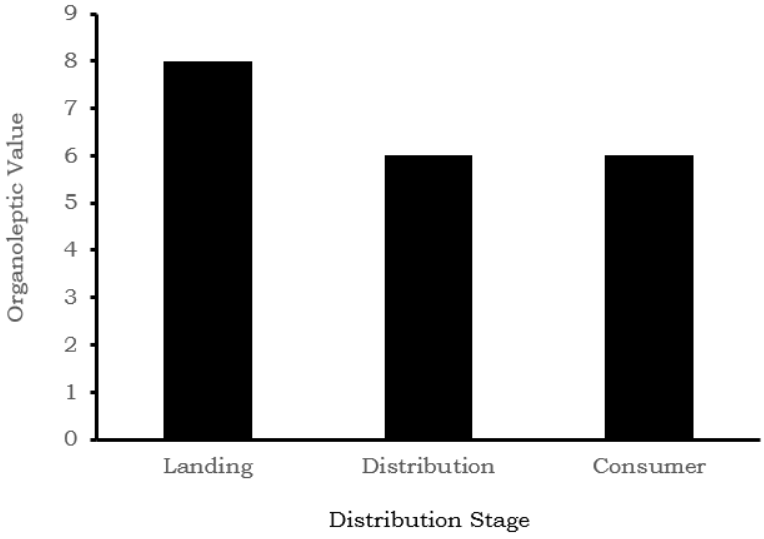

Figure 4. Organoleptic value of skipjack tuna texture in each distribution stage.

The results of the organoleptic tests of skipjack tuna at Dufa-dufa Fish Landing indicate a decline in quality during the distribution of fish from the landing to the market. The fish in lane I exhibited an average condition value of 8, categorizing them as very fresh with a value range of 8-9. In contrast, lane II exhibited a category 7, indicating marginal freshness with a value range of 7-8. Additionally, skipjack tuna in lane III, with an average organoleptic value of 6, was classified as less fresh, with a value range of 6-7. However, it was still deemed suitable for consumption, as its value remained within the acceptable range of 6-7. According to the 2013 edition of SNI 2793, an organoleptic value greater than 6 indicates that the fish remains fresh and suitable for consumption. This assertion is further substantiated by Husni *et al.* (2015), who delineated an organoleptic value threshold of 6 as the demarcation between freshness and suitability for consumption. In accordance with the findings of Metusalach *et al.* (2014), the organoleptic value for quality fish and suitable for consumption is 6.

The variation in skipjack tuna quality at each distribution node was assessed through a Kruskal-Wallis test analysis. The results of the organoleptic test of skipjack tuna on the eyes, gills, and texture were then compared between distribution nodes. The results of the Kruskal-Wallis analysis indicated that the organoleptic value of skipjack tuna in the eyes, gills, and texture had a significance value of less than 0.05, suggesting that there was a real difference between fish distribution nodes. This finding indicates that the rejection of the null hypothesis (H0) and the acceptance of the alternative hypothesis (H1) are statistically significant, suggesting the presence of a discrepancy in the quality of skipjack tuna across different distribution nodes, distribution stages, and marketing channels within the local market of Ternate City. The impact of distribution stages on skipjack tuna quality is elucidated in Table 1.

The Kruskal-Wallis test results indicate that the significance value (Sig) obtained at each distribution stage is 0.000 (significance value <0.05). This indicates that the quality of skipjack tuna varies at each distribution node. Although these nodes are close together, disparities in handling methodologies, sanitation standards, and hygiene practices among the facilities used during distribution have been observed. These disparities result in variations in fish quality. These results align with the conclusions of Irianto and Giyatmi (2009), who stated that fish quality is influenced by factors such as distribution distance, time, handling methods, sanitation, and the cleanliness of facilities used for handling. A similar viewpoint is articulated by Afiyah *et al.* (2019), who stated that an increase in distribution distance corresponds to an increase in travel time, which ultimately decreases fish quality. Prasetyo *et al.* (2024), using organoleptic observation methods, revealed that most species fell into two freshness categories, but *Upeneus moluccensis* stood out, being classified into three distinct classes. Dali and Husain (2020) also revealed that the handling of fish catches impacts fish freshness.

Table 1. Influence of track distribution on fish quality skipjack tuna in Dufa-dufa Fish Landing.

	Eye	Gill	Texture
Kruskal-Wallis H	50,660	58,955	56,142
Df	2	2	2
Asymp. Sig.	.000	.000	.000

The bar diagram presented here illustrates the variation in skipjack tuna quality during the distribution process, with the quality differences occurring between the handling process during landing and distribution and trade. In this context, temperature emerges as a pivotal factor in maintaining the quality of the fish during distribution. The proximity of the distribution centers, where ice is not readily available, results in a decline in fish quality. In contrast, the use of ice is the most prevalent handling method employed to maintain the quality of fish during distribution (Putro et al. 2008). While the use of ice is crucial in maintaining the temperature of fresh fish during transport, observations indicate that distributors often forgo its use on the way to the destination. Instead, distributors utilize ice only when the fish have reached their destination.

CONCLUSION

Maintaining fish quality was the main key to ensuring the distribution and quality of fish to reach consumers. Based on the results of this study, the distribution of fish from Dufa-dufa Fish Landing to consumers has not been implemented with good handling. Based on organoleptic tests at each distribution node of skipjack tuna at Dufa-dufa Fish Landing, Ternate City, it was found that skipjack tuna experiences a decrease in quality during the distribution process. The results of the Kruskal-Wallis test showed that the quality of fish seen from the organoleptic assessment of the eyes, gills, and texture, based on the fish distribution route, shows a very real difference.

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