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The Effect of Citronella Oil and Sesame Oil Emulsion Coating on The Quality and Storability of Mangoes (*Mangifera Indica* L.)

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Abstract

One of the most promising agricultural commodities is the cultivation of mangoes. One way that can be used to maintain the quality and freshness of the fruit in a simple way is to do an emulsion coating. The purpose of this research was to determine the effect of citronella oil and sesame oil emulsion coating on the quality and storability of mango (*Mangifera indica* L.). The method used in this study was a Completely Randomized Design (CRD) with two factorial treatments and controls. The first factor was citronella oil under a concentration of 0.5% and 1%. The second factor is sesame oil under a concentration of 0.5% and 1%. The two oils were combined in the emulsion into three treatment combinations, namely S0W2, S2W0, and S1W1. The parameters measured in the observations were hardness, damage, and glucose levels in the fruit. The results showed that the level of hardness of mangoes decreased in the four treatments. Then it was found that there was an effect of delaying the maturity of the fruit with the S1W1 treatment because it was not damaged like the other treatments. While glucose levels in the fruit have increased due to the ripening process. Coating treatment with a ratio of citronella oil concentration of 0.5% to 0.5% sesame oil is the most effective treatment combination in maintaining quality and shelf life because this treatment can delay damage to mangoes.

Keywords: Emulsion coating, Citronella oil, Sesame oil, Mango, Fruit ripening delay

INTRODUCTION

Indonesia is an agricultural country with high competitiveness in producing natural resources. If the production of its the natural resources is well-developed, it could be the fulcrum of the country's economy. One of the most promising agricultural commodities is the cultivation of mangoes. Besides being easy to develop and suitable for the Indonesian climate, this plant also has a high selling value. Mango fruit is also a fruit that has high popularity in the eyes of the public, so it is called the King of Fruits (Iswanto, 2002). The sweet taste, soft texture, and good nutritional content for health are why this fruit is selling well in the market. But, one of the weaknesses of this fruit is that it has a short shelf life. In fact, because of this problem, it was noted that farmers suffered losses of up to 30% of their total yields. Thus, post-harvest handling needs to be considered, so that the selling value of this fruit is maintained (Pantastico & Kamariyani, 1986).

In Indonesia, research on storability is lacking, when compared with the potential and diversity of food products (Herawati, 2008). Research on storability is needed so that we don't only have a variety of products but also quality ones. During the storage process, mangoes undergo metabolic processes (respiration and transpiration). This metabolism affects the speed of fruit ripening or decay (Purwaningsih *et al*., 2011). Some of the research that has been done is still lacking. It also seems to provide a solution that is difficult for ordinary people to imitate.

Especially the farmers who do not understand the mixture of chemicals, such as applying a mixture of $CaCl_2$, spermidine, rosella flower extract, and so on (Nirmayanti, 2017).

One way that can be used to maintain the quality and freshness of the fruit is to do an emulsion coating. The coating is a way of giving a thin layer on the surface of the fruit to inhibit metabolic processes so that the fruit ripening process can be slowed down. However, this emulsion coating must be at the right level and not excessive. Otherwise, it will damage the fruit (Pantastico & Kamariyani, 1986). Several other requirements must be considered. This coating material doesn't smell or affect the taste of fruit, dries, non-toxic, provides a more attractive appearance, and is inexpensive (Furness, 1977).

Research on the effectiveness of sesame and citronella oil has been carried out by Inggas (2013), on tomato plants. The results of this study turned out to be effective in increasing the shelf life of tomatoes at room temperature. The content of lemongrass oil can inhibit microbial growth, while the function of sesame oil is to close the pores of the fruit (Bankole & Joda, 2004). But, this is done on different tomato plants with mangoes. Thus, it is necessary to determine the effect of sesame oil and citronella oil emulsion layers. Also, the right ratio between sesame oil and citronella oil provides optimal results to maintain the quality of mangoes.

Thus, this research aims to determine the effect of citronella oil and sesame oil emulsion coating on the quality and shelf life of mango (*Mangifera indica* L.). It is also a solution for farmers to use those emulsion coating methods. So that the quality and shelf life of mangoes can be maintained. This method is very simple to perform but gives results that are not inferior to more expensive chemical mixtures. This method also meets the requirements of good emulsion coating because it is safe, easy, and low-cost. It is hoped that this research can help readers, especially mango fruit farmers, in dealing with losses due to this problem. As well as the power to support the competition of Indonesian mangoes in the international market.

