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Analysis of the rate of quality decline of mackerel fish *(Rastrelliger* sp.*)* at low temperature storage using lemon juice *(Citrus limon)* as a natural preservative

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Abstract
Mackerel (*Rastrelliger* sp.) is one of the marine fish favored by the people of Indonesia because the price is affordable for all levels of society. The problem that often occurs in fresh fish products is that they are easy to experience damage and deterioration in quality. This study was conducted to determine the rate of deterioration in the quality of mackerel when stored at low temperatures and determine the concentration of giving the best lemon juice as a natural preservative. Samples were given the treatment of adding lemon juice as much as 0%; 5%; 10%; 15% and stored at low temperatures (around -4 °C to -6 °C) for 7 days. The fifth day (120 hours) of storage, the entire sample has decayed and emits a pungent odor. Based on the results of organoleptic tests, lemon juice has no effect on the physical resistance of fish. The final pH level of fish at 5%; 10%; 15% treatment after 7 days showed fish tended to be more acidic than fish with control treatment (0%).

Keywords: Quality, mackerel, natural preservative, organoleptic

1. Introduction

Mackerel (*Rastrelliger* sp.), known as epipelagic fish, is usually found in coastal and offshore waters. This fish has the characteristics of a flat and elongated body. The presence of black spots or dots near the pectoral fins of male mackerel is a characteristic that distinguishes male and female mackerel (Astuti 2007) [1]. One type of marine fish that is favored by the Indonesian people as a food source is mackerel because of its high economic value, so the price is affordable by all levels of society. Based on data from the Directorate General of Fisheries (2000), the production of mackerel in Indonesia is from 2004 to 2010, production was quite good although there was a decline in production in 2008, but in the following years it continued to increase.

The problem that often occurs with fresh fish products is that they are very easily damaged and susceptible to spoilage or quality decline (Highly perishable food). The process of fish quality deterioration will continue if not inhibited. Fish that experience quality deterioration can affect the quality of its meat, especially for human consumption. Many internal variables relating to the nature of the fish itself and external variables relating to the environment and human handling, have a considerable impact on how quickly this process occurs. Cold chain systems are a good way to handle this product (Zakaria 2008) [11]. The application of low temperatures in fish handling offers several advantages, including extending the shelf life by one to four weeks, and maintaining the freshness and nutritional value of the fish. Under low temperature conditions, the growth of spoilage bacteria and the biochemical processes occurring within the fish body that cause quality deterioration occur at a slower rate (FAO 1995). Therefore, this study was conducted to understand the process of quality deterioration of mackerel during *chilling* temperature storage with the aim of providing information for the general public.

In addition, to extend the shelf life, preservation can also be done by using natural preservatives in the form of lemon juice. Lemon contains citric acid, pantothenic acid, flavonoids, and limonoids that function as antibacterial and antifungal activities (Batubara 2017) [4], so it can help extend the shelf life of fish.

2. Research Objectives

This research was conducted to determine the rate of quality deterioration of Mackerel (*Rastrelliger* sp.) when stored at low temperatures which was assessed subjectively, namely by organoleptic tests and pH tests at the end of storage, and to determine the best concentration of lemon juice as a natural preservative.

Research Methods

This research was conducted on October 24, 2023 for one week, at the Fishery Product Technology Laboratory Gd. 2 FPIK Padjadjaran University. Tools that The materials used in this study included a refrigerator, sterofoam, plastic wrap, knife, pH meter, name label, scale, and tablespoon. Then the materials used in this study include 4 mackerel (*Rastrelliger* sp.) taken from the supermarket as samples, lemon juice with a concentration of 0%; 5%; 10%; 15%, and tissue towels.

The research method used to test the rate of deterioration of mackerel quality is the experimental method of giving treatment of lemon juice with a concentration of 0%; 5%; 10%; 15% and organoleptic observations carried out periodically, namely for 7 consecutive days by looking at changes that occur i n mackerel.

Research Procedure

The fish used was fresh mackerel obtained from Superindo supermarket in Jatinangor *Town Square*, Sumedang Regency. Each fish is weighed differently in each treatment with a weight of 30 - 45 grams. The mackerel was cleaned and then added with lemon juice in accordance with each treatment of giving lemon juice, namely with a concentration of 0%; 5%; 10%; and 15%. Then the fish was packaged using *styrofoam*, tissue towel, and *cling wrap*. The fish were stored at a low temperature (*chiller*) around -4°- 6 °C and then observed periodically for one week subjectively for organoleptic characteristics such as aroma, appearance (surface, scales, and mucus), eyes, gills, and texture and objective observations such as pH and enzyme activity. The pH value was tested by taking 1 g of fish meat, then mashed and added with 10 ml of distilled water which was then tested using a calibrated pH meter.

Results and Discussion

Determination of Post Mortem Phase of mackerel (*Rastrelliger* sp.)

