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Study of Freshness of Mackerel (*Rastrelliger kanagurta* (Cuvier, 1816)) at Rancaekek Market, Resik Market, and Tanjungsari Market

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ABSTRACT

This research aims to know the level of freshness of mackerel (*Rastrelliger kanagurta* (Cuvier, 1816)) contained in Rancaekek market, Resik market, and Tanjungsari market. Methods of the research was survey methods and the level of freshness of the sample using organoleptic test. The samples were observed organoleptically including the appearance of the eyes, gill appearance, mucus appearance, meat condition, aroma, and texture. Based on observations on the freshness of mackerel from the parameters of eye appearance, gill appearance, mucus condition, meat condition, aroma, and texture, it can be concluded that the fish marketed by Rancaekek market scored 7.1, which means that it is in the fresh category, fish marketed in the Resik market got a score of 7.4, which means it is in the fresh category, and the fish marketed by the Tanjungsari market gets a score of 6.9, which means that it is within the fresh limit.

Keywords: Freshness, Mackerel, Rancaekek market, Resik market, Tanjungsari market, *Rastrelliger kanagurta*

1. INTRODUCTION

Fish is a very good source of protein, fat, vitamins and minerals. Fish also contain fatty acids, especially Omega 3 fatty acids which are very important for the health and brain

development for its intelligence potential [7]. Some facts show that higher energy (protein) is needed in conditions of higher environmental salinity [14]. The nutritional content of Omega 3 marine fish is more than freshwater fish because it has the ability to increase the work of the brain in regulating the body's osmotic pressure at high salinity in its environment [12].

The nutritional content of Omega 3 and protein is essential for the human body, especially students because the brain's working system will become faster and the body's growth will be maximized. Jatinangor Subdistrict is an area that is mostly inhabited by students, marked by the presence of several universities, secondary schools, junior high schools, elementary schools and kindergartens [3].

Based on observations, there were the Rancaekek market, the Resik market, and the Tanjungsari market which became the center of purchase for food stall entrepreneurs, vegetable traders and other residents in Jatinangor. Mackerel marketed in Rancaekek market, Resik market, and Tanjungsari market are sent from Ciroyom Bandung Market and Caringin Bandung Market. Mackerel in Ciroyom Market is mostly imported from Cirebon and Caringin Market is mostly imported from Indramayu.



Figure 1. *Rastrelliger kanagurta* (Cuvier, 1816)

The distance between Bandung City and Cirebon City is ± 259 km and Indramayu Regency is ± 240 km with a delivery time of $\pm 5 - 7$ hours plus the distance of Bandung City with Jatinangor District ± 17 km and travel time of ± 1 hour. The distance and time are very vulnerable to the level of freshness of fish products that are marketed because the freshness of the fish has a correlation with the distance and time of delivery. The process of change that leads to the damage process in only about 8 hours since the fish is caught and landed [2].

A very important issue for the fisheries industry is maintaining quality [1]. The process of deterioration of quality in fresh fish occurs due to enzyme activity, bacterial activity, and the process of oxidation of body fat by oxygen from the air. Freshness of fish cannot be increased but the process of change can be inhibited so that the freshness of the fish can be maintained longer.

Fresh fish products are sea fish and freshwater fish that have just been caught that have not undergone any changes and also fish that have been preserved by freezing or cooling but still have properties similar to native fish [13]. Fish have several disadvantages including quality and decay, where this happens after the fish is caught which thus needs to be handled quickly, accurately and correctly to maintain its quality before being marketed and reaching the consumers [10].

Handling by traditional market players in bringing fish and selling is an important factor in the survival of the level of freshness of marine fishery products. The research objective was to determine the level of freshness of mackerel (*Rastrelliger kanagurta*) in the traditional markets of Rancaekek market, Resik market, and Tanjungsari market.

2. MATERIALS AND METHODS

The tools used include sterofom plates, knives, tissue, and coolbox. The materials used include mackerel fish from each markets (Rancaekek market, Resik market, and Tanjungsari market) and ice cube. The method used in this research is an survey method by gathering information about the freshness level of mackerel marketed in the Rancaekek market, Resik market, and Tanjungsari market by scoring test of organoleptic characteristics of freshness level determined in Indonesian National Standard [8].

The first stage are collectic test materials. The material test is Mackerel fish obtained from 3 traditional markets, namely Rancaekek market, Resik market, Tanjungsari market. Mackerel is brought 20 fish for each market. The test material was brought in the morning by using the coolbox and given ice cube with a ratio of 1:2 between fish and steamed ice used as cooling media.

