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THE QUALITY OF SKIPJACK TUNA (*Katsuwonus pelamis*) ON ONE-DAY FISHING IN GULF OF BONE, SOUTH SULAWESI, INDONESIA

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Abstract

One-day fishing, a brief fishing endeavor lasting less than 24 h, entails bringing the catch directly to shore, thereby preserving the freshness of the captured fish. Nonetheless, studies investigating the correlation between one-day fishing techniques and catch quality are scarce. This study aimed to determine the quality of skipjack tuna (*Katsuwonus pelamis*) caught in one-day fishing in Gulf of Bone, South Sulawesi, Indonesia. The research methods included organoleptic, physicochemical (temperature and pH), microbiological (total plate count/TPC), and histamine level analyses. The sampling method used purposive sampling by means of skipjack tuna caught from three one-day fishing fleets, each taking 1–2 fish with a weight of between 1.8-2 kg, and then analyzed in a quality testing laboratory within three hours after landing. The organoleptic test results showed very good quality, with values ranging from 8.23 to 8.81. The physicochemical parameters showed a fish meat temperature of 3.42–5°C and pH of 6.21–6.51, which are still within the range of fresh fish. The TPC value was 9.1×10^3–9.9×10^3 CFU/g, which is far below the threshold of national and international standards. Histamine levels ranged from 3.46–4.22 mg/kg, well below the maximum limit of 30–50 mg/kg set by the food safety standards. Overall, the study results confirmed that the one-day fishing method using trolling lines can produce skipjack tuna with excellent organoleptic, physicochemical, and microbiological qualities that are safe for human consumption.

Keywords: microbiological, physicochemical cold chain, trolling line, food safety

Kualitas Ikan Cakalang (*Katsuwonus pelamis*) Hasil Penangkapan *One-Day Fishing* di Teluk Bone, Indonesia

Abstrak

One-day fishing, merupakan kegiatan melaut dengan durasi singkat kurang dari 24 jam, melibatkan pengangkutan hasil tangkapan langsung ke darat sehingga menjaga kesegaran ikan yang ditangkap. Namun, penelitian yang secara spesifik menyoroti keterkaitan antara metode *one-day fishing* dan kualitas hasil tangkapan masih terbatas Penelitian ini bertujuan untuk menentukan mutu ikan cakalang (*Katsuwonus pelamis*) hasil tangkapan nelayan *one-day fishing* di Teluk Bone, Sulawesi Selatan, Indonesia. Metode penelitian meliputi uji organoleptik, fisikokimia (suhu dan pH), mikrobiologi (*total plate count*/TPC) dan kadar histamin. Metode pengambilan sampel menggunakan *purposive sampling* dengan cara ikan cakalang hasil tangkapan dari tiga armada kapal nelayan *one-day fishing* masing-masing diambil 1–2 ekor ikan dengan berat per ekor ikan antara 1.8–2 kg, selanjutnya dianalisis di laboratorium pengujian mutu dalam waktu kurang dari tiga jam setelah pendaratan. Hasil uji organoleptik menunjukkan mutu sangat baik dengan nilai berkisar 8,23–8,81. Parameter fisikokimia menunjukkan suhu daging ikan 3,42–5°C dan pH 6,21–6,51, yang masih berada dalam kisaran ikan segar. Nilai TPC sebesar $9{,}1\times10^3$–$9{,}9\times10^3$ CFU/g,

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jauh di bawah ambang batas standar nasional maupun internasional. Kadar histamin berkisar 3,46–4,22 mg/kg, jauh di bawah batas maksimum 30–50 mg/kg yang ditetapkan standar keamanan pangan. Secara keseluruhan, hasil penelitian mengonfirmasi bahwa metode *one-day fishing* dengan pancing tonda mampu menghasilkan ikan cakalang dengan mutu organoleptik, fisikokimia, dan mikrobiologis yang sangat baik serta aman dikonsumsi.

Kata kunci: fisikokimia, keamanan pangan, mikrobiologi, pancing tonda, rantai dingin

INTRODUCTION

Skipjack tuna *(Katsuwonus pelamis)* is a pelagic fish of considerable economic importance in Indonesia and is widely consumed. This commodity serves as a significant livelihood for fishermen and is crucial for food security, the fish processing sector, and national fishery exports (Afriliani *et al.,* 2020; Suharyanto *et al.,* 2024). Within the Western and Central Pacific Fisheries Commission (WCPFC) jurisdiction, skipjack tuna in the eastern waters of Indonesia, including Gulf of Bone, are regarded as a sustainably managed stock, with potential for optimized utilization through precautionary management (Hilborn *et al.,* 2020; Pechon *et al.,* 2022).

