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Color Change of Red Dragon Skin Anthocyanin Extract Biosensor for Freshness Application of Gurame Fish (Osphronemus Goramy)

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A B S T R A C T

Freshness of gourami fish is essential in determining the quality of fishery products because fish in fresh conditions will have good quality, so they are safe for consumption. Innovative packaging allows real-time fish freshness monitoring through color changes on the biosensor label. This study aimed to determine the color changes of the biosensor during application to the product. The results of this study, the biosensor applied to the product at a temperature of 4 ° C had a reddish-brown color until the 6th day of storage and on the 7th to 9th day it changed to greenish yellow, this is by the decrease in product quality indicated by the TVN-N value on the 7th day 19,413 mgN / 100g, the 8th 25,883 mgN / 100g and the 9th 33,650 mgN / 100g. The color of the biosensor on the 9th day is the L * value of 50.6, the a * value of 0.4, the b * value of 49.6, and the Hue value of 47 °.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 9: Industry, Innovation and Infrastructure
SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. *Research Background*

Freshness of fish is essential in determining the quality of fishery products because fish in fresh conditions will have good quality, so that they are safe for consumption [1]. The quality of fresh fish can be determined by the changes in pH that occur in fish. Fish is said to be very good for consumption if the pH is 6 - 7, good if the pH is <6, and not good if the pH value is > 7 [2]. The decline in the quality of fish will impact consumer purchasing power, which also decreases [3]. Monitoring the quality of fish during the storage and distribution of the product can be achieved by utilizing innovative packaging technology. Smart packaging is an innovation in the packaging field that can monitor and provide information to producers and consumers regarding the quality of packaged products [4]. Biosensors are part of bright packaging monitoring product freshness in real time. They can reduce losses due to errors in providing information regarding product damage, so that it can improve food safety for consumers [5]. Biosensors can detect the occurrence of quality degradation in the packaged product based on temperature changes, which affect pH changes as indicated by color changes on the packaging [6]. Biosensors will react as indicated by color changes on the biosensor when chemical or biological changes in the packaging indicate product damage [7].

1.2. *Literature Review*

The stability of anthocyanins can be influenced by factors such as pH, enzymes, light, oxygen, temperature, oxidants, and storage. The color of anthocyanins at various pHs is red at pH <6, pink at

pH 6-7, blue-purple at pH 8, green at pH 9-11, and yellow at pH 12 [8]. Changes in anthocyanin color due to changes in pH can indicate freshness by detecting changes in pH that occur in the product, for example, an indicator of freshness in gourami fish. Freshness indicators that use anthocyanins can detect the freshness of fish because anthocyanins are substances sensitive to changes in pH, while a decrease in fish quality is one of the signs of changes in pH in fish. When the fish experience a decrease in quality, the indicator's color will change [9]. Fish quality is said to be very good if the pH is 6-7, good if the pH is <6, and not good if the pH value is >7 [2].
The anthocyanins produced from red dragon fruit skin extract are natural pigments that can make biosensor pH indicators. Anthocyanins from red dragon fruit skin extract will change color when experiencing changes in pH, due to a decrease in product quality. Biosensors with dragon fruit skin anthocyanin extract will change color and pH changes in gourami fish.

1.3. Research Objective

This study aimed to determine the color changes of the biosensor when it is applied to products during storage.

2. MATERIALS AND METHODS

2.1. Color Change Analysis

Color analysis of red dragon fruit peel extract was objectively conducted using a color box [10]. The CIE-Lab box is a rectangular shape with sides of 50 cm made of board with a height of 50 cm, consisting of 4 neon lights of 8 watts, each 30 cm long, placed on each side of the box at a 45° angle. The measurement procedure involves placing the sample in a uniform-sized container and photographing it with the box closed, at a camera-to-sample distance of approximately 40 cm. The camera used is a Canon brand 16 Megapixel camera without flash. The resulting photo is cropped, transferred, and displayed in Adobe Photoshop CS5; color analysis is performed using the histogram window to determine the color distribution or to display L*a*b* values. The L* value indicates brightness, ranging from 0 (black) to 100 (white). The value a* indicates the reflected light that produces a chromatic color mixture of green-red with a red value (+127) and a green value (-128). The value b* indicates the chromatic color mixture of blue-yellow with a yellow value (+127) and a blue value (-128) [11].

