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Beeswax formulation and Wrapping effects on red garifta mango physical characteristics

Beeswax formulation and Wrapping effects on red garifta mango physical characteristics

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Abstract. Red garifta is a mango variety that has an attractive appearance with sweet and fresh taste. It is one of the superior Indonesian fruits which having export potential. Therefore, improving the fruit quality is needed to increase market competitiveness. This study aimed to determine the effect of beeswax coating concentration and wrapping on the Red Garifta mango shelf life. There were two factors, first factor was beeswax concentration (0%, 2%, 4% and 6%), and the second factor was wrapping (without and wrapped with cardboard). The result revealed that 6% concentration beeswax is the best treatment throughout storage period with minimum loss of weight, extended color and proportional hardness. Wrapping also gave better effect on the color intensity, hardness, and less weight loss reduction. Therefore, it could be concluded that the treatment able to increase the red garifta mango shelf life.

Keywords: Fruit Waxing, Wrapping, Quality, Red Garifta

1. Introduction

Mango is tropical commodity with enormous potential for future. There are more than a thousand research about vegetative propagated mango cultivars have been published, such as Irwin (Miami), Carabo (Philippines), Alphonso (India), Bombay Green (Jamaica), Mamuang (Thailand), Tee-Vee-Dee (Ghana), and Madame Francis (Haiti) [1]. In 2010, Idonesian Tropical Fruit Research Institute also already launched new varieties called Red Garifta, which has reddish color, sweet taste, strong aroma , high moisture content (83.1-86%), sugar content (15.5" Brix), vitamin C (45.5 mg/100 g), low acid content (0.21%) and the shape is oval (14-16.5 cm) [2]. The product of mango has been developed, alike pulp, toffee, yoghurt, carbonated mango beverages, mango wine, dry mango powder, chutney, mango custard powder, mango cereal flakes, strained baby food, and mango pickle [3]. Therefore, it is necessary to develop postharvest management alike storage methods of fresh mango for enhancing its shelf life without any detrimental effect during distribution [4].

Mango is highly perishable which a very short shelf life and reach to respiration peak of ripening process. Mangoes are usually harvested at the mature-green stage, then transported to distant markets and [5] ripening in 9-12 days after harvesting period at room temperature [6] and 2-3 weeks in cold storage at 13ºC [7]. This short period seriously limits the long distance commercial distribution. Several study showed that shelf-life could be extended by stored them under optimum temperature, relative humidity, atmosphere composition, and use of ripening retardants [8]. In order to extend the shelf-life

and marketing period of mango, it should be stored at 12ºC and 90-95% RH, because the fruit will not suffer from chilling injury and will undergo normal ripening process [9] [10].

Waxing (edible coating) also has been used for ameliorating the postharvest fruits performance effectively and efficiency [11] [12] [13]. Moreover waxing acts as barrier on the fruits surface to suppress respiration, control moisture loss [14] [15], reducing peel dehydration, maintaining color [16], increasing titratable acidity, firmness, and effective to alleviate chilling injury [17] [18] [19] [20]. Fruit waxing had the greatest effect on preserving fruit quality, especially size, weight, and had a detrimental effect on Vitamin C [21].

Beeswax is obtained from honey combs of bees after the honey has been removed by draining or centrifuging. Beeswax is consists of a complex mixture of various compounds such as hydrocarbons, esters, palmitate, palmitoleat, hidroxypalmitat and oleat esters. These vegetable oil waxes have no any noxious up shots on human health upon consumption. According to FDA, they are food grading vegetable oil waxes. This research intended to observe the effect of beeswax concentration and wrapping for enhancing mango shelf life.

2. Materials and Method

Materials used for this research were red garifta mango from CukurGondang experimental garden in PasuruanDistrict East Java Province Indonesia. The samples were uniform in maturity levels, it should be 80-85%, 100-105 days after the flowering period, mango weight's 315-330 gram, and free of mechanical and biological damage. The wax emulsion main ingredients were beeswax, oleic acid, water, and triethanolamine (TEA). Nested design with 1stfactor : concentration of beeswax (0%, 2%, 4% dan 6%) and 2nd factor : Wrapping (without wrapped and wrapped in cardboard), with 3 replications were applied. Waxing mangoes used dipping method, which started by preparing the ingredient proportions for wax emulsion formulation(Table 1).