Gulf of Bone, situated in South Sulawesi Province and part of the Indonesian Fisheries Management Area *(WPP-NRI)* 713, is recognized as a significant skipjack tuna fishing region. The oceanographic characteristics of this bay are shaped by seasonal upwelling, eddy currents, and elevated water fertility, resulting in a congregation area for large pelagic fish (Zainuddin *et al.,* 2013; Zainuddin *et al.,* 2019; Hasyim *et al.,* 2022). The maximum sustainable yield (MSY) of skipjack tuna in Gulf of Bone is estimated to be approximately 18,049 tons annually, with usage levels typically remaining below the maximum permissible threshold. Environmental variables, including sea surface temperature (30.7–31.5°C) and chlorophyll-a concentration (0.15–0.20 mg m^{-3}), have been demonstrated to influence the spatial distribution and abundance of this species in these waters (Zainuddin *et al.,* 2011). Studies have indicated that areas with heightened primary productivity, as evidenced by enhanced chlorophyll-a concentrations, frequently correspond with increased catch rates of skipjack tuna owing to the prevalence of prey (Angraeni *et al.,* 2024). Research has shown that areas abundant in chlorophyll-a are essential feeding habitats for skipjack tuna, correlating with their distribution and population density in these areas (Abudarda *et al.,* 2021).

Among the fishing techniques employed by local fishermen, one-day fishing, characterized by a duration of less than 24 h with prompt landing of the catch, offers the advantage of preserving the freshness of the caught fish. This method decreases handling time at sea and mitigates the danger of quality degradation due to extended exposure to ambient temperatures (Toledo-Guedes *et al.,* 2016). Compared to methods of catching skipjack tuna using pole and line or purse seine fishing techniques, the utilization of this fishing gear typically entails prolonged handling durations and increased exposure to environmental variables that may jeopardize the quality of the catch (Wu *et al.,* 2018; Heidrich *et al.,* 2022). Furthermore, evidence indicates that the prolonged handling time linked to this procedure may elevate the risk of spoilage and diminish overall fish quality (Miller *et al.,* 2017). Consequently, one-day fishing significantly impacts the organoleptic, physicochemical, and microbiological quality of skipjack tuna (Raoofi *et al.,* 2015; Aberoumand & Fazeli, 2019).

Organoleptic attributes significantly influence consumer approval of skipjack tuna products. A minimum organoleptic score of 7 is frequently essential for guaranteeing high fish quality. The treatment of fish after catch and subsequent processing directly influences the organoleptic characteristics of skipjack tuna (Rossarie *et al.,* 2017). Moreover, sensory characteristics, including flavor and texture, can be affected by the fish's freshness at the time of capture and the prevailing climatic circumstances. Conversely, regarding microbiological quality, the total bacterial count must remain below $5x10^5$ CFU/g. This level is crucial for mitigating the

risk of deterioration and related foodborne illnesses. Prior studies have indicated that optimal storage conditions, particularly maintaining temperatures below 4.4°C, can markedly suppress bacterial proliferation in fishery products (Ameri *et al.,* 2024). Temperature and storage conditions are crucial for prolonging shelf life and preserving fish quality by inhibiting microbial growth (Rosnes *et al.,* 2006). Moreover, an optimal pH range of 6–7 preserves the freshness and safety of fish throughout storage (Small *et al.,* 2012).

Numerous studies have examined the potential of skipjack tuna fisheries in Gulf of Bone; nevertheless, research explicitly addressing the correlation between the one-day fishing strategy and catch quality remains limited. This study aims to determine the quality of skipjack tuna (Katsuwonus pelamis) caught by one-day fishing in Gulf of Bone, South Sulawesi, Indonesia. The findings are expected to provide valuable scientific insights into fishery resource management.

MATERIALS AND METHODS

Sampling of Skipjack Tuna

Skipjack tuna were obtained from fishermen's catch utilizing trolling line *(pancing tonda)* fishing gear during a one day fishing trip, including an operational duration of 8 to 10 hours and a fishing ground at Gulf of Bone (fishing ground shown in Figure 1) at the specified coordinates: Coordinates 4°13'57.66"S - 120°46'36.02"E, 4°24'5.26"S - 120°46'13.16"E, 4°24'30.75"S - 120°38'51.20"E, 4°29'21.21"S - 120°35'31.23"E, 4°36'11.12"S - 120°49'18.06"E, 4°41'16.97"S - 120°45'42.64"E, 4°44'1.35"S - 120°55'50.90"E, 4°50'19.47"S - 120°45'18.82"E, and 4°54'38.75"S - 120°53'33.85"E correspond to the Lamuru Village fish landing site, Bone Regency, South Sulawesi, Indonesia (04023°54.17' S - 120019°59.13' E) in July 2025.