3. RESULT AND DISCUSSION

The color analysis of red dragon fruit skin extract was carried out objectively using a color box [10]. The CIE-lab box is rectangular with a side length of 50 cm, made of a board with a height of 50 cm, and consists of 4 8-watt neon lamps with a length of 30 cm placed on each side of the box with a slope of 45 °. The measurement procedure was carried out by placing the sample in a container of uniform size and photographing it with the position of the closed board box at a distance between the camera and the sample of ± 40 cm. The camera used was a 16 Megapixel Canon brand camera without flash. The resulting photos were cropped, moved, and displayed in the Adobe Photoshop CS5 program, with color analysis using a histogram window to determine the color distribution or to display the L * a * b * value. The L * value indicates brightness with a value of 0 (black) to 100 (white). The a * value indicates reflected light, which produces a mixed chromatic color of green-red with a red value (+127) and a green value (-128). The b* value indicates a blue-yellow mixed chromatic color with a yellow value (+127) and a blue value (-128) [11].

3.1. Visual Color Change of Biosensor

The visual results of the color that have been done show a change in color on the biosensor, along with a decline in product quality. [12] stated that the compounds produced during the storage process, which are volatile bases, will react with the biosensor, causing a change in color on the biosensor at a temperature of 4 ° C during application to the product.

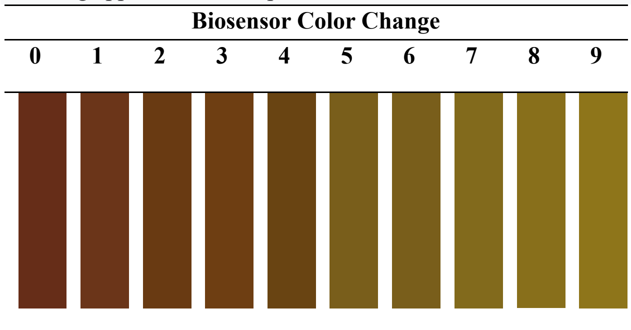

Figure 1. Visual Color Change of Biosensor

Based on Figure 1, the color change on the Biosensor indicator can be seen from the 1st to the 6th day, it is brownish red, and the color changes from the 7th to the 9th day to greenish yellow. On the 7th day, the fish's pH was 7.12, on the 8th day, the fish's pH was 7.29, and increased on the 9th day to 8.50. The TVBN content of gourami fish on the 7th day was 19,413 mgN/100 g, on the 8th day, 25,883 mgN/100 g, and on the 9th day, it increased to 33,650 mgN/100 g. The color change from the 7th to the 9th day shows an increase in the pH value to alkaline with increasing TVBN levels.

3.2. L* Value

The L* value is a value that indicates the level of color brightness, with the lowest value being 0, which indicates that the color is very dark (black), and the number 100 indicates a very light color (white). The higher the L* value, the brighter the sample is, and the lower the L* value, the darker the color. The average results of the L* values obtained can be seen in Figure 2.

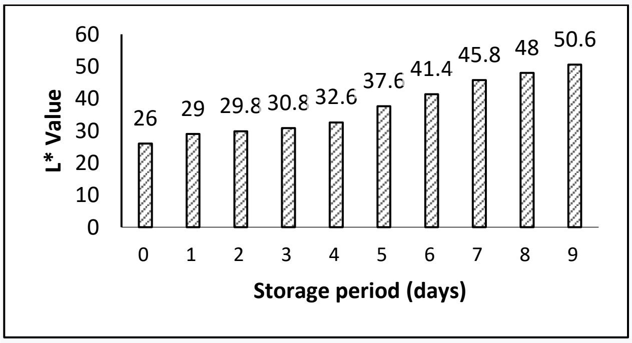

Figure 2. L* Value

The observation results shown in Figure 2. show that during the storage period of the sample with a constant temperature of 4°C in the refrigerator, the results from day 0 showed an L* value of 26, day 1 showed an L* value of 29, day 2 showed an L* value of 29.8, day 3 showed an L* value of 30.8, day 4 showed an L* value of 32.6, day 5 showed an L* value of 37.6, day 6 showed an L* value of 41.4, day 7 showed an L* value of 45.8, day 8 showed an L* value of 48 and day 9 showed an L* value of 50.6. These results indicate that the L* value has increased. Research by [13] stated that the color indicator film sample of erpa leaves stored at a cold temperature of 3±2°C experienced an increase in the L* value from day 0, which was 39.67, to 53.91 on day 12. The average L* value in the Biosensor sample after storage was higher than before storage. This indicates that the sample became brighter during storage, which means that the *L value increased due to degradation of anthocyanins caused by storage time and storage temperature [13]. The increase in the L* value indicates that the color of the Biosensor is fading and approaching white.

