Coating Performance Based on Palm Oil Derivatives Compared to Plant-Based and OPE-Based on Pineapple Fruit

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ABSTRACT
Indonesia is the fourth largest pineapple producing country in the world. This makes a lot of pineapple exported to foreign countries including Asia, Europe, and America. The length of export shipping causes a decrease in quality which results in poor pineapple conditions in faraway countries. This problem encourages the need for supporting technology to extend shelf life, one of which is edible coating. This study aims to evaluate the effect of postharvest treatment with edible coating on the physicochemical properties of MD2 pineapple. The treatments were, A (Control: Non Wax), B (Palm-based wax), C (Plant-based wax), D (OPE-based wax) all of which were stored in cold storage (7 ± 0.5°C). Percentage of weight loss, firmness, respiration rate, and shell color were observed once a week for 42 days. The result is that wax application has no significant effect on shell discoloration, firmness, and weight loss. Edible coating only had a significant effect on the CO_2 production parameters where treatment B had the lowest CO_2 production.

Keywords: *Pineapple, Edible Coating, Palm Stearin, Postharvest Technology.*

1. INTRODUCTION

Indonesia is the fourth largest pineapple producing country in the world with a production of 2.45 million metric tons of pineapple in 2020 [1]. This makes pineapple not only marketed domestically, but also exported to foreign countries. Indonesian pineapples have been exported to various continents such as America, Europe, and countries in Asia.

The wide circulation of the pineapple market causes the long storage of the pineapples that have been picked. Long storage duration causes a decrease in pineapple quality. This decrease was seen in the firmness, external defects, and changes in the appearance of the pineapple [2]. One of the technologies applied to maintain the quality of pineapple from this problem is edible coating. Edible coating is a method of applying a thin layer on the surface of the fruit to suppress the rate of gas and water vapor exchange, so that the ripening and browning process of fruit can be slowed down. This layer added to the surface of the fruit is not harmful if it is consumed with the fruit [3].

Many studies of edible coatings have been conducted previously, such as apples [4], strawberries [5], tomatoes [6], pineapples [7], and oranges [8]. In these studies, edible coatings are proven to be able to maintain water content, maintain firmness, reduce respiration rate, improve appearance, and can maintain the quality of chemical compounds in fruit.

This research will use palm stearin as the main ingredient of edible coating on MD2 pineapple. Previous research stated that this palm-based coating can slow the increase in weight loss, slow down the yellowing of the fruit, and slow down the decrease in gloss and brightness in guava. This makes guava preservation better [9]. Palm stearin-based waxing will then be compared with Plant-based wax and OPE-Based wax which have been applied in one of the pineapple producers in Indonesia, PT Great Giant Pineapple.

2. MATERIAL AND METHODS

2.1. Wax Preparation

This study consisted of 4 different treatments, namely A (Control, without wax), B (Palm-based wax), C (Plant-

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based wax), and D (OPE-based wax). Palm-based wax was made using palm stearin, palm oil, cmc, aquades and emulsifier tween 80. Mixing was carried out at a temperature of 60^0C using a magnetic stirrer.

Treatment B (Plant-based wax) and C (OPE-based wax) are the types of wax applied to PT Great Giant Pineapple. Each ingredient still needs to be diluted according to the company's operational standards.

2.2. Plant Materials and Treatments

Pineapple MD2 harvested in shell color 0 with a size of 12 and a mass of 1-1,1 kg obtained from PT Great Giant Pineapple – Plantation Group 4, East Lampung. Defect-free fruit was washed with clean water and allowed to dry at room conditions. The samples for treatment A were then stored while the fruit samples for treatment B-D were each coated with wax that had been prepared by the dipping method. The fruit that has been coated with edible coating is then left for 30 minutes until the coating dries. After that, the fruit was stored with treatment A (Control, without wax) fruit in cold storage at 7ºC and 90-95% RH.

2.3. Fruit Ripening Index Assesment

Assessment of the fruit ripening process was identified by changes in color and firmness of the fruit. The fruit ripening process was identified by the change in color and firmness of the fruit. Fruits were evaluated at 7-day intervals for color, fruit weight loss, CO2 production, and firmness. Skin color is determined using the shell color index on the pineapple. Internal browning of meat is visually graded from 0 (normal) to 6 (very severe browning) [10].

