PAPER

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Effect of ozone technology applications on physical characteristics of red cayenne pepper (*Capsicum frutescens* L.) preservation

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Abstract. Research on the application of ozone technology to red cayenne pepper had been done. The purpose of this research was to determine the changes in the physical characteristic, i.e. TPA (Texture Profile Analysis) and color parameters (*L*, *a**, *b**) of red cayenne pepper by treated with ozone technology. The research method was red cayenne pepper were not sprayed with ozonated water then stored in room temperature, air-conditioner room temperature, cold storage, cold storage dedicated ozone (R0, A0, C0, and Z0) and red cayenne pepper were sprayed with ozonated water then stored in room temperature, air-conditioner room temperature, cold storage, cold storage dedicated ozone (R1, A1, C1, and Z1). The storage times were five days, ten days, 15 days, 20 days, 25 days, and 30 days. During the storage period, the visual appearance, change in texture, color, and weight loss were measured. The results showed that ozone technology treatment and the length of storage time influenced the texture, color, and weight loss of red cayenne pepper as a conclusion the red cayenne pepper treated by sprayed with ozonated water and stored in cold storage dedicated ozone could maintain the quality of red cayenne pepper for 30 days.

1. Introduction

Red cayenne pepper (*Capsicum frutescens* L.) is one of the essential commodities in agriculture in Indonesia. Generally, red cayenne pepper sold on the market is only able to survive a few days outdoors. When farmers have a large harvest, it will certainly make the price of chili on the market through a decline. This is indeed not comparable to the initial capital of farmers when planting chili. Storage is a form of postharvest handling action that is always related to the length of time and maintains the value of stored commodities. Various types of storage technologies have often been introduced to agribusiness to preserve the quality of fresh produce, but until now the use of storage technology is still not optimal for use. Limited knowledge and improper storage technology become a barrier factor not yet effective utilization of storage technologies in maintaining the quality of horticultural products. So we need a study of storage technology for horticultural commodities so that storage can work efficiently and effectively.

Ozone is an active antimicrobial agent with high reactivity, penetration, and spontaneous decomposition into non-toxic products [1]. Ozone has been declared in many countries as a potential use for food processing and is stated in the US as GRAS (Generally Recognized as Safe) [2]. Several

researchers have shown that treatment with ozone appears to have a beneficial effect in extending the storage life of fresh non-cut commodities such as broccoli, cucumber, apples, grapes, oranges, pears, raspberries, and strawberries by reducing microbial populations and by oxidation of ethylene [3] [4] [5]. The use of ozonated water has been applied to fresh-cut vegetables for sanitation purposes reducing microbial populations and extending the shelf-life of some of these products [6] [7].

Color and texture about fruits and vegetables may be described as attributes for the characteristics that impart distinctive quality. Colors and appearance attract consumers to a product and can help in impulsive purchases. At the point of sale, consumers use appearance factors to indicate freshness and flavor quality (Barrert *et al*., 2010). The purpose of this research was to determine the changes in the physical characteristic, i.e. TPA (Texture Profile Analysis) and color parameters (L, a*, b*) of red cayenne pepper by treated with ozone technology.

2. Methods

2.1. Ozonated water dissolution

The step of making ozonated water was by dissolving ozone into the water. The tool used for dissolving ozone into the water was an ozone generator used to produce ozone with an ozone capacity of 150 g/h in 150 liters of water for 60 minutes.

2.2. Spraying ozonated water to red cayenne pepper

Volume ozonated water to scattered was 500 mL for 5 kg of red cayenne pepper. Spraying was done in cold storage every 3-5 days. Spraying ozonated water was carried out evenly on the entire surface of the red cayenne pepper.

