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THE EFFECT OF CHITOSAN COATING ON COLOR AND BRIX OF RED GRAPES (*Vitis vinivera)* IN STORAGE

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ABSTRACT

Fruits are a type of perishable agricultural product. One of the post-harvest handling efforts to maintain the freshness of the fruit is chitosan coating. Research has been carried out on various level concentration of chitosan as a coating for grapes (Vitis vinivera) and storage time. This study aims to determine the effect of chitosan concentration on water content, color and brix of red grapes after storage. Chitosan coating was carried out by immersion methods at various levels of chitosan concentration, namely 0%, 0.5%, 1%, 1.5% and 2% (w/v) with immersion times of 30 seconds and 60 seconds. Based on the statistical test, it is shown that the chitosan concentration of 1.5% (w/v) with immersion time of 60 seconds and storage time on the 5th day is the most optimum for the brightness level of the grapes because the chitosan layer can close the pores of red grapes so that the respiration process aerobic and CO_2 which affect color can be inhibited by chitosan solution.

Keywords: Chitosan, edible coating, grape, post harvest, shelf life

I. INTRODUCTION

Red grapes (*Vitis vinivera*) have been known since 5000 years BC. This plant is known as an antioxidant, which contains vitamin A, vitamin C, vitamin E, vitamin B1, vitamin B2 (Rowe, 2009). While minerals that are contained in grapes are protein, iron, phosphorus, magnesium, fiber, calcium, potassium, acids (Hernani, 2005).

Fruit is one of the agricultural products that is consumed fresh. After the harvesting process, the fruit still continues its metabolic function, one of which is respiration. According to Pujimulyani (2012), when fruits are ripening, there are changes in constituent substances, including changes in carbohydrates, proteins, fats and changes in taste and organic acids. The respiration rate of climateric fruit has increased rapidly after harvesting, while non-climateric fruit has a rate of respiration which gradually decreases. The peak of respiration rate in climateric fruit occurs when the fruit is ripe and decreases after it ripes. Meanwhile, the respiration pattern in non-climatic fruit does not increase the rate of respiration when ripes. This physiological process is the process of ripening the organs in the fruit. The ripening process is a series of processes that change color, taste and texture that occurs until the state or condition of the harvested organs is accepted by consumers for consumption or processing. The process of ripening fruit is closely related to the respiration and photosynthetic activities of each plant. Ripening usually increases the amount of simple sugars that give a sweet taste, decreases organic acids and phenolic compounds that break down acid and an increase in the essential substances that give fruit to the fruit (Pantastico, 1989).

One of the post-harvest handling efforts to maintain the freshness of the fruit is chitosan coating. Research on chitosan coating to extend the shelf life of fruits has been done by previous (Suseno et al., 2013), but not many have studied for non-climatic fruit, one of which is red grapes. So this research needs to be done to develop knowledge about chitosan coating on red grapes.

II. MATERIALS AND METHODS

This research was conducted at the Laboratory of Biological Physics, Faculty of Agricultural Technology, Universitas Gadjah Mada on September 16, 2020 - September 23, 2020. The conditions during the study were set at an average temperature was 29 ^{0}C with humidity of 73%. The tools used are: 1000 ml glass beaker, 500 ml measuring flask; 100 ml measuring cup, stirring rod, 1 ml measuring pipette, magnetic stirrer, hot plate, blender, thermohygrometer, pocket refractometer, and chromameter. This study used a completely randomized design method (CRD) which consisted of 2 factors, namely the chitosan level (a) with 5 levels, namely; a_1 = 0%; a_2 = 0.5%; a_3 = 1%; a_4 = 1.5% and a_5 = 2% and immersion time (b), namely; 30 seconds (b_1) and 60 seconds (b_2). The combination carried out there were 9 treatments, each treatment was repeated 3 times so that the number of experimental units was 27 experimental units.

2.1. Research Procedure

The chitosan with various concentrations (0.5, 1, 1.5, 2% w/w) was prepared by dissolving the corresponding amount of chitosan in the solution containing 1 % w/w acetic acid. Then distilled water is added to the suspend solution until the volume reaches 100 ml (Suseno et al., 2006). The mixture was stirred at 40^{0}C for 15 minutes using a magnetic stirrer. Chitosan solution at the level of 0.5%, 1%, 1.5% and 2% (w/v) was placed in a glass beaker. The red grapes were dipped in the respective chitosan solutions of 0.5%, 1%, 1.5% and 2% (w/v), drained and dried for 30 minutes, after which they were stored at room temperature and observed every two days observation during 7 days. 630 grapes were used in this study, while 189 samples were analyzed for brix evaluation and 9 samples were measured for color testing. The same fruit were used for the next color measurement.