3.3. a Value*

The a* value is a value that indicates the degree of redness in the Biosensor indicator. The a* value is located on a scale of 127 to -128. The higher the a* value (positive), the more intense the red color will be; the lower the a* value (negative), the more intense the green color will be. The +a* value is located in quadrant I, and the -a* value is in quadrant III [14]. [13] stated that anthocyanin pigments tend to have a +a* value, so the indicator is in the red range. The average a* value obtained can be seen in Figure 3.

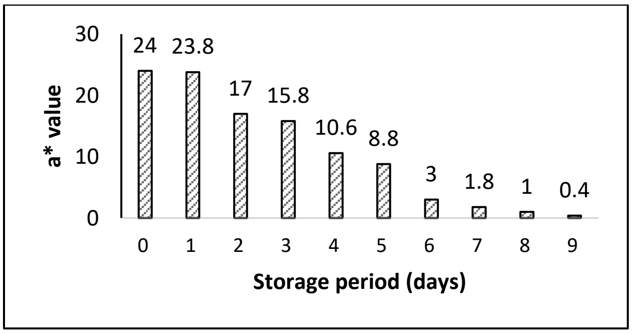

Figure 3. a* Value

The observation results shown in Figure 3. show that during the storage period of the sample with a constant temperature of 4°C in the refrigerator, the results from day 0 showed an a* value of 24, day 1 showed an a* value of 23.8, day 2 showed an a* value of 17, day 3 showed an a* value of 15.8, day 4 showed an a* value of 10.6, day 5 showed an a* value of 8.8, day 6 showed an a* value of 3, day 7 showed an a* value of 1.8, day 8 showed an a* value of 1 and day 9 showed an a* value of 0.4. These results indicate that the a* value has decreased. The decrease in the a* value indicates a change in color in the Biosensor. The degree of redness in the Biosensor visually changes from its original color to red. This decrease in the a* value also occurred in a study conducted by [13], where the a* value of the Biosensor indicator at a cold storage temperature of 3±2°C on day 0 was 37.89 to 15.18 on day 12. This study is also similar to the study conducted by [14], where the a* value on the freshness indicator label decreased at a storage temperature of 5°C on day 0 by 13.25 to 0.68 on day 6. The results of several studies indicate that the length of storage causes a decrease in the degree of redness in the Biosensor. In addition to the length of storage, temperature can also cause a decrease in the degree of redness in the Biosensor. [13] stated that lower temperatures tend to maintain the degree of redness (+a) longer. The decrease in the degree of redness is caused by the speed of the reaction of the structural transformation of the flavum cation (red) to chalcone (colorless).

*3.4. Value b**

The b* value is a quantity that indicates colors ranging from yellow to blue. The b* value is on a scale of 127 to -128. The b* value indicates that the higher the b* value (positive), the more intense the yellow color will be, and the lower the b* value (negative), the more intense the blue color will be. The +b* value is in quadrant II, and the -b* value is in quadrant IV [15]. The average results of the b* values obtained can be seen in Figure 4.

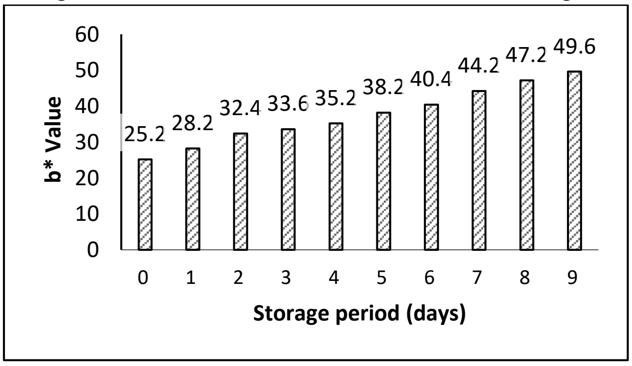

Figure 5. b* Value

The observation results are shown in Figure 17. show that during the storage period of the sample with a constant temperature of 4°C in the refrigerator, the results from day 0 showed a b* value of 25.2, day 1 showed a b* value of 28.2, day 2 showed a b* value of 32.4, day 3 showed a b* value of 23.6, day 4 showed a b* value of 35.2, day 5 showed a b* value of 38.2, day 6 showed a b* value of 40.4, day 7 showed a b* value of 47.2 and day 9 showed a b* value of 49.6. These results indicate that the b* value has increased. The b* value on the Biosensor after storage is higher than before storage. This increase in the b* value also occurred in a study conducted by [13] where the b* value of the Biosensor indicator at a cold temperature of 3±2°C on day 0 was 12.42 to 37.61 on day 12 which was caused by the degradation of anthocyanin into chalcone color (colorless) causing an increase in the degree of yellowness (+b) on Biosensor. The b* value will continue to increase as the storage time is extended.

