Melanosis Rate of Vannamei Shrimp (*Litopenaeus vannamei*) Stored at Room Temperature Harvested from Intensive and Traditional Ponds in Serang, Banten Province

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Abstract. *This research aims to differentiate melanosis rate of vannamei shrimp (Litopenaeus vannamei) stored at room temperature harvested from intensive and traditional ponds. Fresh vannamei used as sample harvested from an intensive and traditional ponds in Serang. This Research carried out for 10 hours at room temperature using randomized block design method with treatment duration of 0, 2, 4, 6, 8 and 10 hours in cold box to differentiate melanosis level of freshly harvested vannamei. Data were analyzed using ANOVA test, for data with significant differences, followed by HSD test. Melanosis test were performed using melanosis score sheet tested by 12 standard panelists, whereas for test of freshness, it analyzed using pH and TVB test. Observations during the study, as well as the results of the analysis showed that different storage time treatment produced significant differences. Melanosis starts after 4 hours in storage for shrimp harvested from intensive ponds, whereas shrimp harvested from traditional ponds starts after 6 hours. The result of freshness from intensive and traditional ponds showed pH 8.61 and 7.2, while TVB showed 32.96 mgN/g and 25.5 mgN/g, respectively. Suggesting that the melanosis rate in shrimp harvested from intensive ponds is faster compared to the traditional one.*

Keywords: *Rate of melanosis, vannamei shrimp, intensive ponds, traditional ponds*

1. INTRODUCTION

Shrimps are known as food source containing remarkably high protein and water content in perishable commodities category. Due to these attributes, the market always demands shrimp to be fresh and above the minimum export quality standards, however this is difficult to fulfill (Nirmal & Benjakul 2009). Freshness is the main indicator of shrimp quality, as it can be seen from the physical appearance such as color, texture, and odor. Shrimp quality can deteriorate due to internal or even external factors, such as poor handling in the distribution chain (Erick 2012)

Internal factor that can reduce the quality of shrimps are enzymatic oxidation reactions, which promote formation of melanosis. Shrimp cephalothorax is known to contain high polyphenol oxidase and tyrosinase enzymes, the latter being able to oxidize tyrosine amino acids into quinones which have reactive properties and forming black melanin macromolecules known as blackspot, if the enzyme is active at its optimum conditions, e.g., pH 6 and 45°C (Giménez *et al.,* 2010). Blackspot formation in shrimp is an example of color deformation caused by the activity of the polyphenol oxidase (PPO) enzyme (Martinez & Whitaker 1995). Activity of the PPO enzyme reaches maximum at pH 6, above that, melanosis begins to form (Perceka *et al.* 2014)

Melanosis begins to form in cold temperatures a few hours after harvest, this caused by the reaction of the polyphenol oxidase enzyme which oxidizes phenol (Nirmal & Benjakul 2012) or/and tyrosinase enzyme which oxidizes the tyrosine amino acid into quinones. Quinones polymerization produces a black pigment, which is not harmful to human health, but affecting its appearance and thus loses its market value (Montero *et al.,* 2001).

Melanosis formation or blackspot in shrimp and crab during postmortem storage, severely damaging market value and causing economic loss. (Fang *et al*., 2013) stated that melanosis is a process that is triggered by a biochemical mechanism due to the oxidation of phenols to quinones through an enzyme complex called polyphenol oxidase, followed by nonenzymatic polymerization which forms heavy and very dark pigment compounds. According to (Montero *et al.,* 2001), polyphenol oxidase in tiger shrimp has different effect at different locations.

One of the most important aspects of microbial growth are pH value during storage time (Sipatuhar *et al.,* 2021). This is an important index to determine seafood qualities. The main reason for spoilage in seafood is due to the growth of microorganisms leading to unwanted tastes and odors, which can be tested using total volatile base nitrogen (TVB-N) test as an indicator of freshness

Melanosis is one that causing the formation of black color, which become the main consideration for consumers in refusing fresh shrimp (Senapati *et al.,* 2017). White leg shrimp (*Litopenaeus vannamei*) is one of the most important exports among shrimp, the unfavorable discoloration associated with melanosis at its surface and changes in freshness of quality over time are of particular concern.

