Identification of Banana Quality (Musa paradisiaca Var. Sapientum L.) Through the Using of Coconut Shell Charcoal and Potassium Permanganate as Absorber

Sholihat

Agricultural Engineering Faculty- Agriculture Industry Department Serambi Mekkah University, Banda Aceh, Indonesia.

sholihat.usm@gmail.com

Abstract. One of the most frequently encountered problems in handling bananas is the ease of it characteristic to decay so they cannot be stored longer. Thus a technology is needed to increase the shelf life of banana. The use an absorber from coconut shell charcoal which is applied with potassium permanganate is a method that can be used. In this study the effectiveness of the absorber was tested using gas chromatography. The results obtained show that the ethylene concentration can be pushed by the addition the number of the absorber. The treatment carried out is by compare it at two temperatures. Where at a temperature of 13 0C, the ethylene concentration is about 102.78 ppm for an absorber of 10 g. At 20 g it is 95.13 ppm. At 30 g it is 64.23 ppm and at 40 g is 65.85 ppm. At a temperature of 28 0C in the 8th hour the ethylene concentration was 104.30 ppm for 10 g absorber. At 20 g, it is 101.12 ppm. At 30 g is 89.22 ppm. At 40 g, it is 64.20 ppm. Absorber treatment affects ethylene production, and slows the physical and chemical processes of Raja banana which is characterized by green colour until the end of storage time and retained hardness, high starch content, low sugar content and small amount weight loss. generally, the treatment of ethylene potassium absorbent material greatly influences the maturation effect, by suppressing ethylene production and maintains the green color, texture and aroma of Raja banana within 15 days at 28 0C and 45 days at 13 0C.

1. Introduction
As one of the horticultural plants, bananas are tropical fruits that are familiar to the world community because they have a good taste and have a complete nutritional content for health. Large productivity of banana production makes Indonesia become one of the largest banana producing countries and give a lot contribute on national fruit production [1]. Indonesia's export value is relatively small compared to the other countries such as Philippines, Malaysia and Thailand [2]. This actually happens because of the quality of bananas from Indonesia is relatively low. One of the causes is due to ethylene gas produced by the banana itself. Maturity of bananas will be accelerated in the presence of ethylene gas. Many ways can be used to delay the maturity of plantains. One of them is the use of ethylene gas absorbent media such as husk charcoal,
coconut shell charcoal, etc. with ethylene (ethylene absorbant) absorbers such as potassium permanganate which can be combined with both temperature and packaging.

Several studies related to about the delay time in the maturity of research conducted by [3] showed that Raja Bulu Banana that given ethylene binder in a 0.07 mm polyethylene plastic bag was able to press the ripeness of the banana for 3 weeks at room temperature. Similarly, research by [4] banana shelf life can be extended for more than 2 weeks with a combination of 1-MCP, KMnO4 and packaging. Yudha, et al (2013) revealed that the shelf life of Banana Kirana can last up to 10 days with WSF and KMnO4 packaging treatments. [5] reported that cold storage at a temperature of 13 °C can maintain shelf life of 13-25 in variety Pisang Mas, Latundan, Khulai Khai, Saba, Lakatan and Bungulan. [6] also reported the ripening of bananas could be inhibited for 38 days, if it stored in polyethylene plastic bags using KMnO4.

This research specifically aims to determine the effectiveness of ethylene potassium permanganate absorbent media and its effect on the quality of Raja Bulu Banana during delays time in maturity.

2. Methodology
The materials used in this study were Raja Bulu banana, polyethylene plastic bag, gauze, coconut shell charcoal, KMnO4, benlate 50, wax, glue, tools needed were Rheometer to measure hardness, refrigerators, gas chromatography to measure ethylene gas and Cromamometer Minolta CR-200 for measuring the color. In Figure 1 it could be seen how the research flow was carried out.