Firmness is determined in the central region of each fruit and adjacent to the fruit core [11]. Measurements were carried out using a destructive method where 3 MD2 pineapples were used for each treatment and each time interval. The tools used are a penetrometer (GY-2 Portable Hardness Tester; Zhejiang Top Cloud-Agri Technology Co., Ltd; China) with a pressure head size of 8 mm in diameter; according to the respective specifications (scale value 0.5-4 kg/cm (x105pa), accuracy: ± 2 mm, Pressure head insertion depth: 10 mm and Size: 140 mm * 60 mm * 30 mm), the results are expressed in Kgf.

2.4. Fruit CO2 Production and Weight Loss (%)

In measuring this, 3 MD2 pineapples were used as replicates for each treatment. These fruits were used to measure CO_2 production from day 0 to day 42 with an interval of 7 days. Changes in CO_2 concentration were detected in a closed container with a height of 31 cm * width of 24 cm and a capacity of 9 L. HT-2000 Digital CO_2 meter was used for this procedure (CO2 range: 0-9999 mg/kg, 10-99% RH, 0-50 °C; Dongguan Xintai Instruments; China).

Before measuring CO_2, the fruit was weighed to determine its mass using digital scales [12]. After that, the fruit is put into the container with the CO_2 meter carefully and ensured that it is tightly closed. This measurement is carried out in a cold storage. Changes in CO_2 concentration were calculated for 1 hour in each fruit. The respiration rate is then determined using the following equation:

$$Rr = \frac{\Delta CO_2}{\Delta T} x \frac{Fv}{W} \quad (1)$$

Where Rr is CO_2 production in mL (CO2)/kg*h, ΔCO_2 is the gas concentration for CO_2 in mL/L after 1 hour minus the initial readable CO_2 gas concentration, Fv is the free volume of the respiratory space in L and W is fruit weight in kg. The free volume was obtained as the total volume of the container minus the volume occupied by the pineapple using the water displacement method [13]. Furthermore, the percentage of pineapple fruit weight loss was determined as the percentage of pineapple weight loss relative to the initial weight taken as 100% [14]

2.5. Statistical Analysis

Statistical analysis were performed using SPSS Version 26.0 software (SPSS Inc.; Chicago, IL, USA). All data were analysed by an analysis of variance of one-way (ANOVA). The analysis used a significant difference at $P < 0.05$ determined by Duncan's Multiple Range Tests (DMRT).

3. RESULT AND DISCUSSION

3.1. Effect of Wax Treatment on Fruit Ripening

Pineapple maturity level can be identified by shell color and firmness [13]. The results of statistical analysis showed that the shell color change was not significant for waxing. In this study, the cold storage temperature played a more important role in inhibiting the discoloration of the fruit shell than the waxing treatment itself. Shell color in all treatments was still 0 until the 35th day. Changes only occurred on day 42, where only treatment C showed an increase of 1 level of shell color (Figure 1).

The results of statistical analysis also showed that firmness is not significantly affected by the treatment of several types of wax. Firmness has a fluctuating value in each treatment during storage (Figure 2). In this study, the greatest firmness was in treatment B, namely palm-based wax, which was 13500.32 ± 3035.09 Kgf/cm^2 (Table 1). The firmness of treatment B along with 3 other treatments is within the range of the best firmness mentioned in the literature for MD2 pineapple, which is between 4-7 N or 8,111,37-14,194.91 kgf/cm2 (ding 2016).