Research on the melanosis rate in vannamei shrimp stored at room temperature was carried out in order to be used as a reference for all parties involved e.g., merchant, consumers, in conducting cultivation, processing, and consumption. This research aims to determine the melanosis rate of vannamei shrimp at room temperature storage from 0 to 10 hours harvested from intensive and traditional ponds.

2. RESEARCH METHODS

The research was conducted from February 2023 to May 2023 in intensive and traditional ponds in Pontang Serang, Banten Province. The material used is vannamei shrimp (*Litopenaeus vannamei)* weighing 18g $\pm$ 2g harvested from intensive ponds at the BAPPL-STP Serang and traditional ponds in Pontang Serang.

Research Method

Vannamei shrimp samples were harvested from intensive and traditional ponds with harvest age around 90 days and amount per kilogram of 50-60 shrimps. Then cool it quickly, by storing it in a cool box containing ice cubes. The vannamei shrimp taken as samples have an intact condition by having a clean and clear appearance, sturdy inter-segments, intact body organs and fulfill the organoleptic quality requirements according to SNI 01-2346-2006. After that, shrimp sample is washed, collected into polyethylene plastic, and stored in a cool box with 2:1 ratio of ice and shrimp weight. The bottom of the cool box is coated with ice, then the shrimp that have been put in plastic on top of it, and closed with a layer of ice. Vannamei shrimp were stored at room temperature and tested with a span of 0, 2, 4, 6, 8 and 10 hours. The test was carried out using parameters test for melanosis, organoleptic, pH and TVB-N.

Data Analysis

The experiment carried out using randomized block design (RBD) with pond type and storage time as variables. Variables of pond type are intensive pond and traditional one, while the variables of storage time are 0, 2, 4, 6, 8 and 10 hours. Melanosis test was performed by 12 standard panelists to determine the level of melanosis more accurately. Data Obtained from the test results for melanosis, pH and TVB were analyzed by ANOVA test, with 95 % confidence level ($p<0,05$). If ANOVA results have significant differences, analysis continued using HSD test. For organoleptic results, data were analyzed using Kruskal-Wallis followed by multiple comparison

Melanosis Test

Melanosis test was carried out by 12 panelists through visual observation from 0th hour, and every 2-hour interval to the 10th hour. Melanosis assessment methods used the research method conducted by Montero (Montero *et al.*, 2001). This method used by panelists to assess how much melanosis has formed in shrimp by comparing the sample with images of shrimp that have been given numbers and descriptions. Shrimp samples were placed on trays and examined by 12 panelists and used a ten-point melanosis assessment, which are:

0 : 0 % melanosis growth
2 : 20 % melanosis covering shrimp body
4 : 20 % to 40 % melanosis covering shrimp body
6 : 40 % to 60 % melanosis covering shrimp body
8 : 60 % to 80 % melanosis covering shrimp body
10 : 80 % to 100 % melanosis covering shrimp body

Organoleptic Test

Organoleptic test was carried out using fresh shrimp scoresheet according to SNI 01-2728.1-2006 criteria regarding to Fresh Shrimp Specifications 1. Vannamei shrimp were placed on trays and tested by 30 semi-trained panelists (BSN 2006).

TVB-N Test

The principle of TVB-N test based on the increase of volatile base compounds as a result of protein degradation with boric acid which is then titrated using HCl. TVB-N test was carried out using the Conway method based on the procedures listed in SNI 2354.8-2009 (BSN 2009).

pH Test

The pH test is carried out based on the procedures listed in SNI 06.6989.11-2004, using a pH meter that is calibrated with a pH 4 buffer solution in advance, as per every measurement (BSN 2004)

3. RESULTS AND DISCUSSION

Melanosis Test

The deterioration of the shrimp quality is closely related to the appearance of the black color found in the shrimp carapace. The formation of color can be affected by enzymatic and non-enzymatic reactions. Melanosis rate in shrimp strongly influenced by high concentration of tyrosine substrate in shrimp chitin shells, oxygen, and tyrosinase enzyme. The oxidative enzyme tyrosine will be converted into black melanin which covering almost the entire surface of the shrimp skin (Haard & Simpson 2000).

a. b. c. d. f.

