Senduduk (*Melastoma malabathricum L.*) Extract as a Green-Indicator for Monitoring Shrimp Freshness

Aliefia Noor
Department of Physics
Universitas Bangka Belitung
Indonesia
aliefianoor@gmail.com

Evi.J
Department of Physics
Universitas Bangka Belitung
Indonesia
evi.junaedi0025@gmail.com

Mustari
Department of Physics
Universitas Bangka Belitung
Indonesia
mustari100314@gmail.com

Aisyah D.A.T. Safitri
Department of Physics
Universitas Bangka Belitung
Indonesia
aisyahderiayu@gmail.com

Fitri Afriani
Department of Physics
Universitas Bangka Belitung
Indonesia
fitriiafriani@gmail.com

Yuant Tiandho
Department of Physics
Universitas Bangka Belitung
Indonesia
yuant@ubb.ac.id

***Abstract*— The freshness of shrimp is the main priority for consumers. Nutrition and taste of seafood are directly proportional to its freshness. After seafood spoil, the anaerobic metabolism will produce ammonia compounds. In this article, the senduduk (*Melastoma malabathricum L.*) extract is used to monitor shrimp freshness. Senduduk has flavonoid compounds in high amount, and it can change its color due to the presence of ammonia. A green indicator is made on Whatman paper immersed in senduduk extract and dried at room temperature. The experiment on ammonia solutions shows that the indicator effectively changes color from red, purple, and gray as an indication of the increase of ammonia gas received by the indicator. The indicator also showed consistent color changes for shrimp tests. To observe the quantitative color change, we compute the color intensity based on the image processing method using ImageJ software.**

***Keywords*—Seafood, Senduduk, Shrimp**

I. INTRODUCTION

Shrimp is one of the fisheries commodities in Indonesia besides crabs, squid, and fish. The Ministry of Maritime Affairs and Fisheries (Kementerian Kelautan dan Perikanan) released data on the increase in national shrimp production from 338,060 tons in 2009 to 639,589 tons in 2013 [1]. The increasing production is due to the ever increasing market demand, both domestic and international, in shrimp production in Indonesia [2].

High nutritional value in shrimp strongly supports the life of microorganisms such as bacteria. Bacterial activity in shrimp can reduce the quality of shrimp which is indicated by changes in color, aroma, taste and even a spoilage process [3]. The spoilage of shrimp is also caused by poor handling, resulting in a decrease in the shelf life and nutritional value of shrimp [4]. The simplest method to detect spoilage is through olfactory sensory, but this method has its disadvantages, that is if we store the shrimp in a container the odor it is impossible to smell and detected. The alternative to solve this problem is to use an indicator label based on the colorimetric method [5]. The advantages of this method compared to other methods are accurate and efficient to detect spoilage in all types of seafood [6].

Indicator labels can be synthesized using natural materials and synthetic materials. But natural materials provide enormous potential because they are non-toxic and environmentally friendly. Some natural ingredients that have been used as indicators of the freshness of seafood are *Ruellia simplex*, *Brassica olereceae*, *Bauhinia blakeana Dunn* [5], and curcumin [3].

Most of the area in Bangka Belitung Islands borders the sea. Agricultural development is quite difficult in this area, primarily since the Bangka Belitung Islands have been widely known as the largest tin producer in Indonesia, resulting in many post-mining tin sites [7]. One of the plants that can survive around the post-mining area of tin is senduduk (*Melastoma malabathricum L*). Senduduk fruits which are deep purple are indicative of a relatively high number of flavonoids [8],[9]. Flavonoids are ammonia-reactive compounds that have the potential to be used as a green indicator of shrimp freshness [10].

II. METHODS

Senduduk fruit was collected from Bangka, Indonesia (5.46 gr) and it mixed with ethanol (20 ml) and distilled water (5 ml). The ingredients were crushed using a Philips HR 2115 blender to obtain senduduk fruit extract. After that, the extract was added with HCl 1 M until it reached pH 2 and aging at 30℃ for 24 hours. Then the extract was filtered using Whatman paper no. 41.

We use the Whatmann paper no. 1 which has a size of 6 cm x 1 cm as a substrate of indicator label. After that, the substrate is dipped in senduduk extract for 30 seconds. Furthermore, the indicator label is dried at room temperature in a closed container to avoid environmental contamination.