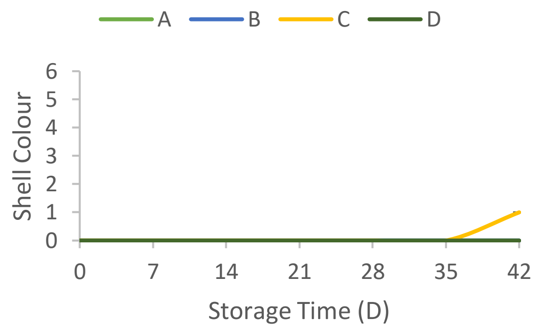

Figure 1 Shell colour treatment A, B, C, D during 42 days cold storage

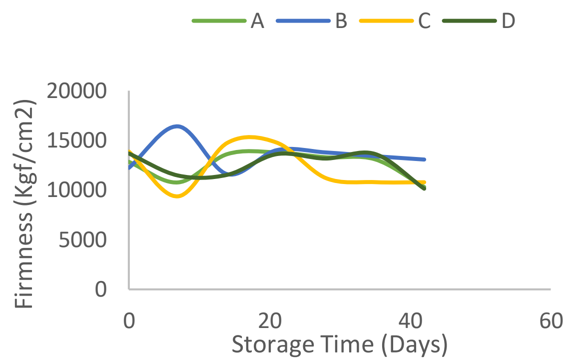

Figure 2 Firmness treatment A,B,C,D during 42 days cold storage

Table 1. Influences of the treatments applied on the shell colour, firmness, CO_2 production, and weight loss of the fruit after 42 days of storage.

Variables studied				
Treatment	Shell colour	Firmness (Kgf/cm^2)	R Rate ($ml.CO_2/kg*h$)	Weight loss (%)
A	0	12529.36 ± 2293.65[a]	4.88 ± 0.56[b]	12.30 ± 0.46[a]
B	0	13500.32 ± 3035.09[a]	3.14 ± 0.78[a]	11.92 ± 0.5[a]
C	1	12220.33 ± 1849.66[a]	3.15 ± 0.60[a]	8.73 ± 1.7[a]
D	0	12458.02 ± 2106.15[a]	4.44 ± 0.61[b]	13.26 ± 2.3[a]

Note: * Each value represents a mean ± standard error. Mean values in each column followed by the same lower-case letters are not statistically different by Duncan's multiple range test.

** A (Control, without wax), B (Palm-based wax), C (Plant-based wax), and D (OPE-based wax)

3.2. Effect of wax treatment on fruit CO_2 production

Based on statistical analysis, the use of edible coatings significantly affects changes in CO_2 production during storage at cold temperatures. CO_2 production has an increasing trend from time to time (Figure 3). Among all treatments, the lowest CO_2 production was in treatment B, namely palm-based wax, with CO_2 production of 3.14 ± 0.78 $ml.CO_2/kg*h$ (Table 1).

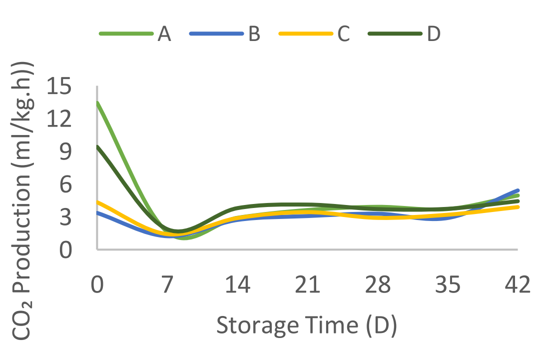

Figure 3 Production of CO_2 treatment A, B, C, D during 42 days cold storage

3.3. Effect of wax treatment on weight loss.

Based on statistical analysis, edible coating treatment has a significant effect on changes in weight loss during storage. Figure 4 shows the percentage change in weight loss from all treatments during storage. However, the smallest weight loss can be seen after 42 days in treatment C where weight loss decreased by 8.73 ± 1.7% (Table 1). Changes in weight loss due to the respiration process in fresh pineapple. Respiration creates a substrate that is synthesized in the internal fruit which then produces water byproducts which are then released by the fruit [14].

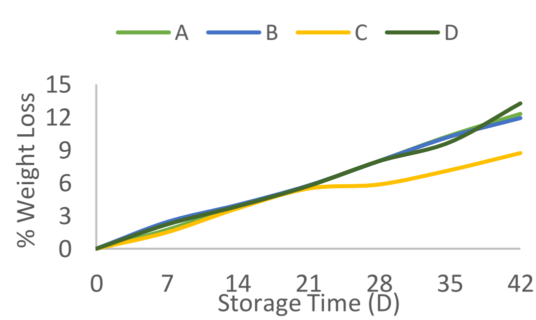

Figure 4. % Weight Loss treatment A, B, C, D during 42 days cold storage

4. CONCLUSIONS

Edible coating has no significant effect on shell colour, firmness, and weight loss. Edible coating only had a significant effect on the CO_2 production parameters where treatment B (palm-based wax) had the lowest CO_2 production.

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