Figure 1. Level of melanosis from (a) 0 %, (b) 20 %, (c) 40 %, (d) 60 % to (e) 80 % in vannamei shrimp.

The melanosis test results for storage treatment after 10 hours at room temperature between vannamei shrimp harvested from intensive and traditional pond showed that changes in melanosis levels had almost the same degradation pattern at different rate. The average melanosis test results for intensive pond samples and traditional one for room temperature can be seen in Figure 2.

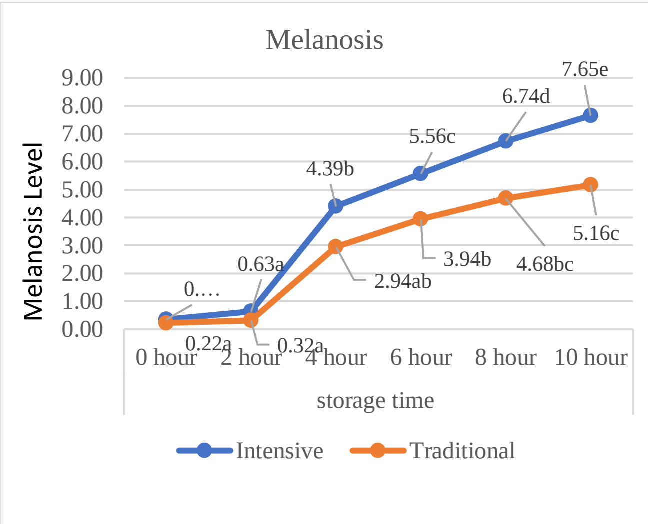

Figure 2. Melanosis level for vannamei shrimp at room temperature storage (28 °C ± 0,5 °C).
Note: Different letters indicating differences significant ($p < 0.05$).

Figure 2 shows that melanosis levels for vannamei shrimp from intensive and traditional ponds after 10 hours of storage at room temperature (28 °C ± 0.5 °C) are 6.98 and 5.16. Which means, shrimp from intensive pond having more melanosis during 10 hours of storage at room temperature compared to shrimp from traditional ponds.

ANOVA test results for melanosis at room temperature showed melanosis level for vannamei shrimp from intensive pond was not significantly different from traditional pond. However, there was a significant difference between the different storage time treatments ($p < 0.05$). Subsequent test results showed that a significant difference began to occur after 6 hours of storage at room temperature, with a specification of 40% to 60% melanosis covering the shrimp body. The shelf life of 0 to 4 hours provides a specification of 20% to 40% melanosis covering the shrimp body. Therefore, both vannamei shrimp from intensive ponds and traditional ponds cannot be stored for more than 6 hours at room temperature because the growth of melanosis has reached 60%

Montero *et al.*, (2001) defines melanosis as a process caused by biochemical reaction due to the oxidation of phenols to quinones through an enzyme complex called polyphenol oxidase. This reaction is followed by nonenzymatic polymerization of quinone, which forms heavy and very dark pigment compounds. Melanosis or blackspot in shrimp is a natural postmortem mechanism that involves complex enzymatic reactions, i.e., polyphenol oxidase (PPO), in which oxygen, oxidizing peptides, and phenolic amino acids are present. The polymerization of the color will form a high molecular black pigment (Mcevily *et al*., 1990). Melanosis growth highly dependent on species variant, changes in physiological susceptibility cycle, type of substance that prevents melanosis growth, concentration and employed application method (Gómez-Guillén *et al.*, 1990)

Presence of melanosis in shrimp occurs mostly on head area because of their digestion process occurs in the head of the shrimp (Sipatuhar *et al.*, 2020) According to (Farchan 2007), in cephalothorax (shrimp head) there is jaw (mandible) which functions as tool to destroying food, where most of bacteria, around 80 % originate from shrimp head. Beside this function, shrimp head also containing enzyme that will deteriorate its body itself after death.