To test the stability of an indicator, we examined it under the influence of temperature variations. Essential to ensure that the indicator color changes are not caused by temperature but by ammonia gas produced during the shrimp spoilage process. Stability testing is done by storing the indicator label in an empty bottle at a temperature of -15℃ (cold temperature) and a temperature of 30℃ (room temperature). The color change of the indicator is observed by taking photos at 0, 1, 2, 3, 4, 10, 13, 20, 25, 28, 32, 38, 41, 50, 56, and 90 hours using a smartphone camera 5 MP. Qualitative color analysis is done visually while the quantitative value of the color intensity is done using ImageJ.

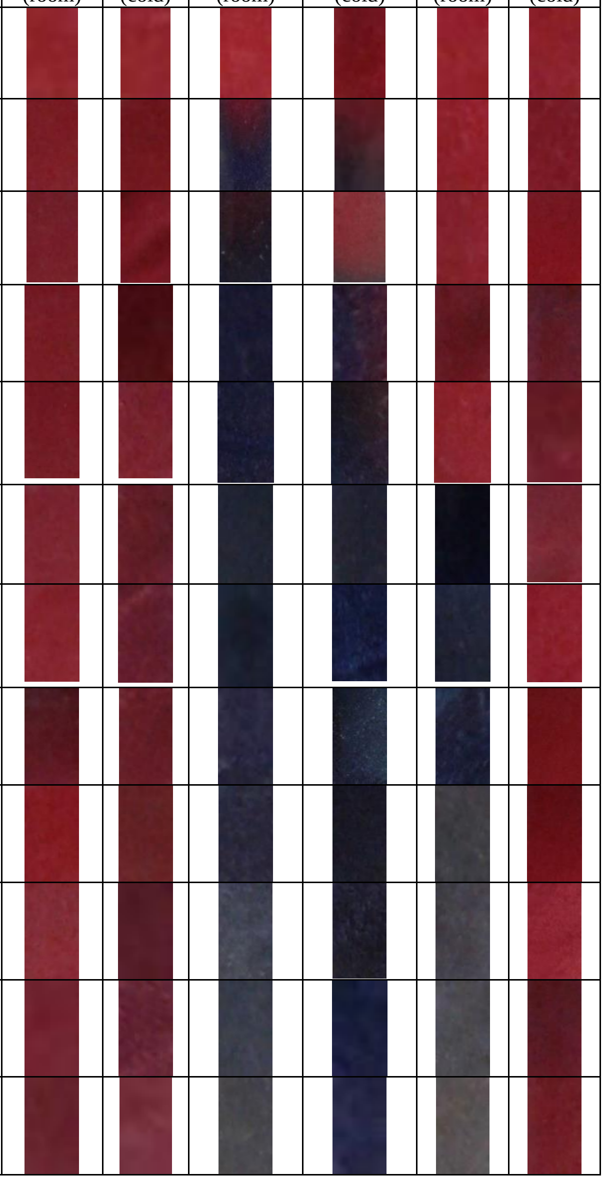
To test the sensitivity of the indicator label for shrimp spoilage, we examined the indicator label for ammonia gas (0.01%) and shrimp. The method of observing the performance of indicator labels on shrimp spoilage and ammonia gas is similar to the technique used in measuring the stability of indicators against changes in temperature. In this study explicitly there were six samples including empty bottles of room and cold temperatures, ammonia at room and cold temperatures, and shrimp at room and cold temperatures.

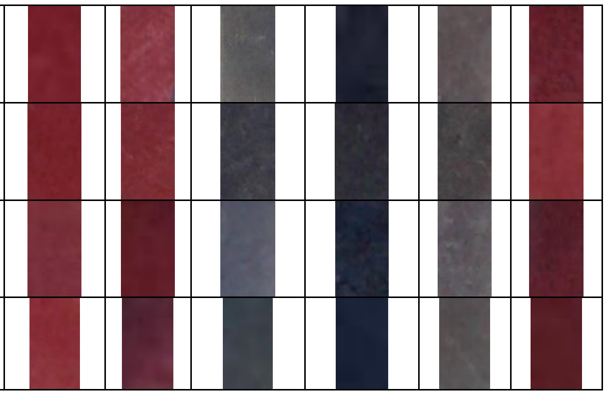
III. Results and Discussion

The results of testing performance indicators for the three conditions, namely: empty bottle, ammonia gas, and shrimp are shown in Table 1.