![Figure 1. Flowchart during the Research](image-url)
3. Results and Discussion

The Making of Absorber from Coconut Shell Charcoal

The making of ethylene absorbent material, it is made by mixing coconut shell charcoal and starch so that the glue process occurs. To get a truly pivot absorbent pellet, it furnaces about 2 hours at 600°C (Figure 2). In this study, a development was made in the form of pellets from coconut shell charcoal which in its application was combined with Potassium Permanganate.

![Figure 2](image)

Figure 2. Ethylene absorber media from Coconut Shell Charcoal

Testing the Effectiveness of Absorber using Gas Chromatography

Research about the adsorption of coconut shell charcoal has been carried out, among others by [7] using coconut shell activated charcoal to adsorb Cu2+ metal.

| Temperature | Absorber(g) | Time (hour) | Ethylene Concentration (ppm) |
|-------------|-------------|-------------|-------------------------------|
|             | 10          | 2           | 4                             | 6           | 8           |
| 13 °C       | 150.00      | 140.34      | 127.00                        | 113.13      | 102.78      |
| 20          | 150.00      | 136.25      | 118.34                        | 105.12      | 95.13       |
| 30          | 150.00      | 117.44      | 89.59                         | 72.49       | 64.23       |
| 40          | 150.00      | 99.90       | 81.72                         | 76.89       | 65.86       |
| 10          | 150.00      | 149.23      | 133.95                        | 119.97      | 104.30      |
| 20          | 150.00      | 145.00      | 132.37                        | 110.42      | 101.12      |
| 30          | 150.00      | 137.20      | 121.44                        | 99.72       | 89.22       |
| 40          | 150.00      | 130.65      | 120.23                        | 97.76       | 64.20       |

Table 1 shows that the tendency of ethylene concentration is decreasing by the increasing of absorber. According to Setyaningsih (1995) in Indrawati (2003) the occurrence of this process is in accordance with the adsorption mechanism where there are three basic stages of the adsorption process including: 1) substances absorbed in the outer charcoal; 2) substances move through charcoal pores; 3) substances absorbed into the inner wall of charcoal.

Measurement of the rate of Ethylene Production and Respiration Rate

To find out the climacteric phase of banana, respiration rate was measured. This aims to determine a good storage tolerance so that it can be determined during storage termination. There was a surge in CO2 production on day 5 is about 47.12 ml CO2 / kg. Hour at room temperature. Along with this, there was a surge in ethylene production rates on the same day, which was the 5th day is about 1.82 ppm / hour. This is in accordance with what was revealed by [8] that an increase in CO2 concentration coincides with the formation of ethylene gas (C2H4). At temperature of 130°C, the peak rate of ethylene production occurred on the 11th day is about 0.96 ppm / hour.

Banana Quality Study on Treatment of Maturation Delay

Ethylene Concentration

Ethylene production when its treatment without absorber tends to be higher than the absorber treatment. The presence of KMnO4 is thought to inhibit enzymes and other substances that stimulate ethylene formation. This is reinforced by [9] which reported that acrylic acid is an ingredient that will
directly form ethylene (C2H4) and if the organic acid is disturbed, the formation of ethylene will be inhibited directly. In addition there is an ethylene binding mechanism by KMnO4. This ethylene binding process occurs because KMnO4 as an oxidizer can react or bind ethylene by breaking the double bonds present in the ethylene compound into the form of ethylene glycol and mangandioxide with the following reactions:

\[ CH_2 = CH_2 + KMnO_4 \xrightarrow{\text{H}_2\text{O}} CH_2OH + MnO_2 \]

EthyleneEthylene GlicolMangandioxide

The highest average value of ethylene concentration was found in the treatment without absorber, both at a temperature of 28 0C at 8.65 ppm and at temperature of 13 0C at 4.67 ppm. When the temperature is 28 0C the absorber treatment was 5.40 ppm, 20 g was 2.79 ppm, 40 g was 2.72 ppm and the absorber was 40 g at 2.16 ppm. While at temperature of 13 0C absorber 10 g of 4.45 ppm, 20 g of 4.18 ppm, 30 g of 1.94 ppm and 40 g of 3.79 ppm.