2.2. Research Parameters and Analysis

In this study, color measurements were carried out with a Minolta CR-400 chromameter. According to Soekarto (1985), the Hunter Lab color system has three attributes, namely the values of L, a, and b. The L value indicates the brightness of the sample (chromatic color, 0 = black to 100 = white). Red to green chromatic colors are indicated by the value of a (a = 0 to 100 for red, a = 0 to - 80 for green). Blue to yellow chromatic colors are indicated by the value of b (b = 0 to 70 for yellow, b = 0 to - 70 for blue). While testing for chemical properties includes measuring water content and brix. Testing the Brix value (%) using Atago pocket refractometer.

Shiekh et al (2013) identified that one of the important factors in the perception of strawberry fruit quality is the color of the fruit. The chitosan concentration of the coating solution gave rise to significant differences in fruit color. Apart from that, brix value is also an important maturity index for fruits, and edible coatings are effective in lowering total suspended solid, or, in other words, lowering ripening rates (Moalemiyan et al., 2011). Data were analyzed using one way ANOVA and Duncan's test at a 5% confidence range.

III. RESULTS AND DISCUSSION

3.1. Water Content (%)

Pantastico (1986) states that fruits and vegetables experience loss water after harvesting. The results of red grape's water content can be presented in Figure 1. The average water content (%) of red grapes at 60 second immersion with level 0.5%, 1%, 1.5% and 2% are 83.49%, 83,19%, 82.62%, and 82.14 %, respectively. Figure 1 shows that in the 30 second immersion treatment, the water content decreased from the 0th observation day to the last observation day at various levels of chitosan coating. The immersion treatment for 60 seconds decreased at the chitosan coating level of 0.5%, 1.5% and 2%, while at the 1% chitosan level the water content decreased until the fifth day of observation. The results of the analysis of water content in grapes during storage are presented in Figure 1.

Lost water tremendously big influence on the weight of food, this due to the greatest content in the yield horticulture is air. Nakasone and Paull (1998) states that this air loss depends on types of commodities, cultivars, fruit conditions before harvest, deficit in air vapor pressure

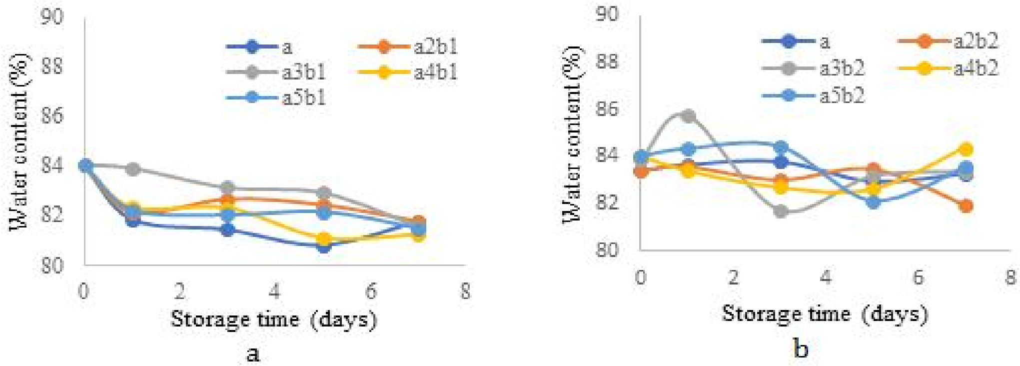

Figure 1. Changes in Water Content (%) of Stored Red Grapes During Post Harvest Storage
(a) Immersion Time of 30 Seconds (b) Immersion Time of 60 Seconds