2.3. Storing red cayenne pepper

This research use several treatments with storage variations, those were that R0 = not sprayed with ozonated water and stored at room temperature, R1 = sprayed with ozonated water and stored at room temperature, A0 = not sprayed with ozonated water and stored at air-conditioned room temperature, A1 = sprayed with ozonated water and stored at air-conditioned room temperature, C0 = not sprayed with ozonated water and stored in cold storage, C1 = sprayed with ozonated water and stored in cold storage, and Z0 = not sprayed with ozonated water and stored in cold storage dedicated ozone, Z1 = sprayed with ozonated water and stored at a cold storage room dedicated ozone. Room temperature ranges from 25 – 28 ℃ with air humidity ≤70%, air-conditioned room temperature ranges from 16 – 20 ℃ with air humidity ≤70% and temperature of cold storage ranges from 2 – 7 ℃ with air humidity of 80 – 90%. In cold storage dedicated ozone was given ozonation every day for 1 hour to get ozone density of 15 grams/m^3. This time was based on the ozone density equation that was:

$$\text{Ozon density} = \frac{\text{ozon capacity (g/hour)} \times \text{times (hour)}}{\text{room volume } (m^3)} \quad (1)$$

2.4. Texture analysis

The texture of red cayenne pepper was analyzed by the Texture Profile Analysis (TPA) method using the Brookfield CT3 Texture Analyzer. Samples were pressed with a probe 2 mm in diameter and repeated three times. The probe speed is 2.5 mm/s, 3 mm deformation, and 4.5 g trigger. The observed parameters include *hardness, springiness, cohesiveness,* dan *adhesion*.

2.5. Color analysis

The color of red cayenne pepper was analyzed using Digital Colorimeter applications. The parameters selected are L*a*b* or RGB. The sample was placed in the white box line. Click the video and video preview then the cursor was directed to four sides in the preview video, and the data on display was recorded. Color measurement was done three times.

3. Results and Discussion

3.1 The texture of red cayenne pepper

Texture analysis was carried out on red cayenne pepper were sprayed and not sprayed with ozonated water then stored in room temperature, air-conditioner room temperature, cold storage, and cold storage dedicated ozone. The storage time observed was five days, ten days, 15 days, 20 days, 25 days, and 30 days. Parameters found in the determination of this texture profile analysis include hardness, springiness, cohesiveness, and adhesion.

Figure 1 showed that red cayenne pepper was sprayed and not sprayed with ozonated water then stored in *cold storage* has a tendency to have a higher hardness value than stored in room temperature and air-conditioner room temperature. Hardness is the maximum peak at the first pressure or the first bite [8].

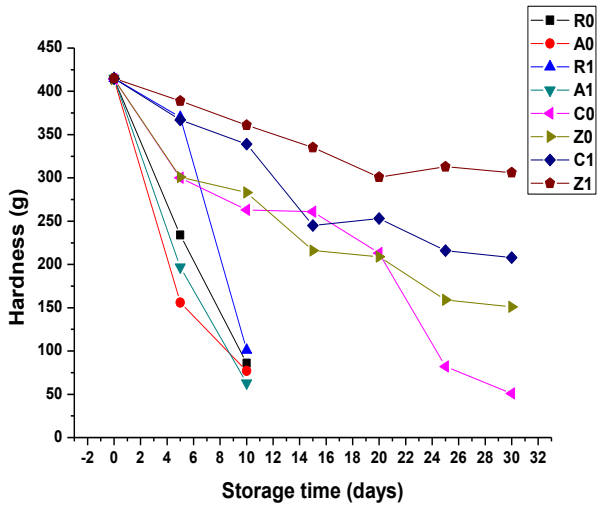

Figure 1. The hardness of red cayenne pepper with storage variations

Figure 2 also shows that the red cayenne pepper sprayed and not sprayed with ozonated water then stored in cold storage (2 - 7 ℃) has a higher tendency for springiness value compared to storage room temperature and air-conditioner room temperature. Springiness or elasticity can be interpreted as recovery time between the end of the first bite and the beginning of the second bite [8].