RESEARCH METHODS

The research was conducted at the Physiology Laboratory, Faculty of Mathematics and Natural Science Education, Indonesian University of Education. The research was conducted from October to December 2022. The tools used were 10 ml measuring cups, pipettes, mixers, trays, funnels, scales, containers, refractometers, centrifuges, and bottles. The material used is homogenous indramayu mango (*Mangifera indica* L.). The criteria for young mangoes used in this study are marked with a light green color. The sorting process is carried out by selecting the fruit to be used in the study, so that all samples are homogeneous and in good condition. Ready-to-use citronella and sesame oils, oleic acid, tween 80, 96% alcohol, and water.

The research method used was a completely randomized design (CRD) with two factorial treatments and controls. The first factor was citronella oil with a concentration of 0.5% and 1%. The second factor is sesame oil with a concentration of 0.5% and 1%. The two oils were combined in the emulsion into three treatment combinations, S0W2, S2W0, and S1W1. The treatment was repeated three times a day for two weeks with storage at room temperature (27-30˚C). There were four experimental units and each experiment consisted of 3 units as three repetitions. The parameters measured in the observations were hardness, damage, and glucose levels in the fruit.

Emulsion preparation was carried out at each concentration of a mixture of sesame oil and citronella oil as a coating to be used in the study. The emulsion consisted of a mixture of citronella oil (0.5% and 1%), sesame oil (0.5% and 1%), tween 80 (1%), oleic acid (0.5%), alcohol (3%), and water in 100 ml. volume/volume emulsion. The ingredients for the emulsion are mixed using a mixer for 5 minutes. If there are no lumps in the emulsion that has been mixed, the emulsion is said to be homogeneous (stable).

Indicator of the success of this research is if there is a difference between mangoes stored without any treatment (control) and mangoes coated with citronella oil (S1W0), sesame oil (S0W1), and citronella oil and sesame oil (S1W1). These differences are reviewed based on hardness, damage, and glucose levels in mangoes. Indicators of good storability of mangoes based on the level of hardness, is the hardest; based on the intensity of damage, is the lowest level of damage; and based on the glucose level, is the lowest glucose level because it indicates no spoilage during the storage process.

RESULTS AND DISCUSSION

Mango Fruit Hardness

After the mangoes were stored for two weeks and given an emulsion coating every three days, the final hardness results can be seen as follows.

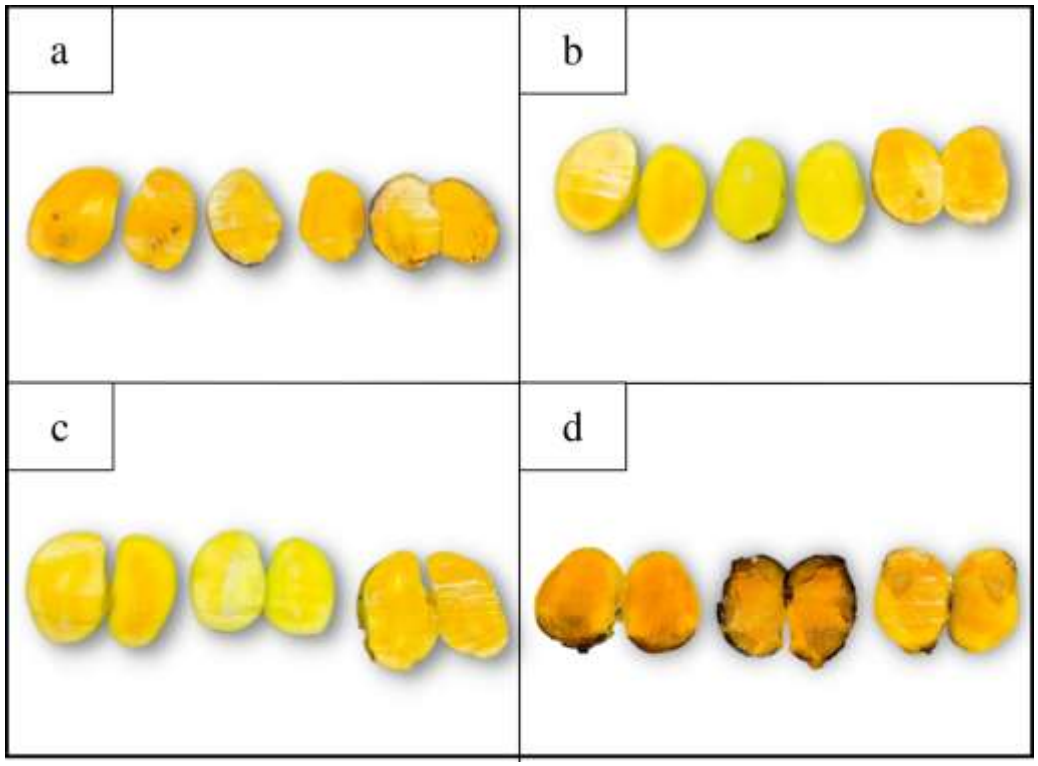

Figure 1. Endocarp cross-section (a: S2W0; b: S0W2; c: S1W1; and d: control).