The post mortem phase is the stage of fish decay from the time the fish dies until it is unfit for consumption. This phase includes the pre-rigor, rigor mortis, and post rigor phases. It is known that quality fish has a good level of freshness which can be determined from the post mortem phase. The determination of the post mortem phase aims to determine the level of fish deterioration by using the five human senses with the parameters of the appearance of the eyes, gills, mucus, odor and texture of the fish. Based on the observations, the organoleptic characteristics of mackerel in the four treatments during the post mortem phase were obtained using a score sheet that has been determined by the National Standardization Agency with SNI 01-2346-2006 (BSN 2006). The time of the post mortem phase of mackerel stored at low temperature with 4 treatments, namely *pre rigor* conditions for 0%, 5%, 10%, and 15% treatments occurred at 0 hours, *rigor mortis phase* at 48 and 24 hours respectively. The *post rigor phase* occurred at 96 and 72 hours and the deterioration phase occurred at 144 and 120 hours. When entering the deterioration phase the fish began to decay.

Organoleptic Assessment

Determination of the deterioration of fish quality subjectively (organoleptic) is done using a score sheet that has been established by the National Standardization Agency SNI 01-2346-2006 (BSN 2006). In the observation time range of 0 to 168 hours, there is a decrease in the quality of fish quality. The decline in quality is characterized by a decrease in the level of freshness of the fish as indicated by the physical properties of the fish. For the value of the four organoleptic treatments of mackerel eyes can be seen (Table 1).

Eye

Organoleptic value of mackerel eyes with 5% treatment based on assessment, the value is higher than the other three treatments, with values of 9 in the *pre rigor* phase, 9 in the *rigor phase*, 3 in the *post rigor phase* and 1 in the deterioration phase. The characteristics of fish eyes that experience quality deterioration are that the longer the fish eyes will be increasingly opaque by thick mucus and faded brilliance (Ilyas 1983).

Table 1: Organoleptic value of mackerel eyes

Parameters		Pre Rigor	Rigor	Post Rigor	Deterioration
Eye	0%	9	5	3	1
	5%	9	9	3	1
	10%	9	7	1	1
	15%	9	7	1	1

Gills

Organoleptic value of mackerel gills with 15% treatment based on assessment was higher than the other three treatments with a value of 9 in the pre rigor phase, 7 in the rigor phase, 3 in the post rigor *phase* and 1 in the deterioration phase. The characteristics of gill eyes that experience quality deterioration are a change in color from red-brown to gray, thick slime, and have a foul odor (Berhimpon *et al.*, 2003).

Table 2: Organoleptic value of mackerel gills.

Parameters		Pre Rigor	Rigor	Post Rigor	Deterioration
Gills	0%	9	5	1	1
	5%	9	7	1	1
	10%	9	7	1	1
	15%	9	7	3	1

Mucus

Organoleptic value of the amount of mucus in mackerel with four treatments**,** the results showed that the longer the storage, the more and thicker the slime and the provision of lemon juice with 3 different levels did not have any effect on the fish studied and the slime was increasingly brownish yellow in color. This is because fish mucus is released from the glands in the skin and forms a thick clear layer around the fish body (Murniyati and Sunarman 2000) [7].

Table 3: Organoleptic Value of Mackerel Slime

Parameters	Pre Rigor	Rigor	Post Rigor	Deterioration
Mucus 0%	9	5	1	1
5%	9	5	1	1
10%	9	5	1	1
15%	9	5	1	1

Junianto (2003) [6] states that the mucus on the body of the released fish is mostly composed of glucoprotein and mucin which is an ideal medium for bacterial growth.

The appearance of Mackerel Mucus after decomposition

Table 4: Mackerel Mucus Appearance after Decomposition

			
0%	**5%**	**10%**	**15%**

Aroma

Organoleptic assessment showed that the aroma value of mackerel with 15% treatment was significantly higher than the other three treatments. In the pre-rigor phase, the value reached 9, in the rigor phase it reached 7, in the post-rigor phase it reached 5, and in the breakdown phase it reached 1. The aroma has a characteristic citrus odor, but during the post-rigor phase, the citrus aroma turns into an unpleasant aroma. According to Junianto (2003) [6], the factor that accelerates the onset of unpleasant odor in fish is due to low glycogen levels so that the rigor mortis process takes place faster.

Table 5: Mackerel aroma after spoilage

Parameters	Pre Rigor	Rigor	Post Rigor	Deterioration
Aroma 0%	9	5	3	1
5%	9	5	3	1
10%	9	5	3	1
15%	9	5	5	1

Texture

The organoleptic value of texture in the mackerel studied varied because the use of low temperature also affects the elasticity of the fish texture because the chemical and physical composition of the fish is inhibited so that the texture state of the fish is the same as the condition of the live fish (Rully 2010) [9]. However, when entering the deterioration phase, the texture of the fish turns soft and inhomogeneous. This is because the fish muscle weakens again and loses its elasticity (post rigor phase) due to uncontrolled bacterial and enzyme activity resulting in degradation of fish muscle protein.