Samples were acquired using purposive sampling methods. Skipjack tuna caught during the three one-day fishing events, with each fleet landing 1-2 fish weighing between 1.8 and 2 kg per fish, were aseptically processed and conveyed to the laboratory in insulated containers with a fish-to-ice ratio of 1:3 to sustain a temperature of <5°C. Laboratory examination was conducted within three hours of landing to mitigate alterations in quality parameters.

Organoleptic

The organoleptic qualities of skipjack tuna captured by fishermen employing one-day fishing methods were assessed according to SNI 2346:2011 (BSN, 2011). The quality criteria evaluated in skipjack tuna include the eyes, gills, surface mucus, meat, odor, and texture using a fresh fish score sheet. Subsequently, six standard panelists evaluated the quality specifications. The data collected from the evaluation sheet were subsequently organized into a table, and the quality value

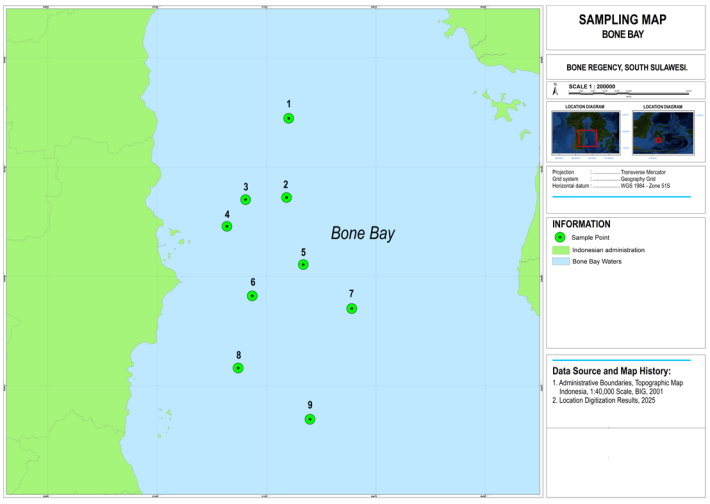

Figure 1 Map of fishing grounds at Gulf of Bone, South Sulawesi

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was ascertained by calculating the average result for each panelist at a 95% confidence level. The quality value is determined using the following formula:

$$P\ (x - (1.96 \times s / \sqrt{n}) \leq \mu \leq (x + (1.96 \times s / \sqrt{n})) \approx 95\%$$

Where P is the confidence level, x is the sample mean, 1.96 is the standard deviation coefficient at the 95% level, μ is the population mean, s is the standard deviation of the quality value, and n is the number of panelists.

Physical and Chemical Test

Temperature and pH evaluations as physical and chemical analyses on skipjack tuna were performed utilizing a Fluke 52 II Dual Probe Digital Thermometer, which has a temperature range of -40°F to 500°F with an accuracy of ±2.0°F. The thermocouple probe was inserted into the fish body or central location. The pH was evaluated using an HI981036 digital pH meter, which has a range of 0.00 to 12.00 pH, a precision of 0.01 pH, and an accuracy of ±0.05 pH. The probe tip was inserted into the fish flesh.

Total Plate Count (TPC)

Total bacterial testing was performed according to SNI 2332.3:2015 (BSN, 2015). Bacteria were cultivated using the pour-agar method and incubated at 35°C for 48 h, allowing for growth and multiplication, resulting in countable colonies. The analysis was conducted using 25 g of sample in 225 mL of Butterfield's phosphate buffer solution, subsequently diluted from 10^{-1} to 10^{-5}. Then, 1 mL of each dilution was inoculated onto plate count agar via the spreading technique and incubated. The total bacterial count was determined using the following formula:

$$N = \frac{\Sigma C}{[(1 \times n1) + (0.1 \times n2)] \times d}$$

Information:
N = number of product colonies;
ΣC = total number of colonies counted on all plates;
n1 = number of plates counted in the first dilution;
n2 = number of plates counted in the second dilution;
d = first dilution counted