TABLE 1. THE CHANGING COLOR OF THE INDICATOR LABEL

Hours	Empty (room)	Empty (cold)	Ammonia (room)	Ammonia (cold)	Shrimp (room)	Shrimp (cold)
0						
1						
2						
3						
4						
10						
13						
20						
25						
28						
32						
38						
41						
50						
56						
90						





In empty bottles without the presence of ammonia or shrimp, it appears that the colors of the indicator label do not change up to 90 hours. It occurs in empty bottles placed at room temperature and in cold conditions. These results indicate that the indicator label is stable against changes in temperature. Both empty bottles at different temperatures still have the same original color: red.

For ammonia testing, it appears that the label indicator has a significant color change. The color change of the indicator labels is consistent in the order: red-dark purple-gray. Both ammonia temperature conditions produce a similar pattern. It can be seen that ammonia at room temperature results in a faster color change on the indicator label. It is understandable because at room temperature ammonia is more volatile than in cold temperatures. Thus, the exposure of ammonia gas of the label indicator at room temperature is more than that of ammonia gas in cold temperatures.

A similar pattern of color change also occurs on the indicator label for shrimp. Shrimp decay process will produce ammonia gas as a by-product. The faster the spoilage of shrimp, the more ammonia gas accumulates. Shrimp at room temperature will quickly change the color of the indicator. Cold shrimp indicate the results that are quite different; the color of the indicator is still the same for up to 90 hours. These results suggest that shrimp stored at cold temperatures are more durable than shrimp stored at room temperature [11].

The results of color quantification of the indicator label are shown in Fig. 1.

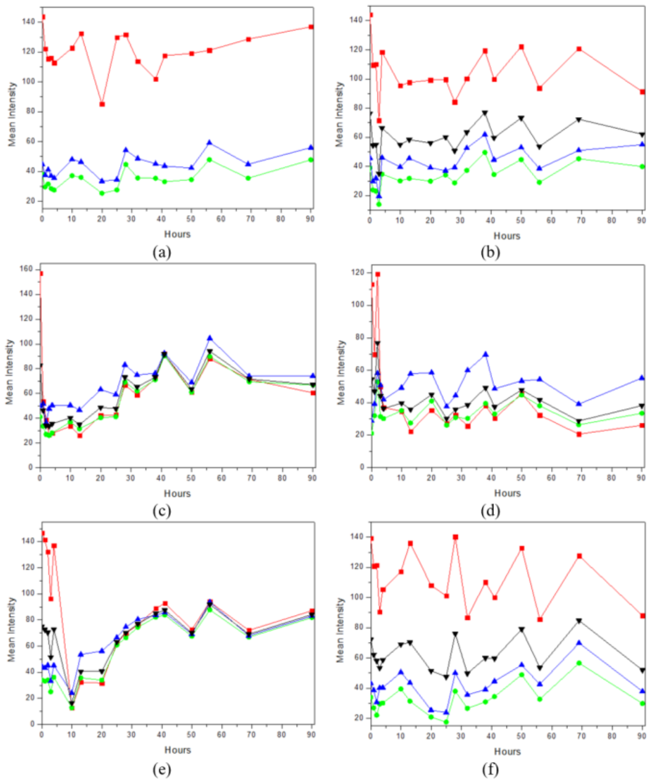


Fig. 1. Quantification of indicator label colors: (a) empty bottle (room), (b) empty (cold), (c) ammonia (room), (d) ammonia (cold), (e) shrimp (room), (f) shrimp (cold) (—■—: red; —●—: green; —▲—: blue; —▼—: gray)

In general, if the indicator label does not change color significantly, the red component will be more dominant than the other colors. Whereas if the condition of the indicator has been exposed to ammonia gas or changes in color, then the dominance of red will decrease and be replaced by blue.

IV. Conclusions

The senduduk extract based indicator label has excellent stability against temperature changes. The change in color of the indicator is not caused by changes in temperature but by the presence of ammonia gas. Tests on ammonia also showed that the color change of the indicator label was influenced by the amount of ammonia exposure on the label indicator. The higher the amount of exposure, the faster the indicator changes color. Tests on shrimp also show the ability of label indicators to monitor shrimp spoilage. For room temperature shrimp, the color of the indicator label changes faster than the indicator in cold temperature shrimp. It can occur because the cold temperature will slow down the spoilage rate. The color quantification of the indicator label has shown that for conditions not exposed to ammonia, the highest intensity is red whereas when exposure to ammonia is high enough the blue color dominates.

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