Table 6: Mackerel texture after spoilage

Parameters	Pre Rigor	Rigor	Post Rigor	Deterioration
Texture 0%	9	7	5	1
5%	9	7	5	1
10%	9	9	5	1
15%	9	9	5	1

pH value

The pH value is one of the indicators used to determine the freshness of fish. In the process of fish decay, changes in the pH of fish meat play a very large role because it affects the process of autolysis and bacterial attack. Based on testing the pH value of the three treatments of mackerel with the addition of lemon juice, during low temperature storage, the following results were obtained (Table 7).

Table 7: pH value

Squeeze Treatment Lemon	Initial pH	Final pH	Average
0%	5.9	8.77	7.35
5%	5.96	8.6	7,28
10%	5.87	8.58	7,25
15%	5.91	8.4	7.15

In Table 7, the highest average pH was 0% treatment with a value of 7.35 and the lowest average pH was 15% treatment with a value of 7.15. In accordance with the statement of Metusalach *et al*. (2014) [8] that fish quality is said to be very good if the pH of the meat is 6 - 7, good if the pH is < 6, and not good if the pH value is > 7 and the difference occurs because the concentration of lemon juice has a significant effect on the pH value of mackerel because the higher the level of lemon juice, the final pH value is smaller, this is thought to be due to the acidic properties produced by lemon juice so that samples given lemon juice have a smaller pH value than those not given lemon juice.

Fish that is no longer fresh has a higher pH (alkaline) than fresh fish. This is due to the generation of alkaline compounds such as ammonia, trimethylamine, and other volatile compounds. When fish die, the biochemical processes that occur take place anaerobically which produces lactic acid that can reduce the pH of fish meat (Santhi 2017) [10].

Conclusions

Based on the analysis of the rate of quality deterioration of mackerel that has been carried out using low temperature storage with lemon juice as a natural preservative, it can be concluded that lemon juice has less effect on the physical resistance of fish that has been observed using organoleptic tests and pH tests. The treatment with 0% lemon juice showed the highest average pH of 7.35, while the treatment with 15% lemon juice showed the lowest average pH, recorded at 7.15. From the results of this study, it can be concluded that the pH level consistently increased in all treatments using lemon juice concentrations. Unfortunately, none of the treatments proved effective in maintaining the physical condition of the fish. This can be seen from the damage observed in the tested fish, ranging from fish that were not given any lemon juice concentration to fish that were given a lemon juice concentration of 15%.

References

1. Astuti. Pendugaan beberapa Parameter Biologi Ikan Kembung Lelaki (*Rastrelliger* kanagurta) yang di Daratkan di TPI Muara Angke, Jakarta Utara. *Skripsi*. Departemen Manajemen Sumberdaya Perairan. Fakultas Perikanan dan Ilmu Kelautan. Intitut Pertanian Bogor. Bogor; c2007.
2. Berhimpon S. *Mikrobiologi Perikanan Ikan. Bagian 1. Ekologi dan Pertumbuhan Mikroba Serta Biokimia Pangan. Laboratorium Pengolahan dan Pembinaan Mutu Hasil Perikanan*. Fakultas Perikanan dan Ilmu Kelautan, Universitas Sam Ratulangi Manado; c1993.
3. Badan Standardisasi Nasional. S*urimi Beku–Bagian 1: Spesifikasi.* SNI 01-2694.1-2006. Jakarta: Badan Standardisasi Nasional (BSN); c2006.
4. Batubara NA. Efek Air perasan buah jeruk lemon (Citrus lemon) terhadap laju aliran, nilai pH saliva dan jumlah koloni Staphylococcus aureus (*in vivo*). *Skripsi*. Medan: Universitas Sumatera Utara; c2017.
5. Food and Agriculture Organization. Quality and Quality changes in Fresh Fish. Hush HH (ed). Rome: FAO Fisheries Technical Paper No. 1995;331(75):0-65.
6. Ilyas. *Teknologi Refrigerasi Hasil Perikanan.* Jilid 1. Jakarta: CV Paripurna. Junianto, 2003. *Teknik Penanganan Ikan.* Jakarta: Penebar Swadaya; c983.
7. Murniyati dan Sunarman. *Pendinginan, Pembekuan dan Pengawetan Ikan.* Yogyakarta: Kanisius; c2000.
8. Metusalach Kasmiati, Fahrul Jaya I. Pengaruh Cara Penangkapan, Fasilitas Penangan Dan Cara Penanganan Ikan Terhadap Kualitas Ikan Yang Dihasilkan. Jurnal IPTEEKS PSP UNHAS. 2014;1(1):45-52.
9. Rully N. Teknik Penanganan Ikan Basah Segar di Kapal, PPI dan Tempat Pengolahan; c2010. https://www.scribd.com/document/343750 30/penanganan-ikan (diakses tanggal 11 Mei 2019).
10. Santhi DGD. Pemeriksaan Organoleptis Dan pH (Keasaman) Sebagai Syarat Mutu Keamanan Ikan Tuna (*Thunnus* Sp). Udayana Denpasar; c2017.
11. Zakaria R. Kemunduran Mutu Ikan Gurami (*Osphronemus gouramy*) Pasca Panen pada Penyimpanan Suhu Chilling. *Skripsi Teknologi Hasil Perikanan.* IPB. Bogor; c2008.