3.5. Value Hue (H°)

The °hue and chroma values visually describe the actual color obtained from calculating the a and b values, so they are easy to use to identify label color changes that occur. The chroma value is the purity of the color that indicates a color change from solid to white [15]. Research conducted by [15] states that Hue value is a color reflected by an object. Hue value is measured from the degree of angle between 0° and 360°. The representation of Hue value can be seen in Figure 6.

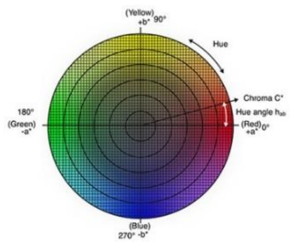

Figure 6. Color Quadrant

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The hue value is the angle of the color, which has a value from 0° to 360°. Each value formed will produce a different color. The Hue value will describe the actual color. This study produces Hue values ranging from reddish brown to greenish yellow. The average results of the Hue values obtained can be seen in Figure 6.

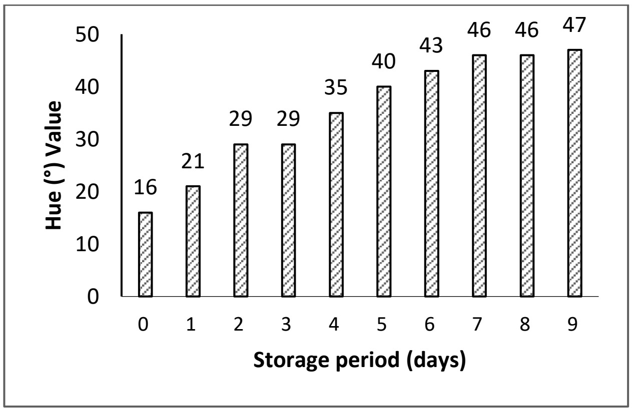

Figure 7. Hue value during product storage

The observation results shown in Figure 7. show that during the storage period of the sample with a constant temperature of 4°C in the refrigerator, the results from day 0 showed a Hue value of 16° with a range of reddish brown in quadrant I, day 1 showed a Hue value of 21° with a range of reddish brown in quadrant I, day 2 showed a Hue value of 29° with a range of reddish brown in quadrant I, day 3 shows a Hue value of 29° with a range of reddish brown in quadrant I, day 4 shows a Hue value of 35° with a range of reddish brown in quadrant I, day 5 shows a Hue value of 40° with a range of reddish brown in quadrant I, day 6 shows a Hue value of 43° with a range of reddish brown in quadrant I, day 7 shows a Hue value of 46° with a range of yellowish green in quadrant I, day 8 shows a Hue value of 46° with a range of yellowish green in quadrant I and day 9 shows a Hue value of 47° with a range of yellowish green in quadrant I. The results show that the Hue value has increased. The results obtained can show the actual color change. The color change in anthocyanin when applied to the Biosensor is not the same as the color change of anthocyanin in the pH sensitivity test results. The pH sensitivity test of anthocyanin color in acidic conditions is reddish brown, in neutral conditions, the red color fades, and when alkaline, it is yellow. Anthocyanin applied to the Biosensor experiences a color change in acidic to alkaline conditions; in acidic to neutral conditions, it is reddish brown; when alkaline, it is greenish yellow. Research conducted by [9] showed something similar. The pH sensitivity test of anthocyanin is red when acidic and neutral, and then yellow when alkaline. Anthocyanin is applied to the Biosensor indicator; the color change occurs in acidic to neutral conditions, the indicator is red, then when the Biosensor is in alkaline conditions, the indicator is purple. This color change indicates that anthocyanins from red dragon fruit skin can be used as an indicator.

4. CONCLUSION

The L* value during storage day 0 was 26, increasing to the 9th to 50.6. The a* value during storage day 0 was 24, decreasing to the 9th to 0.4. The b* value during storage from day 0 was 25.2, increasing to the 9th to 49.6. The Hue value during storage from day 0 was 16°, increasing to 47 ° by day 9 47°

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