Organoleptic Test at Room Temperature

The freshness value of shrimp was tested organoleptically, including observations of appearance, odor, and texture. Organoleptic test results at room temperature for intensive and traditional pond can be seen in the Table 1.

Table 1. Organoleptic test results of Vannamei shrimp at room temperature storage (28 °C)

Pond Type	Parameters	Storage Time (Hours)					
		0	2	4	6	8	10
Intensive	Appearance	8.47± 0.2e	7.9 ± 0.16e	7.6 ± 0.4d	7 ± 0.4c	6.3 ± 0.15b	5.5 ± 0.18a
	Odour	8,02 ± 0.2f	7.6 ± 0.4e	7.1 ± 0.09d	6.6 ± 0.2c	6.2 ± 0.02b	5.6 ± 0.15a
	Texture	8.3 ± 0.4d	7.9 ± 0.14cd	7.7 ± 0.2c	6.7 ± 0.4b	6.4 ± 0.38b	5.9 ± 0.4a
Traditional	Appearance	8.3 ± 0.12e	8.2 ± 0.2e	7.5 ± 0.4d	7.3 ± 0.5c	6.5 ± 0.9b	5.2 ± 0.7a
	Odour	8.3 ± 0.31f	8.1 ± 0.12e	7.6 ± 0.1d	7.3 ± 0.3c	6.6 ± 0.9b	6.05 ± 0.9a
	Texture	8.17 ± 0.2d	7.5 ± 0.2cd	7.14 ± 0.2c	6.6 ± 1.0b	6.0 ± 0.9b	4.9 ± 0.4a

Note: Organoleptic values were calculated based on mean (mean ± SD), mean of the columns and rows with different letters indicated significant differences ($p < 0.05$)

Apperance

Appearance is the first characteristic that can be assessed by panelist (DeMan 2010). This appearance evaluation aims to find out panelist acceptance, which is assessed from surface appearance, integrity, neatness, and color of shrimp

Analysis of *Kruskall Wallis* shows the appearance value of shrimp in intensive shrimp ponds and traditional ponds at confidence level of $p < 0.05$. Further testing shows the appearance of intensive pond shrimp and traditional ponds does not have significant effect on storage at 0 to 2 hours, but have significant effect on the confidence level of $p < 0.05$ at 4, 6, 8 and 10 storage hours. The vannamei shrimp at room temperature from intensive pond began to become unacceptable after 6 hour with a value of 6.8. Shrimp from traditional ponds began to become unacceptable after the shrimp had been stored for 10 hours with a value of 6.2. This shows that shrimp from intensive ponds decline in quality faster than shrimp from traditional ponds. Shrimp specifications are intact, missing transparent, pale, slightly pink in color, small black spots, less sturdy between segments and more and more spread of melanosis. The minimum threshold for fresh shrimp fit for consumption is 7 (Murniyati & Sunarman 2011).

The appearance value on shrimp freshness is related to the formation of color on the shrimp body which is the result of biochemical reactions such as lipid oxidation, resulting in yellowish discoloration and the formation of melanosis. This enigmatic reaction will continue even if the shrimp is stored at a cold temperature of -15ºC to -5ºC (Tsironi *et al.* 2009). Changes in food color are one of the parameters for deteriorating quality, as shrimp will change color during storage from red to pale, caused by astaxanthin oxidation. Red pigment to produce a red color which is characteristic of astaxanthin, disappears (Niamnuy *et al.*, 2008)..