Table 1. Beeswax Formulation

Treatment	Beeswax (gram)	TEA (ml)	Oleic acid (ml)	Water (ml)
2%	20	7	3	970
4%	40	13	7	940
6%	60	20	10	910
8%	80	27	13	880

Beeswax was heated at temperature 90-95ºC, TEA and oleic acid was added and stirred for homogenization. Wax emulsion was cooled until it reached the temperature± 26ºC, then it was stirred with water well until homogeneous. Red garifta mango was dipped in the wax emulsion for 10 – 30 s and dried it in room temperature, then wrapped used cardboard. The samples were taken at interval of six days for hardness, colour, and weight loss analysis.

Colour Intensity analysis

The colour skin of red garifta mango assessed by using colour reader, that expressed redness (a+) and yellowness intensity (b+).

Texture/hardness measurement

Fruit texture was assessed by using texture analyzermachine that connected with computer. The force required to penetrate 10 mm inside, using a probe 6 mm. The machine was set with compression mode at 20 mm min^{-1}, result was expressed in term of force recorded in Newton (N).

Weight loss analysis
A fruits in each block were separately marked before storage and weighed. The same fruits were consistently weighed at each sampling interval during the whole storage period. The result was expressed on a percentage basis.

$$\text{Weight loss (\%)} = \frac{W_0 - W_a}{W_0} \text{x100\%}$$

W_o= weight before storage (g)
W_a= weigth after storage (g)

3. Results and Discussion

3.1. Colour Intensity (Redness and Yellowness)

The results of this study indicated that beeswax concentration and wrapping were not significantly effects to the reddish and yellowish levels of red garifta mangoes (Figure 1 and 2). The color alteration of mangoes without wrapped was quicker than wrapped mangoes. The redness and yellowish intensity decreased as long as increasing of beeswax concentration.

The red mango color alteration is caused by respiration process, and the color changing speed of mangoes which stored at room temperature is faster than stored in cardboard [8]. The oxygen availability in open space more than in cardboard, so it will affect the respiration rate. The increasing beeswax concentration also affect the speed of respiration. The beeswax covered the mango peel pores, make the oxygen migration rate into the fruit is inhibited, so the rate of respiration becomes slow.

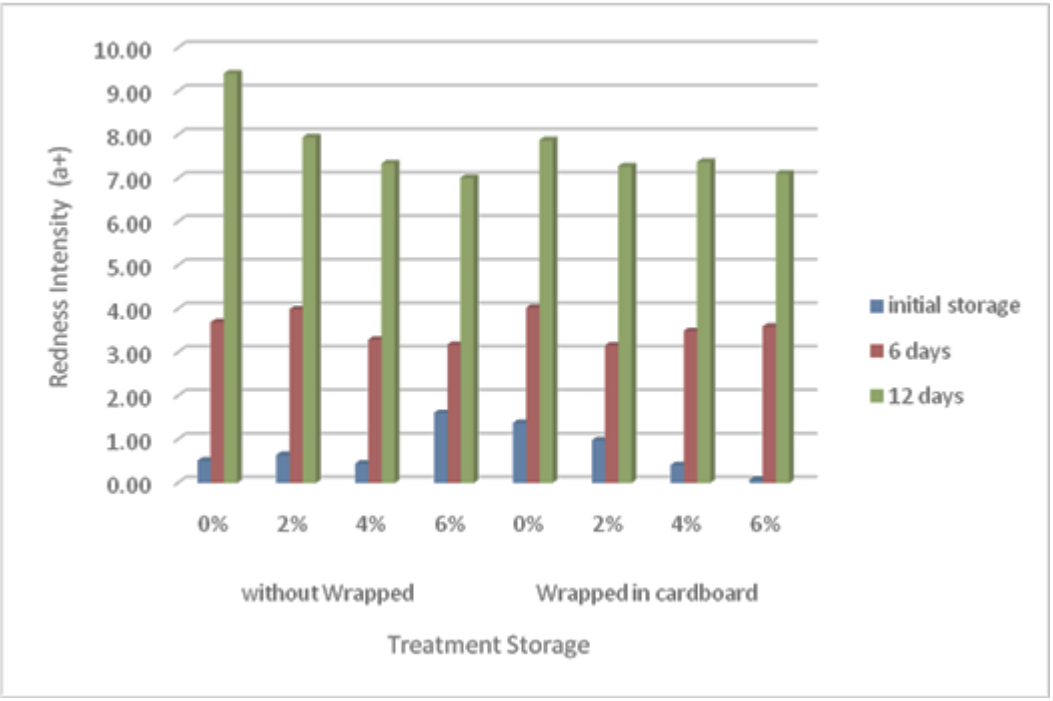

Figure 1. The redness of red garifta mango during storage

The mango ripening process involves a series of biochemical reactions, resulting into increased respiration, ethylene production, change in structural polysaccharides causing softening, degradation of chlorophyll, developing pigments by carotenoids biosynthesis, change in carbohydrates or starch conversion into sugars,organic acids, lipids, phenolics and volatile compounds, thus leading to ripening of fruit with softening of texture to acceptable quality [6] [16].