The second stage are determination of fish freshness by organoleptic characteristics. This research was conducted by 20 semi-trained panelists with each panelist testing 3 fish from different markets. Parameters in organoleptic characteristics are eyes, gills, body surface mucus, meat condition, aroma, and texture. The panelists will score the organoleptic characteristics on the scoresheet. The more fresh the fish is observed, the higher the score will be. Freshness level determined in Indonesian National Standard is presented in Table 1.

Table 1. The Level of Freshness Fish

Specification	Score
Eyes	
- Convex eyeballs, clear cornea and clear pupils.	9
- Flat eyeball, clear cornea and clear pupil	8
- The eyeball is flat, the pupil is slightly grayish, the cornea is slightly murky.	7
- The eyeball is slightly concave, pupil is slightly grayish, the cornea is slighthy murky.	6
- The eyeball is slightly concave, pupil is grayish, the cornea is slightly cloudy.	5
- Concave eyeball, grayish pupil, murky cornea.	3
- The eyeball is very concave, the pupils are gray, the cornea is very murky.	1

Gill	
- Red gill colour, bright and have very little transparant mucus	9
- Red gill colour, brightless and very little transparant mucus	8
- Pink gill colour with a little slighthy murky mucus	7
- Pink gill colour with slighthy murky mucus	6
- Pale pink gill colour with murky mucus	5
- Gray gill colour with milky white mucus clots	3
- Gray gill colour with brown white mucus clots	1
Body Surface Mucus	
- Clear mucus layer, transparent, bright shiny.	9
- Clear mucus layer, transparent, slightly bright mucus layer.	8
- The mucus layer is slightly murky.	7
- The mucus layer is murky.	6
- Mucus slighthy thick and murky.	5
- Thick mucus slightly clumping and murky.	3
- Thick mucus clots and murky.	1
Meat	
- Meat incision is very clear, there is no reddish along the spine, the stomach wall is strong.	9
- Meat incision is clear, there is no reddish along the spine, the stomach wall is strong.	8
- Meat incision is slightly less clear, there is no reddish along the spine, the wall of the stomach is strong.	7
- Meat incisions are slighthy clear, slightly reddish color along the spine, stomach wall is rather soft.	6
- Meat incisions begin to fade, lots of reddish along the spine, stomach wall is rather soft.	5
- Dull meat incisions, reddish along the spine, soft stomach wall	3
- Very dull meat incisions, reddish along the spine, the stomach wall is very soft.	1
Aroma	
- Very fresh, strong species specific.	9
- Fresh, species specific.	8

- Fresh, less specific spesies	7
- Neutral	6
- A little acid smell.	5
- Strong acid smell.	3
- Strong stench.	1
Tekstur	
- Solid, compact, very elastic	9
- Solid, compact, elastic	8
- A bit soft, slightly elastic	7
- A little soft, a little less elastic	6
- Rather soft, less elastic	5
- Soft fingerprints appear and very slowly disappear	3
- Very soft, finger marks are not lost	1

Source: [8]

Result obtained in the form of values in the scoresheet of organoleptic characteristic of mackerel marketed at Rancaekek market, Resik market, dan Tanjungsari market. The values from scoring test supposed to be primer data. Supporting data were obtained from interviews and direct searches for mackerel handling from the main market to the Rancaekek market, Resik market, Tanjungsari market.

The scoring test data were analysis to know the freshness level of mackerel marketed in the Rancaekek market, Resik market, and Tanjungsari market. The statistics used are using the formula [8] as follows:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}}$$

$$P \left(\bar{x} - \left(1,96 \cdot \frac{s}{\sqrt{n}} \right) \right) \leq \mu \leq \left(\bar{x} + \left(1,96 \cdot \frac{s}{\sqrt{n}} \right) \right) \cong 95\%$$

Information:

P = value interval

\bar{x} = average quality value

x_i = value of quality from panelist to i, where i = 1,2,3 n

- 1,96 = standard deviation coefficient at the level of 95%
- s = standard deviation of quality values
- n = number of panelist

Assessment Criteria [8]:

- Organoleptic values range from 7 - 9 for fresh categories
- Organoleptic values range from 5 - 6 for slightly fresh categories
- Organoleptic values range from 1 - 4 for non-fresh categories

3. RESULT AND DISCUSSION

3. 1. Eye Appearance

The results of organoleptic observations based on the parameters eye appearance of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 2.