Odors

Odor or aroma is a parameter that affects the quality of a processed product. The aroma or smell of food can determine the delicacy of these foods (DeMan 2010). In general, the odor received by the nose and brain is a combination of four main odors, namely fragrant, sour, rancid, and scorched (Farber 2005).

Analysis of *Kruskall Wallis* shows the odor value of shrimp in intensive shrimp ponds and traditional ponds at a confidence level of 0.05, a significant effect between pond types and storage time. Further testing showed that the odor value of intensive pond shrimp and traditional ponds did not have a significant effect on storage at 0 to 2 hours, but had a significant effect on the confidence level of 0.05 at 4, 6, 8 and 10 storage hours. Vannamei shrimp at room temperature from intensive ponds showed an unacceptable after 6 hours of storage with an organoleptic mean of 6.6, while traditional ponds began to be unacceptable after 10 hours with an organoleptic value of 6.1. The specification is shrimp having ammonia smell. This shows that shrimp from intensive ponds decline in quality faster than shrimp from traditional ponds

This indicates that vannamei from intensive pond produce unpleasant odor faster than traditional pond, where bad odors is an attribute of deteriorating quality of shrimp product resulting from protein conversion into free volatile compounds by microbes (Herliany *et al.*, 2013). Longer storage time resulting in higher TVB-N content and lower organoleptic value of the odor specification. The longer storage time will increase TVB which evaporates the volatile compounds formed due to the amino acid found in shrimp meat, so that the odor organoleptic value decrease (Sipatuhar *et al.*, 2020)

Unpleasant odor in shrimp products are the results of the formation of amine compounds (TMA), sulfides, alcohol, ketones, aldehydes and organic acids by microbes (Gram *et al.*, 2002). Some microbe which can be found in shrimp are *Carnobacterium* species *(C. divergen, C. maltaromaticum* and strains resembling *C. alterfunditum*), *Brochotrhix thermosphacta* and *Serratia liquefaciens* (Jaffrès *et al.*, 2011). *C. divergen* is decomposer bacteria that produces light/mild unpleasant odor which is described as boiling milk, fermentation, or/and stale cheese smell.

Texture

The texture is one of the factors that determine the acceptance of a product. The purpose of texture evaluation is to find out the panelist's acceptance of the level of elasticity of a product that can be assessed using the sense of touch, which is through excitatory touch (Muchtadi 2013).

Analysis of *Kruskall Wallis* shows the texture value of shrimp in intensive shrimp and traditional ponds at a confidence level of $p < 0.05$, a significant effect between types of ponds and storage time. Further testing shows the texture value of intensive pond shrimp and traditional ponds does not have a significant effect on storage at 0 to 2 hours, but has a significant effect on the confidence level of $p<0.05$ at 4, 6, 8 and 10 storage hours. Vannamei shrimp at room temperature from intensive ponds showed unacceptable after 6 hours of storage with an organoleptic average value of 6.7, while traditional ponds began to be unacceptable after 10 hours with an organoleptic value of 6.1 Specifications of shrimp texture changes, namely, texture become less elastic, compact, and soft. Texture changes in the of shrimp are produced by decomposer enzymes and microbes.

Texture changes in shrimp are produced by enzymes and decomposer microbes. It is also indicating deterioration in quality, it can be seen from texture becoming soft and crumbles, due to growth of decomposer microbes, where as shrimp with good quality have texture that is elastic, dense and compact as if it was just harvested (Herliany *et al.*, 2013). According to Sipatuhar *et al.*, (2020) Shrimp that are stored for a long time will experience a decrease in their organoleptic value due to the process of breaking down complex compounds into simple compounds by bacteria and uncontrolled enzyme activity which affects the texture of the shrimp. Changes in the quality of the organoleptic texture due to the activity of enzymes such as protease enzymes cause softening, so that the texture of shrimp becomes soft (Lougoss & Kirnana 2005)

Organoleptic test results for 10 hour storage treatment at room temperature between intensive and traditional pond as a whole show that changes in organoleptic values had a similar pattern of organoleptic value reduction, with almost the same rate. Shrimp observed from intensive and traditional ponds are still considered to have characteristic of fresh shrimp (organoleptic value of 7 to 9) up to the 6 hours of storage. After 10 hours of storage, it is categorized as medium quality (organoleptic value of 4.5 to 6). According to research by Karmila *et al.*, (2016) about organoleptic value of fresh giant prawns stored at room temperature, it shows that giant prawns (*Macrobrachium rosenbergii*) were observed until the 12 hour of observation after it died, they were categorized as medium quality (organoleptic value of 4.5 to 6).