Based on the research, the level of hardness (exocarp and endocarp) in mangoes from the beginning to the end of storage has decreased. This can be seen based on differences in fruit texture in each treatment that has been done. When viewed from the cross-section of the endocarp, it is clear that the control treatment without any emulsion coating had the softest texture. Then, followed by coating treatment S2W0, coating treatment S0W2, and coating treatment S1W1. Based on fruit cross-sectional observations (Figure 1) the S1W1 coating treatment can keep freshness and reduce the ripening rate of mango (*Mangifera indica* L.) fruit more than the control treatment.

This is in line with research conducted by Prastya *et al.* (2015) on the quality and shelf life of tomatoes. The results showed that there was an effect of coating on sesame oil and citronella oil at the best concentration (0.5%). The coating extends the shelf life of tomatoes by 24 days at room temperature. The low hardness is due to the use of citronella oil as a coating material which can inhibit the entry of oxygen into the tissue. Hence, the enzymes that cause a decrease in hardness values become less active. According to Pujimulyani (2009), during the cooking process, raw fruit that has a hard texture will become soft. Hardness is a structural

function of the cell wall that surrounds all cells in plants. The decrease in fruit hardness is generally caused by enzyme activity. The enzymes pectin esterase (PE) and polygalacturonase (PG) break down pectin compounds in the middle lamella (Watada & Aulenbach, 1979). Breakdown of insoluble protopectin into soluble pectin or hydrolysis of starch. This causes the breakdown of the carbohydrate polymers that make up the cell wall, especially pectin and cellulose (Pantastico & Kamariyani, 1986). Thus, it weakens the wall and tissue cohesion bonds, as a result, the texture (hardness) of the fruit becomes soft (Wills *et al*., 2007).

Emulsion coating on mango fruit can inhibit the respiration process by limiting the contact of the fruit surface with oxygen. This will result in a decrease in the activity of polygalacturonase and amylase enzymes so that polygalacturonase (protopectin) and starch are not too degraded into water-soluble pectin ((Wang *et al*., 1983)). (Rudito's research (2011) states that the use of edible coatings can inhibit metabolic processes, as it causes ripening of the fruit and a decrease in hardness. Mangoes without edible coating (control) were still subjected to the respiration process. Meanwhile, fruit treated with edible coatings absorbs less oxygen, making it possible to lower tissue softening (Prastya *et al*., 2015). Also, texture degradation during storage is reduced (Ben-Yehoshua, 1987).

Mango Fruit Damage

After the mangoes were stored for two weeks and given an emulsion coating once every three days, the final results of the damage could be seen as follows.

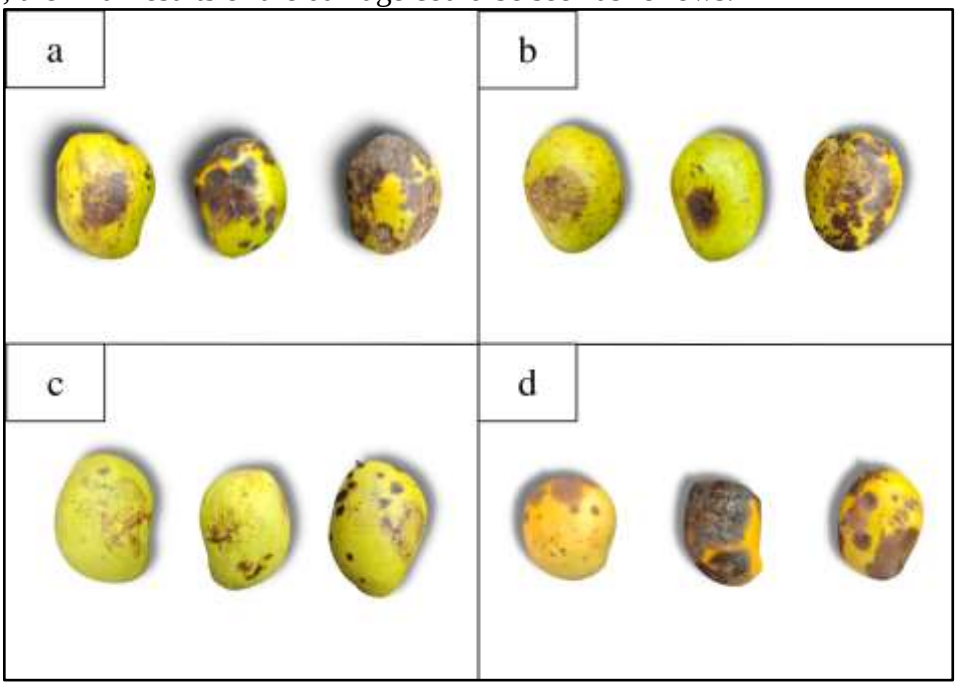

Figure 2. Mango exocarp damage (a: S2W0; b: S0W2; c: S1W1; and d: control).