Table 2. Average Eye Appearance of Mackarel from Rancaekek Market, Resik Market, Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Eye Appearance	6,45	6,80	5,95

Based on the results of the observations (Table 2) it can be concluded that the level of freshness through the parameters of mackerel eye appearance in Rancaekek market is at a score of 6.45, the Resik market is at a score of 6.80, and the Tanjungsari market is at a score of 5.95. From the average value shows that the organoleptically the eye appearance has changed in the condition of the slightly concave eye, the pupil is slightly grayish, and the cornea is slightly murky.

The low score on the appearance of the eye is probably due to the lack of cleanliness of the container when carrying fish and the poor handling done when the fish are in the market. Changes in the shape of the eye that was originally convex then became concave due to the growth of spoilage bacteria. That one of the consequences of the development of bacteria is that the eyes become submerged and light fade [14]. Trawled fish usually carry microbial loads that are 10-100 times greater than those on line-caught fish [7].

In fresh conditions, fish eyes have a convex shape and clear pupil cornea [14]. The results of organoleptic observations performed showed that the appearance of fish eyes from the three markets was in the score below the fresh score limit or consumer acceptance. There needs to be good handling during the pick-up process and when trading to be able to withstand the growth rate of bacteria in the eye and damage due to physical touch.

3. 2. Gill Appearance

The results of organoleptic observations based on the parameters gill appearance of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 3.

Table 3. Average Gill Appearance of Mackerel from Rancaekek Market, Resik Market, and Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Gill Appearance	7,80	7,85	7,65

Based on the observations (Table 3) shows the gill appearance of mackerel in the Rancaekek market is at a score of 7.80, the Resik market is at a score of 7.85, and the Tanjungsari market is at a score of 7.65. From the average value that exists, it shows that organoleptically the gills have changed and are in the condition of the color of the gills starting to become pink colour and there is a slightly murky mucus.

In fresh conditions, the fish gills are red, clean, and there is very little transparent mucus [14]. Changes occur in the gills which were initially bright red to pink due to myoglobin and hemoglobin to methemoglobin and methemoglobin. The most important microbial species responsible of fish spoilage springs from: environment, gut, gill and skin [11]. It can be said that the color changes in the gills can also occur due to an increase in the number of bacteria [14]. Microbiological determinations in fish need at least 48 hours to obtain reliable results. All the parameters, which capacity to obtains results in less than 24 hours, will help in freshness determination or evaluation of fish. Fish spoilage start when it is captured [11].

3. 3. Body Surface Mucus

The results of organoleptic observations based on the parameters body surface mucus of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 4.

Table 4. Average Body Surface Mucus of Mackerel from Rancaekek Market, Resik Market, and Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Body Surface Mucus	8,25	8,05	7,90

Based on the observations (Table 4) shows the body surface mucus of mackerel in the Rancaekek market was at a score of 8.25, the Resik market was at a score of 8.05, and the Tanjungsari market was at a score of 7.90. From the average value that exists, it shows that organoleptically the mucus is in the condition of mucus that is still transparent and slightly bright.

In fresh conditions, the mucus layer on the fish's body is thin and transparent. Fish mucus is produced by mucus glands found in the epidermis of the skin. The mucus glands produce mucin (glycoprotein) which in living conditions serves to reduce friction, prevent infection, dryness, self-defense, and osmoregulation. This mucus release is called hypermia [13].

3. 4. Meat

The results of organoleptic observations based on the parameters meat condition of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 5.

Table 5. Average Meat condition of Mackarel from Rancaekek Market, Resik Market, and Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Meat Condition	7,35	7,80	7,30

Based on the observations (Table 5) shows the meat condition of mackerel meat in the Rancaekek market is at a score of 7.35, the Resik market is at a score of 7.80, and the Tanjungsari market is at a score of 7.30. From the average value, it was shown that organoleptically the meat condition of the fish was slightly less clear meat incision, there is no reddish along the spine, and the wall of the stomach is strong.

Reddish along the spine is the red muscle of the fish. Red muscle is characterized by high myoglobin content and also the specific protein properties of its constituents. As the quality of the fish decreases, the red muscle of the fish will appear out. Changes that occur in fish meat are caused by the fish's blood to be oxidized faster, forming red spots, especially in the upper back near the head [5].