The organoleptic test results at 10 hours of storage at room temperature, between intensive ponds and traditional ponds, show that organoleptic changes, namely appearance, odor, and texture, have the same quality degradation pattern. The deterioration of the quality of vannamei shrimp at storage at 10 hours, shows that shrimp from intensive ponds will decline faster in quality of shrimp from traditional ponds

Shrimp Freshness Parameter

Ph (Power of Hydrogen)

The determination of pH value is one indicator of the measurement of the freshness of fish or shrimp. The pH value of fish meat while still alive generally has a neutral pH and after death pH becomes decreased (Suwetja 2013). The results of testing the pH of vannamei shrimp from intensive and traditional ponds stored at room temperature 28 °C can be seen in Figure 3 below.

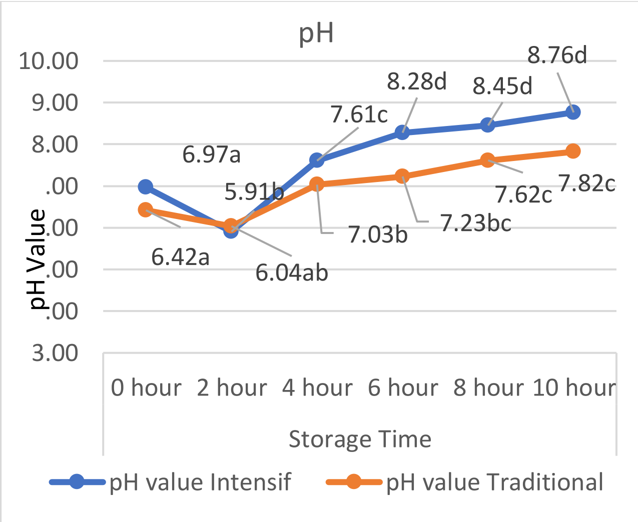

Figure 3. pH value of vannamei shrimp at room temperature storage (28°C ± 0,5°C).

The pH test results of vannamei shrimp in Figure 3. show that shrimp from intensive ponds have a pH range of 6.97 to 8.76, while shrimp from traditional ponds have a pH range of 6.82 to 7.82. In this study, the degree of acidity (pH) of shrimp at 0 hour in intensive pond shrimp is 6.97 and decreased at 2 hour to 5.91. In traditional shrimp ponds at 0 hour is 6.82, decreasing at 2 hour to 6.04. Furthermore, the pH of shrimp has increased at 4 hour until the end of storage at 10-hour. The increase in the pH value of intensive pond shrimp is 8.76 compared to the pH value of traditional pond shrimp which is 7.82. The decrease in pH at the 2-hour was due to the shrimp experiencing a decrease from the pre-rigor phase to the rigor phase, then the pH value would increase again entering the deterioration period.

ANOVA analysis results showed that intensive shrimp ponds and traditional ponds at a confidence level of $p<0.05$ had a significant effect on the pH value during storage at room temperature 28 °C. The test results further showed that a significant difference began to occur after 2 hours of treatment at room temperature, namely the pH increased until the end of storage at 10 hours.

According to Azizah (2015), changes in pH value occur due to the autolysis process. According to Liviawaty & Afrianto (2014) when the fish die, the pH of the fish is around 6.8 to neutral, after that, glycogen which produces lactic acid which will increase the acidity of the meat resulting in a decrease in the pH of the meat. The results of Masengi *et al.,* (2021) the analysis also showed that all fish treated in the prerigor phase with storage from day 0 to day 6 experienced a decrease in pH. The decrease in pH value is caused by more lactic acid being formed and a decrease in ATP.