Water content

The highest average changes in water content occurred at room temperature and it treatment without an absorber of 62.68%. Changes in water content were followed by an absorber of 10 g at 60.51%, 20 g at 61.26%, 30 g at 60.24%, 40 g at 60.34%. At cold temperatures the treatment without absorber was 60.90%, followed by absorber 10 g at 60.67%, 20 g at 61.70%, 30 g at 60.57%, 40 g at 61.42%. In the treatment without absorber the water content tends to be higher due to the maturation process in which the metabolic process of starch breakdown occurs, long chain carbohydrates become sugar whose carbon chain becomes shorter. [10] revealed that as long as this solution is produced by water and energy. This water causes an increase in water content in the fruit.

Starch Content

In Figure 3, the average value of starch contents showed that at temperature of 130 C the treatment without absorber had a lower starch content compared to the absorber treatment is about 26.78%. At 10 g of 28.82%, at 20 g of 28.44%, 30 g of 30.58% and 40 g of 31.16%. while when the temperature is 28 0C, starch content when its treatment without an absorber is about 26.89%. At 10 g of 28.38%, 20 g of 28.57%, 30 g of 29.14% and 40 g of 29.27%.

![Figure 3. The Changes of starch content of Raja Bulu Banaana during the Maturation Delay time a) temperature of 28 0 C, b) temperature of 13 0C.](image)

Total of Sugar
With the addition of the absorber, the sugar tends to be lower because the presence of KMnO4 as an ethylene absorber can inhibit the ripening process by holding the rate of starch into sugar. The Total of sugars tend to be higher in treatments without absorber than using absorber (Figure 4). [8] revealed that the increase in sugar on bananas was caused by the changes due to fruit breathing, available reserve substances and the formation of new carbohydrates. The increase in of the total sugar is due to the overhaul of starch into sugar during storage time which is used as energy in respiration. The decrease in of the total sugar is thought to be due to the sugar which is the result of the change of starch used for respiration so that the total of sugar are decreases. Starch reform could be inhibited by the presence of KMnO4 as an ethylene absorber.

![Graph of Total Sugar Content](image)

**Figure 4.** The Changes of the total sugar content on Raja Bulu Banana during the maturity delay process: a) temperature of 28°C, b) temperature of 13°C.

The Shrink of Weight (Weight Lost)
Based on variance test, the using of absorber treatment has a significant effect on weight loss. While the temperature treatment and interaction both have no real effect on weight loss. Weight loss average values at 28°C showed that the treatment without absorber was 4.07% followed by 10 g at 2.26%, 20 g at 0.62%, 30 g at 0.09%, 40 g at 0.39%. Martodiredjo (1983) in Larasati (2003) reported that low relative humidity can accelerate evaporation, especially at high temperatures, while losing weight due to respiration cannot be avoided, because the results of living plants will continue to breathe. [11] reported that loss of water during storage not only decreases weight loss, but also decreases in quality and damage.

Tannin Content
[10] revealed that the occurrence of reduced tannin levels due to the presence of degraded tannins or tannins in fruits is no longer able to precipitate proteins so that polymerization and enlargement of tannin molecules can occur so that precipitation occurs. The average value of tannin content at 13°C in the treatment without absorber had the lowest value of 0.56% followed by 10 g of 0.58%, 20 g of 0.59%, 30 g of 0.61% (highest tannin content) and 40 g of 0.60%. At room temperature, treatment without absorber was 0.56% followed by 10 g at 0.56%, 20 g at 0.57%, 30 g at 0.57%, 40 g at 0.57%

Hardness
Banana treated with KMnO4, the hardness of it could be maintained until the last storage day. This is due to the absorption of ethylene by KMnO4. [8] also reported that the inhibition of the protopectin maturation process on banana is not hydrolyzed. This is related with the opinion of [11] that the constancy of fruit cells will decrease due to the overhaul of insoluble pectin (protopectin) which turns into water-soluble pectin, so that the amount of water-soluble pectin increases and insoluble protopectin will reduced. The mean value of hardness showed that a temperature of 13 OC and room temperature, treatment without absorber had the lowest hardness value of 3.22 kgf followed by 10 g of 3.28 kgf, 30 g of 3.41 kgf and 40 g of 3.31 kgf.