The presence of blood in fish meat can accelerate the decay process, because blood is a good place for bacterial growth. Fish blood is faster to clot than other land animals. This often causes problems if a lot of blood sticks to the surface of the fish's body because it can cause unpleasant appearance. The appearance of stains is red as a result of the oxidation of hemoglobin by oxygen from the air to methemoglobin. Such variations in the conditions after death affect the process of the muscle rigor [5].

Water loss from fish muscles is the same as that of mammalian skeletal muscles. When post mortem, the pH in fish never drops below 6 as it occurs in halibut and mackerel due to a decrease in post-rigor inhibition. The fall in pH in fish causes fish meat to turn pale, soft, and

runny [1]. Structural proteins and lipids are constituents of fish and shellfish muscles, and they denature as muscle deterioration. Generally, when protein denatures, solubility and functionality change [5].

3. 5. Aroma

The results of organoleptic observations based on the parameters aroma of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 6.

Table 6. Average Aroma of Mackerel from Rancaekek Market, Resik Market, and Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Aroma	7,70	7,65	7,50

Based on the observations (Table 6) shows the aroma of mackerel in Rancaekek market is at a score of 7.70, the Resik market is at a score of 7.65, and the Tanjungsari market is at a score of 7.50. From the average value that exists shows that organoleptically the smell of fish in specific smell conditions has begun to disappear. The change in aroma will continue until the rotten fish is characterized by strong rancid and sour or fishy smell. This change occurs due to oxidation of fat which causes an unwanted rancid odor [14].

Change in aroma come from the body of the fish itself or because of the influence of the surroundings. Changes in the smell of fish are caused by the alteration of proteins by enzymes into free peptides and amino acids. In fresh conditions, the smell of fresh fish is species specific, then develops into the loss of a distinctive odor and a fishy odor arises due to the formation of trimethyl amine and histamine [5].

3. 6. Tekstur

The results of organoleptic observations based on the parameters tekstur of mackerel from Rancaekek market, Resik market, and Tanjungsari market are presented in Table 7.

Table 7. Average Tekstur of Mackerel from Rancaekek Market, Resik Market, and Tanjungsari Market

	Rancaekek Market	Resik Market	Tanjungsari Market
Average Tekstur	7,65	7,80	7,85

Based on the observations (Table 7) shows the mackerel texture in the Rancaekek market is at a score of 7.65, the Resik market is at a score of 7.80, and the Tanjungsari market is at a score of 7.85. From the average value that exists, it shows that organoleptically the fish meat is in a rather soft and slightly inelastic condition.

In fresh conditions, the texture found in fish is solid and very elastic. The texture of the fish will continue to decline until the rotten conditions are characterized by soft flesh and are no longer elastic. Changes in fish texture are caused by changes in meat muscle tissue due to enzymes in the fish's body and microbial enzyme activity that remodel the structure of fish meat [4].

As glycolytic activity slows down, ATP concentration decreases, mainly due to the continuing action of various ATPases in the membrane systems, with most of the nucleotide depleted in 24 hours or less [7]. Both ATP and ADP act as plasticizers for actin and myosin, thus preventing their interaction and keeping the muscle in a state of relaxation [7]. Under normal conditions or relax actin and myosin are in position, but when contracting actin and myosin turn into actinmyosin. Energy is needed to maintain actin and myosin remains separate. Energy requirements in the form of ATP can be obtained through the alteration of glycogen in the muscle through aerobic glycolysis [5]. Glycogen solution can produce lactic acid which will increase meat acidity [1]. This change causes the body's pH to decrease and is followed by a decrease in the amount of adenisine triphosphate (ATP) which results in the inability of muscle tissue to maintain its flexibility [9].

3. 7. Freshness Level Mackerel (*Rastrelliger kanagurta*) Marketed by Rancaekek Market

The level of freshness of mackerel was identified using an organoleptic characteristics by 20 rather trained panelists and determined the quality value by looking for the average results on each panelist at a 95% confidence level. The results of organoleptic testing of mackerel from the Rancaekek market are presented in Table 8.