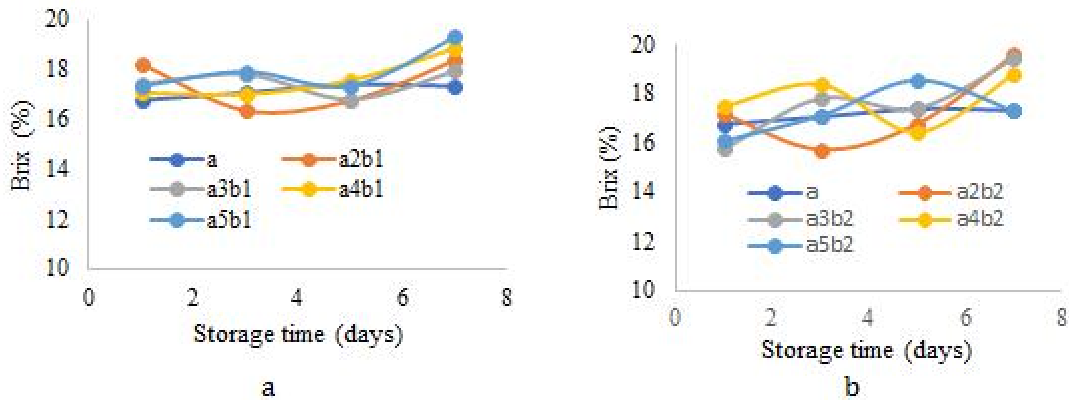

Figure 2. Changes in Brix (%) of Stored Red Grapes During Post Harvest Storage
(a) Immersion Time of 30 Seconds (b) Immersion Time of 60 Seconds

between commodities and air around, wound, moment heat dissipation treatment post-harvest and the presence of coating or wrap material. Chitosan has been reported to be more effective at delaying weight loss in banana and mango (Kittur et al., 2001) and strawberries (Ribeiro et al., 2007) than are starch and cellulose derivatives. Mudyantini et al. (2017) stated that coating chitosan at various concentrations causes the closure pores surface of the fruit skin so that the activity of respiration and transpiration in fruit can be inhibited or reduced.

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3.2. Brix (%)

From the observations obtained brix (%) on the seventh day immersion time 30 seconds 16.36 % at the 0.5% level, 17.93 at the 1% level, 18.84% at the 1.5% level, and 19.30% at the level 2%. At 60 second immersion time, brix (%) red grapes 19.60% at the 0.5% level, 19.44% at the 1% level, 18.82% at the 1.5% level and 17.30% at the level of 2% rate. The content of brix (%) increased from day 0 of observation to day 7 in accordance with the theory presented by Suketi et al (2010) that the main component of total dissolved solids is sugar. During fruit ripening, the total dissolved solids increase due to the breakdown and splitting of carbohydrate polymers, especially starch, into sugar so that the total sugar content

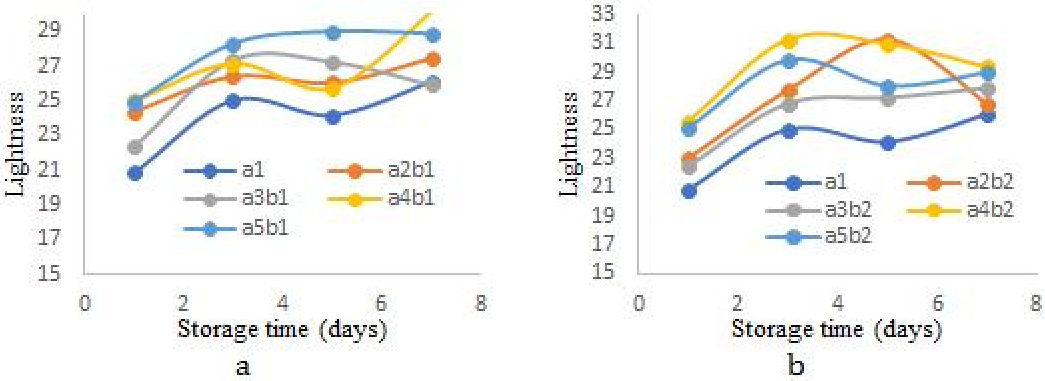

Figure 3. Changes in Lightness of Stored Red Grapes During Post Harvest Storage (a) Immersion Time of 30 Seconds and (b) Immersion Time of 60 Seconds

