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A REVIEW ARTICLE, THE EFFECT OF KILLING TECHNIQUES ON FISH QUALITY DEGRADATION

Artikel Review, Teknik Mematikan Ikan Terhadap Pola Kemunduran Mutunya

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ABSTRACT

Fish is a biological resource rich in protein and amino acids, so it has an important value for public consumption. The freshness level of fish is highly dependent on post-harvest handling methods, especially in the killing process. This study examines the effect of three killing methods, namely *ikejime*, cooling with ice, and the technique of letting the fish flounder on the quality of red tilapia and mujair fish. The parameters observed include pH, organoleptic, and Total Volatile Base (TVB) levels as indicators of freshness. The results show that the ikejime method is the most effective in maintaining fish quality by reducing stress levels and quality decline. The method of cooling with ice is quite effective, while the technique of letting the fish flounder produces the lowest quality due to excessive stress on the fish.

Key words: Fish Freshness, Ikejime, Killing Techniques, Red Tilapia, Tilapia

ABSTRAK

Ikan merupakan sumber daya hayati yang kaya akan protein dan asam amino, sehingga memiliki nilai penting bagi konsumsi masyarakat. Tingkat kesegaran ikan sangat bergantung pada metode penanganan pascapanen, khususnya dalam proses pembunuhan. Penelitian ini mengkaji pengaruh tiga metode pembunuhan yaitu *ikejime*, pendinginan dengan es, dan teknik membiarkan ikan menggelepar terhadap mutu ikan nila merah dan ikan mujair. Parameter yang diamati meliputi pH, mutu organoleptik, serta kadar *Total Volatile Base* (TVB) sebagai indikator kesegaran. Hasil menunjukkan bahwa teknik *ikejime* paling efektif dalam mempertahankan mutu ikan dengan menekan tingkat stres dan penurunan kualitas. Metode pendinginan dengan es cukup efektif, sedangkan teknik membiarkan ikan menggelepar menghasilkan mutu terendah akibat stres berlebih pada ikan.

Kata Kunci: Ikejime, Ikan Mujair, Ikan Nila Merah, Kesegaran Ikan, Teknik Mematikan

INTRODUCTION

One of Indonesia's natural resources with significant potential for development is fish. The protein and essential amino acid composition of fish is beneficial for the body, making it a highly nutritious food (Adawyah, 2007). Lowering the temperature of the fish's environment to achieve a lower body temperature, preventing stress before death, or killing the fish as soon as possible after capture are all measures that can prolong the fish's rigor mortis period (Sufianto, 2004).

The method of killing fish is one of the handling treatments that must be considered, because it affects the quality and shelf life of the fish. Different methods of killing fish affect glycogen content, thus affecting the rate of decline in freshness. Drastic temperature changes can cause stress in fish and kill them. There are several techniques for killing fish, namely by letting them flounder, cold temperatures or by ice, and *ikejime*. Killing fish by flounder is a method of letting fish die naturally by running out of oxygen in the air, this method can cause excessive stress on the fish (Reo, 2010). Cold temperatures with ice is a method of killing fish by placing live fish in ice with the aim of rapidly lowering their body temperature. Ikejime is a technique of killing fish by draining their blood, namely by inserting a sharp object into the fish's brain until the nerves die. With this technique, the fish will die painlessly because the main nerves are dead. Killing fish immediately can prevent increased stress, thereby slowing the rate of decline in fish freshness (Herawati *et al*., 2014).

Fish freshness is one of the factors that determine the selling price of fish and fishery products, as freshness is synonymous with product quality. In the fishing industry, the quality and freshness of fish are crucial in determining their quality after they are caught, as physical, chemical, and organoleptic changes occur rapidly after death. The manner in which a fish dies significantly influences the onset and end of rigor mortis, thus affecting its quality and shelf life (Junianto, 2003).

Thus, this review article aims to examine and compare the efficiency of three fish killing methods: ikejime, ice-chilling, and flounder. These methods affect the quality and freshness of fish, particularly red tilapia and mujair, using organoleptic parameters, pH, and total volatile base (TVB) as quality indicators.