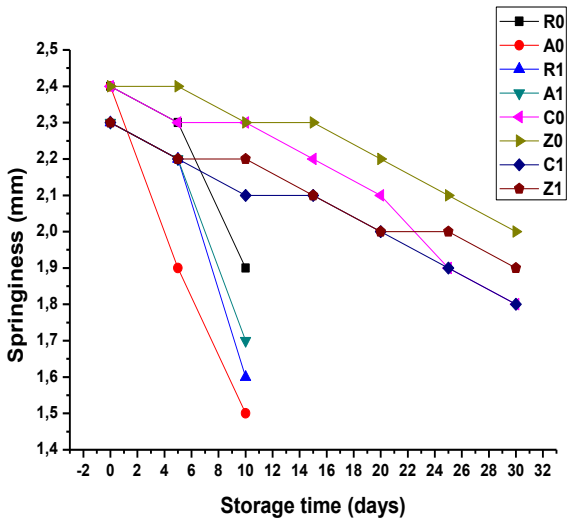

Figure 2. The springiness of red cayenne pepper with storage variations

Figure 3 shows that the treatment of red cayenne pepper stored in cold storage dedicated ozone which has a higher average cohesiveness value compared to other treatments. Cohesiveness is defined as the ratio of the area of pressure during the second compression to the first compression and has no

units. Cohesiveness can be measured as the rate at which the material is mechanically destroyed [8]. Springiness, cohesiveness, and hardness will increase with increasing water content [9]. However, there is no significant difference between room temperature storage, air-conditioner room temperature, cold storage, cold storage dedicated ozone. Hardness, springiness, and cohesiveness are the main parameters used in identifying the texture characteristics of smoked sausages [9].

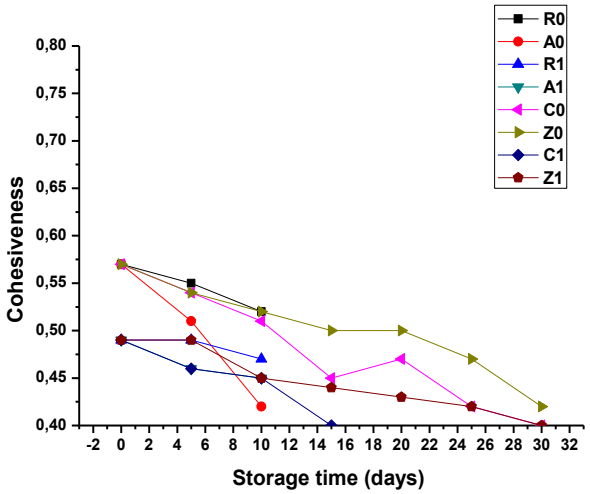

Figure 3. The cohesiveness of red cayenne pepper with storage variations

There is a significant difference between chili stored in cold storage and chili stored at room temperature and air-conditioned room. However, there was no significant difference between chili were sprayed with ozonated water or not sprayed with ozonated water then stored in the same place. The longer the storage of red cayenne pepper, the hardness, springiness, and cohesiveness will decrease.

3.2 The color of red cayenne pepper

Color analysis was carried out objectively using a photoelectric colorimeter called Hunter Colorimeter. The Hunter color notation system is characterized by three parameters L*, a*, and b*. L* values between 0-100 from black to white. The higher the L* value, the higher the whiteness. Value of a* and b* between positive and negative values. For a* shows the degree of green (a*-) to red (a*+), while b* shows the degree of yellow (b*+) to blue (b*-) [10].

Figure 4-6 showed that value of L*a*b on red cayenne pepper was stored in cold storage have a higher value than stored in room temperature and air-conditioned room. Value of a* the more important the color tends to be reddish. For the L*a*b value between the chili were sprayed and not sprayed with ozonated water and stored in the same place, there is no significant difference. The value of b * is getting more significant then the color tends to be yellowish. According to Arslan & Ozcan [11], the red reduction is caused by carotenoid autooxidation whose stability depends on drying conditions, where the rate of damage increases with increasing temperature. The color of this chili is controlled by several carotenoids (capsanthin, capsorubin, and xanthophyll for red; and β-carotene, zeaxanthin for yellowish orange color) [12].