According to Irianto & Giyatmi (2015) live fish that have a meat pH value of around 7.0, will dropping to a pH around 5.8 to 6.2. According to Sipatuhar *et al.*, (2021) the pH range shrimp on day 0 is 6,43 nd increaseuntil day 5 is 7,21. With a decrease in pH, the enzymes in muscle tissue whose activity takes place at low pH become active. Katepsin, which is a proteolytic enzyme that functions to break down proteins into simple compounds, the protein network structure becomes looser, resulting in a slightly soft fish meat. This phase of tissue breakdown by enzymes in the fish body is called autolysis.

Karmila *et al.,* (2016) tested the pH of fresh giant prawns stored at room temperature showing a pH range of 6.87 at 0 hours to 7.6 at 12 hours. Research by Sipatuhar *et al.*, (2019) on whiteleg shrimp state that the longer storage time contributing higher pH value to shrimp, which also in line to decrease in the organoleptic value. This increase in pH value is thought to be caused by prescription amines by decarboxylated amino acids. The results of research conducted on vannamei shrimp are in accordance with the explanation from Leitão & Rios (2000). That is, longer storage time, will make pH value increases along with the decreasing phase of shrimp quality. This is due to the rapid metabolic enzyme reactions in shrimp and the glycogen content in meat due to the death process.

Storage time is directly proportional to the high pH value of shrimp, the standard pH value for fresh shrimp is 7 to 8. Glycogen content in shrimp meat greatly affects the pH value at the beginning of the quality decline. The condition of the shrimp at death determines the accumulation of lactic acid in shrimp meat, the more lactic acid content in the meat means that the pH value decreases and encourages the occurrence of metabolic enzymes (Suwetja 2011). Therefore, vannamei shrimp must be given a rapid cooling treatment, because the storage at room temperature which encourages the enzyme to start reacting which will result in the formation of ammonia, TMA and their derivatives which are linearly correlated with pH and TVB-N values[9].

The results of the pH test for 10 hours of storage treatment at room temperature, between intensive ponds and traditional ponds as a whole show that changes in pH value have the same pattern. The deterioration of the quality of vannamei shrimp at storage at 10 hours, shows that shrimp from intensive ponds decline in quality faster than shrimp from traditional ponds.

TVB-N Test

TVB-N testing is used to determine the freshness quality of shrimp, chemically, by evaporating the compounds formed from the breakdown of amino acids found in fish meat (Suwetja 2013). TVB-N test results from intensive and traditional pond stored at room temperature storage can be seen at Figure 4 below.

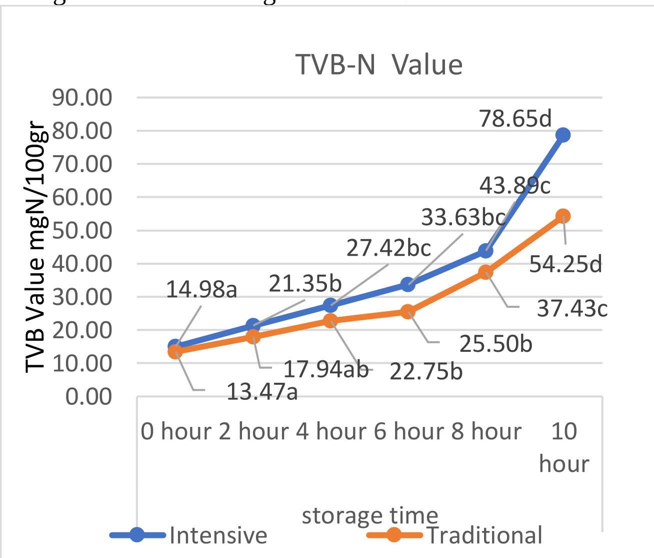

Figure 4. TVB-N value for vannamei shrimp at room temperature storage (28°C $\pm$ 0,5°C).