Histamine

Histamine analysis was conducted using a spectrophotometric approach, as outlined in SNI 2354.10:2016 (BSN, 2016), based on the extraction of histamine from fish muscle tissue using methanol, while concurrently converting histamine into its hydroxyl form. Histamine was subsequently purified using ion exchange resin and transformed into its derivative with orthophthalic dicarboxylic acid (OPT) chemical. Histamine fluorescence was quantified using fluorometry at an excitation wavelength of 350 nm and an emission wavelength of 444 nm. The calculation was performed by inputting the concentration and fluorescence values of the working standard solution into a linear calculator application. The regression correlation coefficient (r), slope (b), and intercept (a) were used to determine the sample concentration. The fluorescence value of the sample was input into the conventional regression equation:

$$y = a + bx$$

Information:
y = sample fluorescence;
a = intercept;
b = slope;
x = sample concentration to calculate

After obtaining the x value, it was multiplied by the dilution factor (fp) and converted back to the sample weight. The histamine value was expressed in μg/g or mg/kg of the sample using the specified formula:

$$H = A \times \frac{\text{Final volume (mL)} - \text{fp}}{\text{Gram sample}}$$

Information:
H = histamine concentration (μg/g sample)
A = concentration (X) derived from the computation in μg/mL

Statistical Analysis

Data were examined using one-way ANOVA at a 95% confidence level (α=0.05). If the analytical findings indicated significant

differences, they were subsequently examined using Tukey›s HSD (High Significant Difference) test.

RESULTS AND DISCUSSION

Organoleptic Quality of Skipjack Tuna

Skipjack tuna caught by the three one-day fishing fleets showed bright eyes, prominent eyeballs, and transparent corneas. The gills were vivid red and devoid of mucus, the skin was bright without any redness along the spine, and the abdominal wall remained intact. The fish had a distinctly fresh aroma, firm texture, elasticity upon finger pressure, and resistance to flesh separation from the spine. The organoleptic quality of skipjack tuna from the three one-day fishing fleets varied between 8.23 and 8.81, with a low coefficient of variation of 2.64%. The organoleptic value generated exceeds that of skipjack tuna caught using a purse seine, which is 7.8 (Sipahutar *et al.,* 2019), and the organoleptic value of 8 for skipjack tuna taken with pole and line (Rossarie *et al.,* 2019). Tukey's HSD analysis results indicated significant differences in the organoleptic qualities of skipjack tuna on each trip of each fleet ($p<0.05$). Figure 2 illustrates the quality and condition of the skipjack tuna, while Table 1 presents the organoleptic parameters of the fish caught in one day.

Table 1 presents the organoleptic characteristics of skipjack tuna obtained during a one-day fishing operation in Gulf of Bone, exhibiting superior quality. This results from the brief fishing operations lasting approximately 8-10 hours, the technique of capturing fish with trolling lines, and the utilization of ice for preserving the catch in storage holds. Ensuring fish quality post-capture relies on optimizing fishing techniques and post-harvest management practices. Reducing stress through the judicious use of fishing methods, along with efficient post-harvest management practices, is crucial for enhancing the freshness and quality of fish, thereby promoting superior organoleptic characteristics (Svalheim *et al.,* 2017; Uglem *et al.,* 2020).

Fishing techniques significantly influence catch quality. Research indicates that methods that reduce stress on fish, such as trolling lines, yield superior quality catches compared with gill nets or trawls (Svalheim *et al.,* 2017). Moreover, rapid fishing methods and the utilization of trolling lines enhance meat quality by reducing stress on fish (Digre *et al.,* 2017; Rossarie *et al.,* 2017). When coupled with prompt post-capture cooling, these techniques preserve the flavor, texture, and overall quality of fish (Tesfay & Teferi, 2017).

Physicochemical Analysis

Measurements of physicochemical characteristics in skipjack tuna caught during a one day of trolling line fishing showed that fish meat temperatures ranged from 3.42 to 5°C, except for one measurement point on vessel 2 (trip 1), which registered 5.0°C, below the overall range seen throughout the fleets. The pH values of the fish meat ranged from 6.21 to 6.51, as indicated in Table 2. The physicochemical conditions of skipjack tuna caught by trolling lines were uniform among fleets, with parameter ranges consistent with the attributes of fresh fish. The consistency was due to the fishing grounds, fishing techniques, and onboard storage practices of the same vessels.