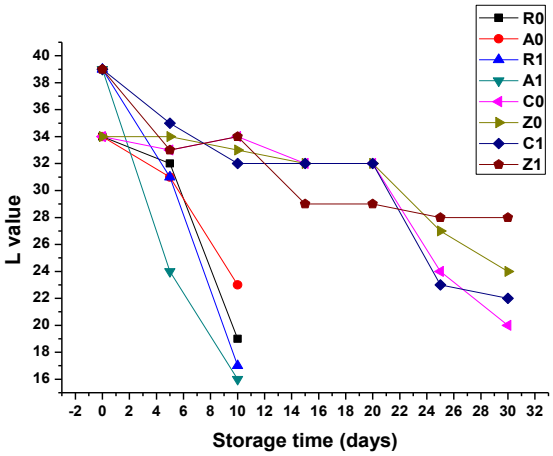

Figure 4. Brightness or L value of red cayenne pepper with storage variations

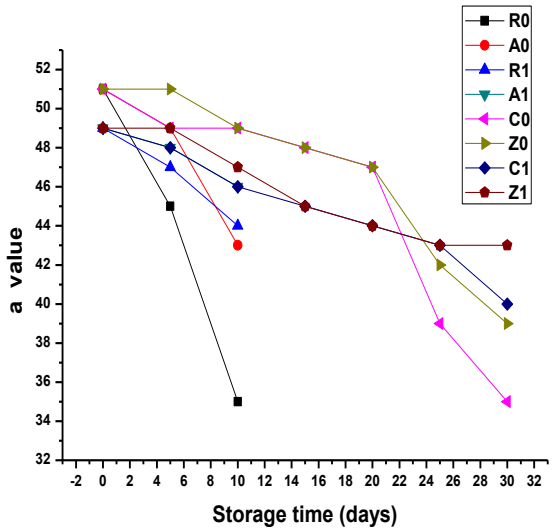

Figure 5. Red component or a* value of red cayenne pepper with storage variations

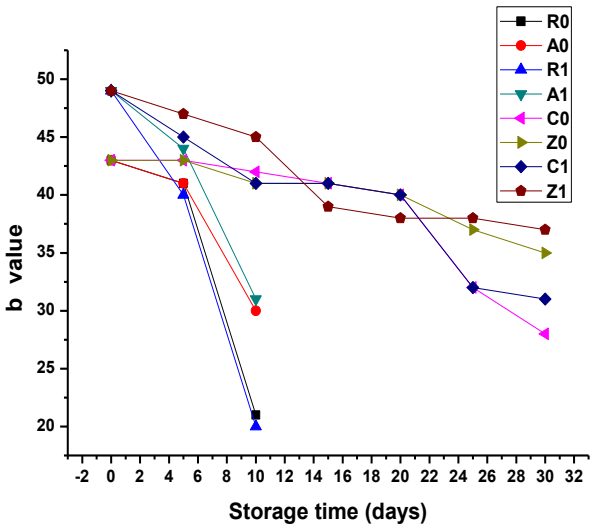

Figure 6. Yellow component or b* value of red cayenne pepper with storage variations

4. Conclusion

Red cayenne pepper was sprayed with ozonated water and not sprayed with ozonated water there no different significant if stored in same place or room. Red cayenne pepper was sprayed with ozonated water and stored in cold storage dedicated ozone have a highest level in hardness, L value and b value. Treatment sprayed with ozonated water and stored in room temperature, and air-conditioner room temperature on cayenne pepper could stay less than ten days while treatment sprayed with ozonated water and stored in cold storage dedicated ozone could maintain the quality of red cayenne pepper for 30 days.

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