RESEARCH METHODS

This research employed a descriptive method with a literature review approach from various research journals and other publications. The literature reviewed consisted of research journals and other publications that discussed the decline in fish quality due to the use of different fish killing techniques. The test fish discussed were specifically focused on fish quality. The literature search results were then grouped by topic, with the journals used as the primary reference sources. Afterward, each journal was analyzed according to the predetermined subtopics**.**

RESULTS

Table 1. Comparison Results of Fish Killing Techniques

Fish Killing Techniques	Types of Fish	Temperature	Results	Source
Ikejime	Red tilapia	0-4°C	Killing red tilapia using the ikejime technique minimizes the stress experienced by the fish and also slows down the quality of the fish, resulting in excellent meat quality.	Masengi *et al*., (2021)

Ikejime	Tilapia fish	4°C	Killing tilapia fish using the ikejime technique can delay the rigor mortis process of the fish for up to 10 hours and also the freshness of the fish from the texture of the meat is better when compared to cold temperature techniques and also floundering.	Owen *et al*., (2023)
Cold temperature	Red tilapia	0-4°C	Killing red tilapia using cold temperature techniques or ice immersion shows that the fish are still experiencing stress and the rigor process is faster compared to the ikejime technique, but it is better than the technique of letting them flounder until they die.	Masengi *et al*., (2021)
Cold temperature	Tilapia fish	0-2°C	Killing tilapia fish using the technique of directly placing them in cold temperatures can delay the rigor mortis process of the fish for up to 5 hours and also the freshness of the fish is better compared to the technique of killing them by floundering.	Owen *et al*., (2023)
Flounder	Red tilapia	0-4°C	Killing red tilapia by letting it flounder until it dies on its own results in the quality of the fish meat declining more quickly due to stress and its energy being used up first.	Masengi *et al*., (2021)
Flounder	Tilapia fish	4°C	Killing tilapia fish using the flounder technique or letting the fish die by itself has been shown to delay the rigor mortis process of the fish by only 3 hours, where the freshness of the fish is damaged more quickly because this technique uses up ATP from the fish more quickly, which ultimately results in the quality of the fish meat decreasing more quickly compared to the ikejime technique and cold temperatures.	Owen *et al*., (2023)

DISCUSSION

Ikejime consistently produces fish with clear eyes, fresh red gills, and natural body color, while maintaining superior organoleptic qualities for longer (Owen *et al*., 2023). In contrast, refrigeration only delays organoleptic quality decline, although the eyes remain intact initially (Mardiah *et al*., 2022). Body color can fade after 20 hours of storage, indicating its effectiveness is highly dependent on duration (Manteu, 2024). Meanwhile, letting the fish flounder is the most damaging method, causing rapid clouding and sinking of the eyes, rapid paleness of the body color due to lipid oxidation and increased enzyme activity, and rapid loss of redness in the gills due to physical stress and severe tissue damage (Reo, 2010).

Ikejime also produces fish with a fresh, clean, and non-fishy aroma from the start, as this method promotes the formation of umami flavor through the gradual breakdown of ATP into inosinate during the slow onset of rigor mortis (Wang *et al*., 2024). Conversely, although cooling slows the temperature, it still gradually causes a change in aroma from fresh and marine to a mild fishy odor, then a strong fishy odor, and finally a sour, rancid, and putrid odor (Luzuriaga and Balaban, 1998). Meanwhile, fish left to flounder before death experience severe stress that triggers lactic acid production and incomplete bleeding, directly accelerating decomposition and the formation of a strong fishy odor (Wang *et al*., 2024).

Ikejime also consistently produces meat with superior textural quality and minimal pH drop, thanks to handling that minimizes muscle damage (Wang *et al*., 2024). Chilling, or cold stunning, also shows good results, with higher pH and ATP levels at the time of death, and delays the full onset of rigor mortis, which contributes to better meat texture (Zampacavallo *et al*., 2015). In contrast, letting the fish flounder is the worst method for textural quality. The stress and intense muscle activity cause lactic acid accumulation, which directly leads to meat toughening, protein denaturation, and loss of desirable muscle structure, resulting in a highly unpleasant texture (Santos *et al*., 2024).

Total Volatile Base (TVB) Test

Total volatile base (TVB) is a measure of the amount of volatile nitrogen compounds (including ammonia, trimethylamine, and dimethylamine) detected in fish muscle. TVB is a key indicator of fish muscle tissue degradation during storage. The total volatile base (TVB) test is used as a chemical indicator of fish freshness because it reflects the accumulation of common volatile compounds, such as ammonia, trimethylamine, and dimethylamine, produced through bacterial protein decomposition. A low TVB value indicates high fish quality, while an increase in TVB value occurs as the fish decomposes (Balladin, 2020).