Mangoes with the S1W1 coating treatment achieved the best results. This is based on indicators of mango fruit damage because it had the lowest intensity of exocarp damage. While the worst attainment was owned by the control treatment with the highest intensity of exocarp damage. Another research conducted by Prastya *et al*., (2015) on tomatoes using coating method showed that tomatoes with the coating treatment of 0.5% citronella oil and 0.5% sesame oil had the lowest damage intensity. This indicates that the mixture of sesame oil and citronella oil with a concentration of 0.5% has an effect. The coating prevents damage during the fruit storage process.

Fruit with S1W1 coating did not experience significant damage. This can happen because citronella oil contains antimicrobial ingredients. Also, sesame oil is useful as an

inhibitor of the rate of respiration in fruit (Tarigan *et al*., 2016). In citronella oil, there is a citral compound, which belongs to the terpenoid group with an aldehyde group. Essential oils that contain aldehydes or phenols, such as cinnamaldehyde, citral, carvacrol, eugenol, or thymol as the main component show the highest antibacterial activity (Yunilawati *et al*., 2021). Thus, citronella oil is good for use as an edible coating to delay damage to mangoes. S1W1 emulsion coating (0.5% citronella oil and 0.5% sesame oil) was the most effective combination to delay damage to mangoes. This combination is able to control the microbes in the fruit so as to extend the shelf life and maintain quality. This is also in accordance with a research conducted by González-Aguilar *et al*, (2009) which found that to maintain good quality and also maintain fruit freshness, the edible coating can be done as well as storage at room temperature.

Mango Fruit Glucose Level

After analyzing glucose levels in mangoes using a refractometer, the following results are obtained.

Table 1. Results of Analysis of Mango Fruit Glucose Levels

No.	Treatment	Glucose Level
1	S0W2	6,2%
2	S1W1	6,6%
3	S2W0	7%
4	Control	6,4%
Average		6,55%

Based on the results of the research, there was an increase in glucose levels in treated mangoes. Glucose levels in the fruit with the S0W2 treatment were the lowest. While the highest glucose levels were in the S2W0 treatment. During the storage process of mangoes, the most common tendency is an increase in glucose levels (Purwati, 1991). Another research conducted by Tarigan *et al*. (2016) using tomatoes experienced an increase in glucose levels during the storage process, especially on the 10th and 15th days. The increases in glucose levels are related to the process that occurs during fruit ripening, the hydrolysis of carbohydrates into glucose compounds accompanied by a decrease in the levels of organic acids and phenolic compounds in the fruit. The more the mangoes ripe, the more its glucose levels increase. This causes change in the ratio of glucose and acidity levels. In addition, carbohydrate hydrolysis can be accelerated by the respiration process. Therefore, coating the fruit skin with an emulsion aims to close the pores on the fruit skin to minimize the occurrence of the respiration process. While the decrease in glucose levels in untreated fruit was due to changes in reducing sugar levels. The increase and decrease in sugar levels follow the fruit respiration pattern.

Concerning mangoes which belong to the climacteric fruit, Baldwin *et al*, (1999) stated that respiration in climacteric fruits increased at the start of storage. Then, it shows a decreasing trend along with the length of storage. According to Kays, (1991) and Wills *et al*. (2007) the most common trend that occurs in fruit during storage is an increase in sugar content followed by a decrease. This respiration pattern can affect the quality of mangoes during the storage period.

CONCLUSION

Some of the observed parameters indicated that the coating treatment with sesame oil and citronella oil emulsions had an effect. The coating resulted in a change in the quality and extended the shelf life of the mangoes. Coating mixture treatment with a ratio of citronella oil concentration of 0.5% with sesame oil 0.5% is the most effective treatment in maintaining quality and shelf life because this treatment can delay damage to mangoes. Yet, coating

mangoes with a ratio of 1% sesame oil and 0% citronella oil can also be another solution as a coating to maintain the quality and shelf life of mangoes at room temperature.

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