Color
The green color of bananas is thought due to the inhibitory mechanism carried out by ethylene absorbers which inhibit the action of the chlorophyllase enzyme which plays a role in chlorophyll degradation. In general, during storage time, Raja Bananas’s color can still be maintained. This is reinforced by [8] that hydrolytic activity of chlorophyllase, which breaks chlorophyll into a part of the fitol and porphyrin nucleus that is still intact, then it cause the chlorophilide will not result in discoloration (Figure 5).

![Figure 5. Raja Banana on the 35th day at 13 °C](image)

Organoleptic
The treatment towards the ethylene absorber by using potassium permanganate, from the results of organoleptic test has an effect on the maturation inhibition process, with the green color, texture and aroma of the Raja banana being maintained (Figure 6).

![Figure 6. Organoleptic test on colour quality score, texture and aroma at room temperature](image)

Hedonic quality score of the colour, texture and aroma based on variance test during the maturation delay, it was found that the absorber and temperature had a significant effect on the three quality scores. The average hedonic quality score showed that a temperature of 130°C, the treatment
without absorber had the highest score of 2.35 (green - rather green), followed by 10 g of 2.11 (green - rather green), 20 g of 2.02 (green-rather green), 30 g is 2.04 (green-rather green) and 40 g is 2.07 (green - rather green). The hedonic quality score on the texture showed that at a temperature of 130C, the highest average score was found in the treatment without an absorber of 1.94 (very hard). Based on the organoleptic test during the delay of maturation at room temperature, the highest score was given by panelists on the 15th day.

Maturation delay process based on organoleptic test during the temperature of 130C, the result showed that the highest score was given by panelists on the 45th day. In general, the temperature treatment of 130C in all treatment using absorber wass able to maintain the colour, texture and aroma of fruit. On the 45th day the result test toward the banana which is treatment without absorber had a hedonic quality score of 3.60 (rather green - medium), hedonic quality texture score of 3.10 (rather hard-medium), scent hedonic quality score of 3.20 (somewhat non-fragrant - medium). At cold temperatures outside physical damage occurs at the same time in all subject test with absorber treatments. But the worst damage is in the treatment without absorber. The limit of panelist receiving toward the organoleptic was stopped on the 45th day because on that day bananas were no longer worth organoleptically tested, because the fruit had shown damage by breaking the fruit skin which was thought to occur due to cold temperatures that were too long to be in cold temperature so that it damaged the banana skin tissue.

4. Conclusion
From the results of the absorber effectiveness shows the addition the number of absorber can reduce the concentration of ethylene by breaking the double ethylene bond to ethylene glycol and dioxide and slowing down the physical and chemical processes of Raja banana. Absorber treatment during the delay of maturity, affect ethylene production, and slow down the process of physical and chemical changes and quality of Raja banana which is characterized by green colour until to the end of storage time and retained hardness, high starch content, and moisture content, sugar content and shrinkage weight (weight loss) that tends to be low. Based on organoleptic test, panelists can still accept the fruit condition until the 10th day for treatment without absorber, 10 g and 20 g absorber. In the absorber of 30 g and 40 g, panelists can still accept the condition of the fruit until the 45th day. Ethylene potassium permanganate absorber gives the effect on inhibition of maturation of Raja banana fruit for 15 days at a temperature of 28 0C and 45 days at a temperature of 13 0C

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