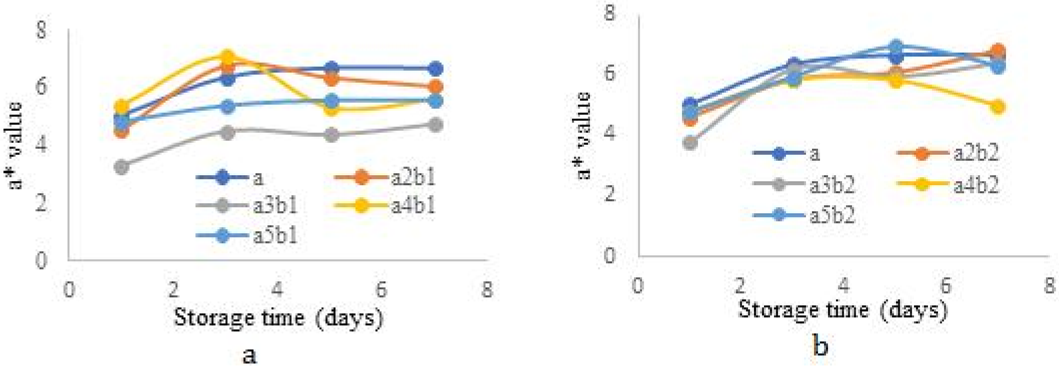

Figure 4. Changes in a* Value of Stored Red Grapes During Post Harvest Storage (a) Immersion Time Of 30 Seconds (b) Immersion Time of 60 Seconds

Table 1. Table of b* Values at Various Levels of Treatment

Days	Value b								
	a	**a2b1**	**a2b2**	**a3b1**	**a3b2**	**a4b1**	**a4b2**	**a5b1**	**a5b2**
1	1,25	1,19	1,45	1,02	1,25	1,91	1,53	1,52	1,43
3	2,09	2,72	1,71	1,14	2,43	2,72	1,30	1,55	1,69
5	2,42	2,58	0,85	1,35	1,87	1,76	1,76	1,42	2,33
7	2,72	1,94	2,30	1,77	2,75	1,67	1,06	1,60	1,69

in the fruit generally increases. According to Novaliana (2008), fruit quality is determined by the total sugar content in fruit as total dissolved solids. During storage there will be changes in the content of starch and simple sugars. The increase in total dissolved solids of fruit during storage was due to the degradation of starch into simple sugars, while the decrease in total dissolved solids was caused by the use of these sugars as a substrate for respiration to produce energy.

Figure 2 shows that in the red grapes immersion treatment the level of 0.5% immersion time of 30 seconds increases until the seventh day of observation. Likewise, the immersion time of 60 seconds showed an increase in brix levels (%) until the seventh day of observation. But based on the one way ANOVA analysis, there was no significant difference to the brix value of grapes. this is probably due to the less than optimal concentration of chitosan and the duration of immersion time.

3.3. Color

One of the important factors in the perception of fruit quality is the color of the fruit. Coating treatments did not report significant changes in initial color coordinates of fruit. It has been observed that uncoated fruits are significantly darker than coated fruit throughout the storage period. Color changes in the skin of the fruit can be used as an indicator of ripeness. Factors that could also have an influence on the development of dark-colored pigments include changes in ascorbic acid and in sugar profiles, peroxidase activity, and other phenolic compounds that are good substrates for enzymatic browning (Nunes et al., 2005).

Based on the research data, it was found that the a value increased both at the immersion time of 30 seconds and 60 seconds at various treatment levels. However, based on one way Anova analysis it was shown that there was no significant difference in the color of chitosan coated grapes. This could be due to the less than optimal chitosan solution in coating the grapes. Edible coating is able to modify the air composition in the fruit by maintaining high CO_2 concentrations in the fruit internals and inhibiting chlorophyll degradation and the formation of beta carotene (Moalemiyan et al., 2011). The chromatic values of red blue to yellow (b) in red grapes are presented in Table 1.

Based on the results of observations, the value of b in the control has increased from the first day of observation to the seventh day of observation by 2.71. However, the rise and fall has no pattern. One Way Anova analysis with a confidence level of 95% showed that each concentration of chitosan with coating of 30 seconds and 60 seconds did not show a significant difference on the brix value and color of grapes.

IV. CONCLUSION

Application of the chitosan-based coating on red grapes with various concentrations of 0.5, 1, 1.5, and 2% in the immersion time of 30 and 60 seconds did not show significant results on water content, brix value, and color. Even though, the optimum brightness value was obtained from a combination of 1.5% concentration and immersion time of 60 seconds. The variation in concentration and duration of chitosan immersion was considered less effective in chitosan coating. Thus, it is necessary to evaluate and change the variation of immersion time of the chitosan coating, then determine the effect of chitosan coating on microbiological characteristics, storage temperature, and vitamin C levels.

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