Table 1 Organoleptic characteristics of skipjack tuna caught using trolling lines in a one-day fishing trip

Fishing vessels	Organoleptic value		
	Trip 1	Trip 2	Trip 3
Vessel 1	8.67+0.17^{b}	8.32+0.14^{a}	8.44+0.15^{a}
Vessel 2	8.23+0.22^{a}	8.44+0.27^{a}	8.77+0.25^{b}
Vessel 3	8.37+0.23^{a}	8.81+0.24^{b}	8.41+0.22^{a}

Different superscript letters within the same column indicate statistically significant differences.

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Figure 2 Quality assessment of skipjack tuna samples

Table 2 Physicochemical test of skipjack tuna caught using trolling lines in a one-day fishing trip

Fishing vessels	Physicochemical value					
	Trip 1		Trip 2		Trip 3	
	Temperature (°C)	pH	Temperature (°C)	pH	Temperature (°C)	pH
Vessel 1	3.97+0.15^{a}	6.21+0.13^{a}	3.92+0.14^{a}	6.38+0.14^{a}	3.94+0.14^{a}	6.48+0.11^{a}
Vessel 2	5.00+0.64^{b}	6.27+0.13^{a}	3.98+0.61^{a}	6.22+0.14^{a}	4.11+0.62^{b}	6.51+0.16^{a}
Vessel 3	3.42+0.12^{a}	6.33+0.13^{a}	3.55+0.10^{a}	6.51+0.13^{a}	3.64+0.12^{a}	6.32+0.12^{a}

Different superscript letters within the same column indicate statistically significant differences.

The consistency of the temperature and pH levels in skipjack tuna caught during this one-day fishing trip suggests that onboard treatment was relatively effective and uniform across fleets. The fish meat temperature of approximately 5°C at the landing site signifies that it was not subjected to extreme heat during catch or initial storage. This indicates that while 5°C is a permissible transition temperature, fish should preferably be maintained at refrigeration temperatures (0–4°C) to avert rotting (Tenyang *et al.,* 2019; Wangtueai *et al.,* 2021). Consequently, fishing vessel 2 indicates that temperature regulation requires enhancement to preserve superior fish quality by maintaining sufficient ice utilization and limiting direct sunlight exposure. Efficient post-catch handling techniques substantially influence the quality and longevity of skipjack tuna, demonstrating that inadequate temperature regulation can lead to a dramatic deterioration in fish quality (Litaay *et al.,* 2023).

Moreover, cold storage markedly postpones pH alterations, which are directly associated with microbial activity (Mu *et al.,* 2017; Najih & Maskur, 2020). A pH value between 6.21 and 6.51 signifies that the fish is in the initial post-mortem stage, during which muscle glycogen has not been fully

converted into lactic acid, indicating that the fish remains fresh (Tri *et al.,* 2021). The pH of fresh fish muscle is typically near neutral, approximately 7.0; however, post-mortem pH may decrease to an acidic range of approximately 5.5 to 6.5, impacting several quality characteristics, including flavor, texture, and spoilage rate (Castillo-Yanez *et al.,* 2007; Hossain *et al.,* 2020). Research indicates that 6–10 h after death, over 90% of fish attain peak rigor mortis when preserved under ideal conditions; however, this process may be postponed in cooler storage environments (0–4°C) (Rucinque *et al.,* 2021). The correlation among capture techniques, stress levels, and pH stability in fish corroborates studies pertinent to optimal fishing practices and their impact on market quality (Petrik *et al.,* 2020; Mujiyono *et al.,* 2024). Tukey's HSD analysis indicated that the physicochemical values of skipjack tuna exhibited significant changes alone in the temperature parameter throughout each trip of every fleet of vessels ($p<0.05$).

Total Plate Count (TPC) Analysis

Microbiological analysis employing the TPC method on skipjack tuna caught within a one-day fishing trip revealed results between 9.1×10^3 and 9.9×10^3 CFU/g, accompanied by a low coefficient of variation of 3.01%, signifying uniformity in microbiological quality between fleets. This value somewhat exceeds that of skipjack tuna caught using pole and line, recorded at 2.5×10^2 (Harikatan *et al.,* 2024), and purse seine, documented at 3.1×10^3 (Sipahutar *et al.,* 2019). The inadequate implementation of sanitation in the equipment used and the neglect of hygienic practices among one-day fishermen lead to cross-contamination of the skipjack tuna catch. The results of Tukey's HSD analysis showed that the total plate count values of skipjack tuna on each trip of each fleet were significantly different ($p<0.05$). The test results are presented in Table 3.