The results of the TVB-N test for vannamei shrimp in Figure 4, showed that the TVB-N levels of vannamei shrimp in intensive ponds at 0 hours were 14.98 mgN/100 g and at 2, 4, 6, 8 and 10 hours increased to 78.65, TVB-N levels in traditional pond shrimp at 0 hour were 13.47 mgN/100 g, and at 2, 4, 6, 8 and 10 hours increased to 54.25. The results of TVB-N levels from intensive ponds began to be unacceptable at 6 hours with a value of 33.63 mgN/100 g. TVB-N levels from traditional ponds began to become unacceptable at 8 hours with a value of 37.43 mgN/100g. According to [39], freshness of fish based on the level of TVB-N that is suitable for consumption is $20 \leq TVB \leq 30$ mgN/100 g. Fish is considered rotten when it has TVB levels > 30 mgN/100 grams. The unit of TVB-N level is mgN/100 g, which is the number of nitrogenous alkaline compounds that evaporate per 100 g of fish meat.

ANOVA analysis results showed that intensive shrimp ponds and traditional ponds at confidence level of 0.05 had a significant effect on TVB-N levels during room temperature storage at 28°C ($p < 0.05$). The results of further testing showed that a significant difference began to occur after 2 hours of treatment at room temperature, namely the TVB-N levels increased until the end of storage at 10 hours. The longer the shrimp storage process, the higher the TVB-N content.

The analysis results of TVB-N levels from intensive ponds and from traditional ponds, shows that longer storage time giving higher TVB-N content. This indicates that vannamei shrimp from both ponds should be cold processed immediately and cannot be stored at room temperature for more than 6 hours, because the TVB-N value will increase during storage (Sipatuhar *et al.,* 2019) TVB-N levels indicate freshness, for fresh fish with an organoleptic value of 9, the TVB-N value was <10 mgN/100 g.

According to Utari (2014) increase in TVB-N value might be caused by autolysis activity or/and decomposing bacteria activity during the storage process. In the enzymatic process, protein will be broken down into simpler compounds, such as peptides, amino acids, and ammonia. TVB-N is a compound formed by the decomposition of proteins into simple compounds e.g., ammonia, TMA, and DMA. This TVB-N value will increase along with storage time due to the degradation enzymes in shrimp body to produce simple compounds which are components of volatile base compounds (Siddiqui *et al.*, 2011). Besides aforementioned research Gokoglu & Yerlikaya (2008) states that the increase in TVB-N value was caused by autolysis and decomposing bacteria activity during storage process. In the enzymatic process, protein will be broken down into simpler compounds, such as peptides, amino acids, and ammonia.

According to Azizah (2015), this TVB value will increase as per increasing storage time due to enzyme degradation in the shrimp body, resulting in simple compounds which are components of volatile bases. According to Karungi *et al.*, (2004), the increase in TVB value during storage is due to the degradation of proteins and their derivatives of a number of volatile bases such as ammonia, histamine, H2S, and trimethyl amines which are mutually rotting. The TVB value obtained from the research results shows that the shrimp at the beginning of storage are still very fresh, the longer the shrimp storage process, the higher the content of the TVB shrimp

The results of the TVB-N test for 10 hours of storage treatment at room temperature, between intensive ponds and traditional ponds as a whole showed that the increase in TVB-N levels had the same pattern of improvement. The deterioration of the quality of vannamei shrimp at storage at 10 hours, showed that the TVB-N content of shrimp from intensive ponds increased faster than shrimp from traditional.

4. CONCLUSION

The results showed that melanosis began to grow at the 6 hours for intensive pond shrimp, and at 10 hours for traditional pond shrimp. The decline in quality of shrimp from intensive ponds is faster than from traditional ponds. This can be seen from the rate of melanosis formation, pH and TVB-N.

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