In a study conducted by Masengi *et al*., (2023), the average TVB value of red tilapia fillets with the technique of letting them die on their own or flounder and with cold temperatures experienced a faster increase in TVB value compared to red tilapia killed by ikejime or stabbed in the brain. Killing red tilapia with the flounder technique experienced a faster increase in TVB value because the energy or ATP content was low and caused by contraction before death. This is supported by the statement of Nurilmala *et al*., (2009), where the TVB value increases if decomposition occurs which increases volatile bases.

pH

The indicator commonly used to determine the freshness of fish is the pH value. In fish spoilage, autolysis and bacterial activity significantly affect the pH value of the meat, as the freshness of the fish can be indicated by the pH value (Munandar, 2009). Unfresh fish have a more alkaline pH value than fresh fish due to the presence of alkaline compounds, such as NH3, C3H9N, and volatile alkaline compounds (Poli *et al*., 2005). This decrease in pH is caused by an increase in the amount of lactic acid formed and a decrease in ATP. During the

rigor mortis phase, the pH value will become more acidic due to the catabolism of ATP and glycogen. The amount of glycogen present in the fish flesh before the fish dies and the buffer volume of the fish flesh affect the pH value (Jiang, 2000). The accumulation of volatile bases causes the pH to decrease and increases in the post-rigor and decay phases (Nurhayati, 2011).

In a study conducted by Masengi *et al*., (2021), the results of the analysis of pH value parameters from three treatments of red tilapia death methods showed different rates of development of the phase of decline in fish freshness. In this study, it was found that the rate of development of the phase of decline in red tilapia freshness by allowing them to flounder until they die was faster than fish killed by cold temperatures and ikejime. Based on the three treatments, the ikejime treatment experienced a slower development of the phase of decline in fish freshness. The energy contained in the fish's body will be broken down by the way the fish die, thus requiring a hard struggle (Reo, 2010). Rough handling methods cause damage to the fish at the time of death, thereby reducing its shelf life and decreasing fish quality (Junianto, 2003). The ikejime technique can prevent increased stress, namely the absence of muscle activity during the processing process, thereby prolonging the rate of decline in fish freshness (Herawati *et al*., 2014).

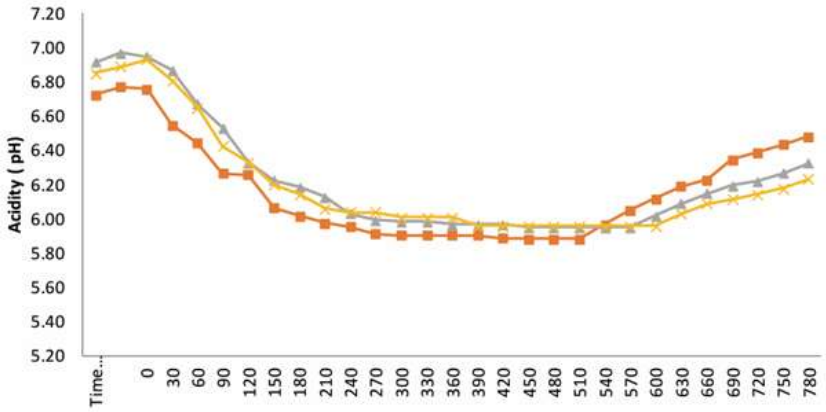

Figure 1. pH of fish with three different killing techniques
flounder; using ice; *ikejime*
(Source: Masengi *et al*., 2021)

CONCLUSION

Fish killing techniques significantly impact the quality and freshness of fish after capture. Based on a literature review, the *ikejime* method has proven to be the most effective in maintaining organoleptic quality, slowing rigor mortis, suppressing increases in total volatile base (TVB) levels, and maintaining stable pH levels in fish meat. This technique minimizes stress levels in fish, thus slowing the rate of tissue deterioration. Meanwhile, the method of killing by cooling with ice has shown considerable effectiveness in suppressing the rate of quality deterioration, although not as optimal as the *ikejime* method. This technique of allowing fish to die naturally by floundering results in lower quality due to excessive stress and accelerated physiological and chemical deterioration in the fish. Therefore, selecting the right fish killing technique, especially in the fishery supply chain, is a key factor in maintaining the quality and competitiveness of fishery products.

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