The TPC value in trolling line-caught skipjack tuna is approximately 10^3 CFU/g, which is much lower than the maximum microbial contamination limit established by food quality regulations. The maximum TPC limit for fresh fish, according to national regulations (SNI 2729:2021) and international standards (International Commission on Microbiological Specifications for Foods), is typically 5×10^5–10^6 CFU/g (Latifou *et al.,* 2019). Consequently, all the tested fish samples were classified as very fresh and deemed safe for ingestion. The prompt implementation of cold storage methods after capture is crucial, as swift cooling can mitigate degradation processes linked to microbial proliferation and enzymatic reactions that lead to spoilage (Zou & Hou, 2016; Sardenne *et al.,* 2021). In contrast, when fish are maintained at elevated temperatures, namely 25°C, there is a notable escalation in the overall bacterial count, increasing from 4.61 to as much as 7.23 Log CFU/g within a 12-hour period (Ali *et al.,* 2022).

Histamine Analysis

The histamine levels in skipjack tuna caught in a one-day fishing trip were comparatively low, ranging from 3.46 to 4.22 mg/kg, with a coefficient of variation of 7.91%, suggesting a commendable degree of consistency between fleets and excursions. Tukey's HSD analysis revealed significant differences in histamine levels in skipjack tuna

Table 3 Total plate count test of skipjack tuna caught using trolling lines in a one-day fishing trip

Fishing vessels	TPC test (CFU/g)		
	Trip 1	Trip 2	Trip 3
Vessel 1	$9.3+0.21^a\times10^3$	$9.1+0.22^a\times10^3$	$9.5+0.20^a\times10^3$
Vessel 2	$9.7+0.04^b\times10^3$	$9.7+0.06^b\times10^3$	$9.8+0.05^b\times10^3$
Vessel 3	$9.9+0.12^b\times10^3$	$9.7+0.11^b\times10^3$	$9.9+0.12^b\times10^3$

Different superscript letters within the same column indicate statistically significant differences.

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Table 4 Histamine test of skipjack tuna caught using trolling lines in a one-day fishing trip

Fishing vessels	Histamine (mg/kg)		
	Trip 1	Trip 2	Trip 3
Vessel 1	3.47+0.27[a]	4.22+0.24[b]	3.82+0.26[a]
Vessel 2	3.58+0.15[a]	3.92+0.18[a]	3.67+0.17[a]
Vessel 3	3.46+0.31[a]	4.14+0.35[b]	3.93+0.33[a]

Different superscript letters within the same column indicate statistically significant differences.

between trips 2 of each fleet (p<0.05). Table 4 presents the results of the histamine analysis of skipjack tuna.

The histamine levels in trolling line-caught skipjack tuna are well below the maximum limit established by international regulations. Histamine is a marker for evaluating fish freshness and quality. Histamine concentrations under 30 mg/kg in fish signify high quality; however, levels beyond 50 mg/kg denote degradation or impairment in fish quality (Chen *et al.,* 2010; Besas & Dizon, 2012; Muscarella *et al.,* 2013). All items examined, with levels ranging from 3.5 to 4.2 mg/kg, may be classified as safe, fresh, and of superior quality. The free histidine concentration in scombridae muscle tissue greatly influences histamine synthesis when fish are inadequately preserved (Hwang *et al.,* 2010).

Factors that intensify histamine accumulation include temperature variations and extended storage without refrigeration, underscoring the necessity for rigorous monitoring protocols (Akbari-Adergani *et al.,* 2012). Inadequate management and storage during the post-harvest process, including temperature misapplication, can lead to histamine production via the decarboxylation of histidine by bacteria in fish tissue (Visciano *et al.,* 2014; Mahusain *et al.,* 2016; Pertiwi *et al*., 2020). This can occur rapidly if fish are maintained at temperatures exceeding 15°C for extended periods, facilitating the proliferation of spoilage microbes that generate histamine (Chung *et al.,* 2017). Maintaining fish at temperatures below 4.4°C is crucial to prevent histamine production by histamine-generating bacteria (Zou & Hou, 2016; Trevisani *et al.,* 2019; Hiruma *et al.,* 2020). Accumulated information from multiple studies highlights the necessity of stringent cold storage protocols to guarantee food safety and preserve the quality and freshness of caught fish.

CONCLUSION

The findings of this study demonstrate that skipjack tuna caught with trolling lines in one day of fishing exhibited superior quality in terms of physicochemical, organoleptic, microbiological, and food safety parameters. All metrics were within acceptable limits and adhered to national and international standards. This combination validates the significant potential of the trolling line approach, both in the realm of sustainable fisheries and in guaranteeing the quality of fishery products and food safety in the future.

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