Table 8. Freshness Level of Mackerel in Rancaekek Market

Parameter	Average
Eye	6,45
Gill	7,80
Body Surface Mucus	8,25
Meat	7,35
Aroma	7,70
Tekstur	7,65
Overall Quality Score	7,1

Information: The quality value is calculated using the average results for each panelist at a 95% confidence level

From the average value shown (Table 8) that organoleptically has changed and is in the condition of the eye that has slightly concave shape, the pupil is rather grayish, and the cornea is slightly cloudy. The gill condition has changed and is in a state where the gill color is pink and there is a rather cloudy mucus. The condition of the mucus is in the condition of the mucus which becomes murky and no longer transparent. The condition of the meat incision is less clear, slightly reddening color along the spine, and the abdominal wall is rather soft. The condition of the specific odor of the type has begun to disappear and the state of the meat is rather soft and slightly inelastic. Based on the observations (Table 8) shows the organoleptic value of mackerel in the Rancaekek market was at a score of 7.1. From the existing quality values it can be said that mackerel marketed in the Rancaekek market is at the limit of fresh conditions and limits on consumer acceptance in buying fish.

3. 8. Freshness Level Mackerel (*Rastrelliger kanagurta*) Marketed by Resik Market

The level of freshness of mackerel was identified using an organoleptic characteristics by 20 rather trained panelists and determined the quality value by looking for the average results on each panelist at a 95% confidence level. The results of organoleptic testing of mackerel from the Resik market are presented in Table 9.

Table 9. Freshness Level of Mackerel in Resik Market

Parameter	Average
Eye	6,8
Gill	7,8
Body Surface Mucus	8,0
Meat	7,8
Aroma	7,6
Tekstur	7,8
Overall Quality Score	7,4

Information: The quality value is calculated using the average results for each panelist at a 95% confidence level

From the average values shown (Table 9) that organoleptically has changed and is in the condition of the eyes that have become flat, the pupil is rather grayish, the cornea is rather murky. Pink colour gill condition with slightly murky mucus accompanied by a slightly murky mucus condition. The condition of the meat incision is slightly unclear, there is no reddish along the spine, the stomach wall is strong. Specific odor conditions of the type have begun to decrease and the state of the meat is rather soft and somewhat elastic.

Based on the observations (Table 9) shows the organoleptic characteristics value of mackerel in the Resik market was at a score of 7.4. From the existing quality values it can be

said that mackerel marketed in the Resik market is at the limit of fresh conditions and limits on consumer acceptance in buying fish. This condition is better compared to other markets, perhaps because the handling is done quickly and avoid the heat of the motorcycle engine because it uses the box in transport from the Caringin market to Jatinangor.

3. 9. Freshness Level Mackerel (*Rastrelliger kanagurta*) Marketed by Tanjungsari Market

The level of freshness of mackerel was identified using an organoleptic characteristics by 20 rather trained panelists and determined the quality value by looking for the average results on each panelist at a 95% confidence level. The results of organoleptic testing of mackerel from the Resik market are presented in Table 10.

Table 10. Freshness Level of Mackerel in Tanjungsari Market

Parameter	Average
Eye	5,9
Gill	7,6
Body Surface Mucus	7,9
Meat	7,3
Aroma	7,5
Tekstur	7,8
Overall Quality Score	6,9

Information: The quality value is calculated using the average results for each panelist at a 95% confidence level

From the average value shown (Table 10) that organoleptically has changed and is in the condition of the eye that has been slightly concave, the pupil is somewhat grayish, and the cornea is slightly murky. Pink colour gill condition with slightly murky mucus accompanied by a slightly murky mucus condition. The condition of the mucus is murky and no longer transparent. The condition of the meat incision is less clear, slightly reddish color along the spine, and the abdominal wall is rather soft. The condition of the specific odor of the type has begun to disappear and the state of the meat is rather soft and slightly inelastic.

Based on observations (Table 10) shows the organoleptic value of mackerel in the Tanjungsari market was at a score of 6.9. From the existing quality values it can be said that mackerel marketed in the Tanjungsari market is just below the threshold of fresh conditions and the limit of consumer acceptance in buying fish. This condition may be caused by the lack of handling carried out when taking fish, the heat generated from public transport machinery makes the temperature of the fish rise and makes the enzymatic and microbial processes fast in decreasing the quality of freshness of the fish.

4. CONCLUSION

Based on the results of this research shows that the freshness of mackerel (*Rastrelliger kanagurta*) marketed in the Rancaekek market gets a score of 7.1, the Resik market scores 7.4, and the Tanjungsari market gets a score of 6.9. The scores obtained in Resik and Tanjungsari markets are above the fresh condition score and above the consumer acceptance limit, while the scores obtained by the Tanjungsari market are at the limits of fresh conditions and the limits of consumer acceptance. Lack of handling given when taking stock and serving when selling causes the value obtained is at the limit of fresh conditions for the Resik market, Rancaekek market, and Tanjungsari market.

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