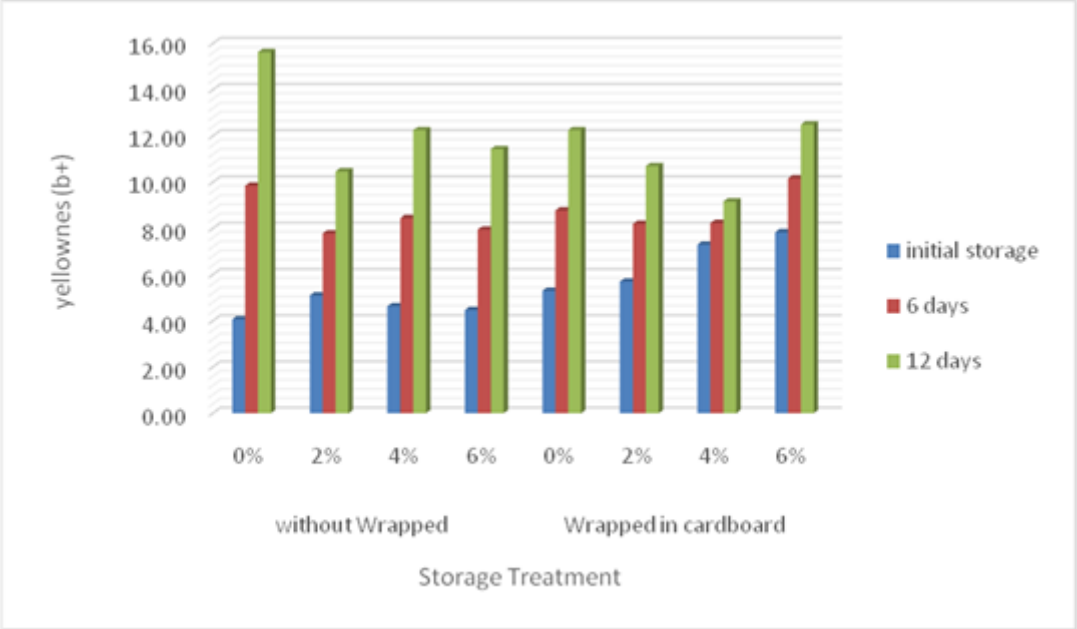

Figure 2. Yellowish intensity of red garifta mango during storage

3.2. Hardness

The ripening process of mango fruit involves a series of biochemical reactions, change in structural polysaccharides causing softening [8]. Mango fruit hardness reduced in all samples (Figure 3). Red garifta hardness without waxing and wrapped rapidly decreased during storage period, this result was consistent with experiment on Shindri var. and SufaidChaunsa var. mango [8]. The previous study treated mango by waxing beeswax 6% significantly able toretain the hardness [22]. The experiment of pineapple waxing also described that waxing was potentially useful method to alleviate chilling injury associated with the major changes of cell embrane as indicated by altering electrolyte leakage, MDA content and AsA and to maintain their quality by retarding dehydration, providing a selective barrier to moisture loss and gas exchange, which lead to reduction of general metabolism rate, improvement of textural quality and maintenance of fruit quality especially hardness[17].

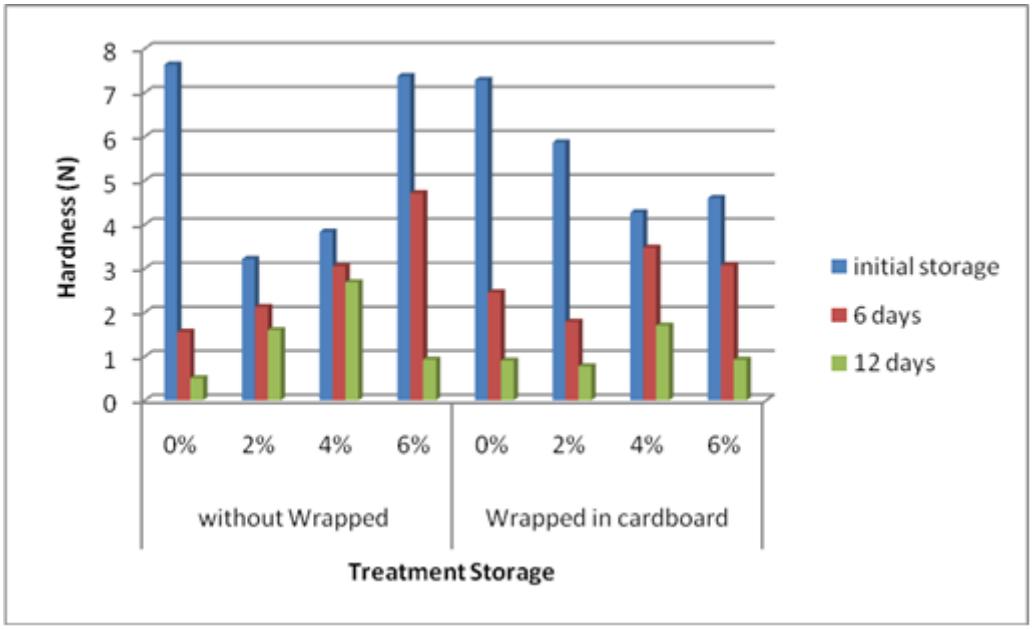

Figure 3. Red garifta mango hardness during storage period

3.3. Weight loss

Fruit weight loss is mainly associated with respiration and moisture evaporation through the skin which affected by packaging [8]. The beeswax coating was effective in slowing down weight loss (Figure 4.). After stored 12 days, the unwrapped red garifta mango weight loss reached 32,82%, while waxing 6% with wrapped in cardboard reached 4,57%. The fruits with beeswax coating and kept at cardboard showed the lowest weight loss, while the highest weight loss was observed in mangoes without waxing (0%) and unwrapped.

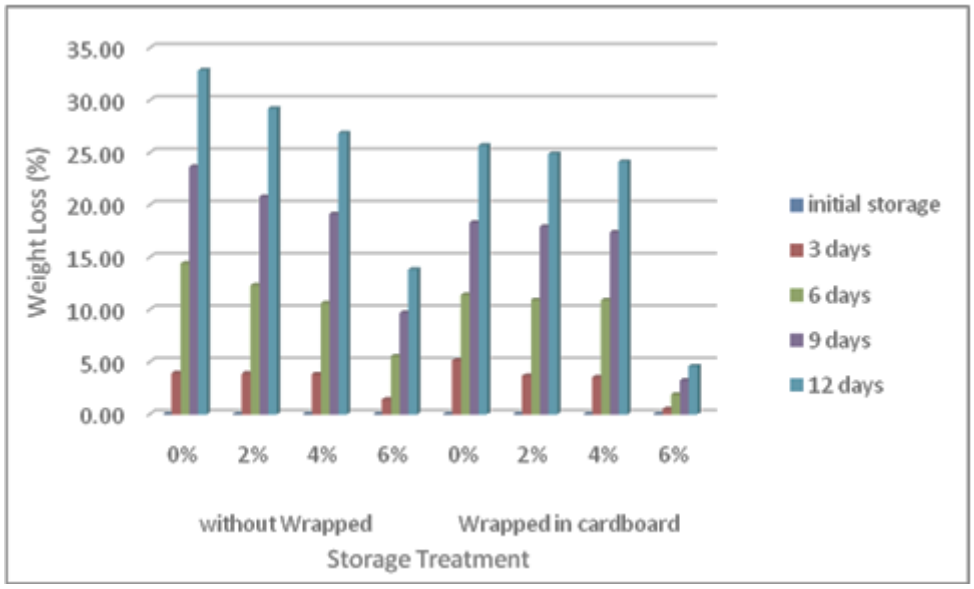

Figure 4.Weight loss of red garifta mango during storage period

The application of wax emulsion is employed to control the weight loss, maintain its appearance and natural gloss [23]. While waxing act as barriers, thereby restricting water transfer and protecting fruit skin from mechanical injuries, as well as sealing small wounds and thus, delaying dehydration [17] [24].

The weight loss reduction could be due to the physical barrier in gas diffusion through fruit stomata by which gas exchange takes place between internal tissues and external atmospheres [25]. The lower weight loss in wrapped condition could be due to combination of a humidity build up, lower metabolic activity and respiration [4].

4. Conclusion

The 6% concentration beeswax is the best treatmentthroughout storage period with minimum loss of weight, extended color and proportional hardness. This study recommends that beeswax 6% as coating material that is effective in waxing. Wrapping treatment also gave better effect on the color intensity, hardness, and less weight loss reduction. Therefore, it can be concluded that waxing and wrapping treatment can increase the shelf life of red garifta mango.

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