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Study of Shallot (Allium cepa L.) Varieties and Storage Duration on Physical and Chemical Properties with Aloe Vera Edible Coating

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Abstract. Shallot (*Allium cepa* L.) is an important horticultural commodity in Indonesia that is prone to quality deterioration during storage. Different onion varieties exhibit varying physical and chemical characteristics, which affect their durability and quality during storage. Storage duration is also a major factor affecting onion quality. Excessively long storage, especially at room temperature, causes a decrease in water content, physical damage, and changes in chemical composition. The use of edible coatings from natural materials such as aloe vera, which contains polysaccharides and antimicrobial substances, can slow down this deterioration by limiting respiration and transpiration in onions. This study aims to examine the effect of variety and storage duration on the physical and chemical properties of onions treated with an edible coating based on aloe vera gel. The study used a completely randomized design (CRD) with two factors, namely variety (Tajuk, Bima Brebes, and Gayo) and storage duration (2 and 4 weeks), both with and without edible coating. The parameters observed included weight loss and moisture content. The results showed that variety and storage duration affected the weight loss and moisture content of shallots. The application of aloe vera edible coating was proven to reduce the rate of weight loss and maintain moisture content better than the control. The Tajuk variety showed the best performance with the lowest weight loss and more stable moisture content, while the Gayo variety experienced the highest weight loss and was more susceptible to quality deterioration. The optimal treatment was obtained in the Tajuk variety with edible coating and 2 weeks of storage, which was able to maintain the physical and chemical quality of shallots better. These findings demonstrate the potential of aloe vera-based edible coating as a natural preservation method to extend shallot shelf life.

Keywords: Aloe vera edible coating, moisture content, shallot (*Allium cepa* L.), storage duration, variety, weight loss.

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1. Introductions

Shallot (*Allium cepa* L.) is one of the important horticultural commodities in Indonesia in terms of both consumption and economic value. The various varieties of shallot exhibit different physical and chemical characteristics, which affect their durability and quality during storage. Research on variety variation is important to determine which varieties are most suitable for longer preservation using natural methods. In addition, the fact that shallots are prone to physical and chemical deterioration during storage necessitates effective and safe preservation methods [1]. Shallot varieties differ in terms of shape, skin color, size, and chemical content, such as sulfur compounds that play a role in flavor and durability. For example, the Bima Brebes variety has a high rate of damage when stored at suboptimal temperatures compared to the Tajuk and Bali Karet varieties, which are relatively more durable [2]. Storage duration is also a major factor affecting the quality of shallots. Excessive storage, especially at room temperature, causes a decrease in water content, physical damage such as softening or rotting, and changes in chemical content including pH and active compounds that support quality [3]. One way to slow down the decay process and extend the shelf life of post-harvest products is to use edible coatings. The use of edible coatings made from natural ingredients such as Aloe vera, which contains polysaccharides and antimicrobial substances, can slow down this decline in quality by limiting respiration and transpiration in shallots [4]

Aloe vera edible coating is known to have the potential to maintain freshness and extend the shelf life of various horticultural products. The gel of aloe vera, which is rich in bioactive compounds, acts as a barrier to oxygen and water entering or exiting, thereby reducing physical and chemical damage during storage [5]. Edible coatings can be protein, polysaccharide, or lipid-based, and one material that can be used is aloe vera gel, which contains many bioactive compounds with antimicrobial and antioxidant effects. Aloe vera gel is also biodegradable, making it environmentally friendly and helping to maintain product freshness [6]. The physical and chemical properties of shallots, such as weight loss and moisture content, are greatly influenced by the post-harvest treatment of the shallots. This coating application is expected to optimize the storage capacity of various varieties of shallots with different storage periods, thereby generating economic benefits and reducing post-harvest waste. The edible aloe vera coating not only reduces the rate of respiration but also forms a physical barrier against pathogenic microorganisms, thereby slowing down decay. The combination of coating treatment with adjustments to storage duration is expected to produce an effective and efficient preservation strategy [7]. Therefore, this study aims to evaluate the effect of shallot varieties and storage duration on the physical and chemical properties of shallots coated with aloe vera-based edible coating.

2. Materials and methods

2.1 Shallot samples

The material used in this study was shallots of three varieties (Tajuk, Bima Brebes, and Gayo), each weighing 2 kg. Samples of each variety were coated with an edible aloe vera coating at a concentration of 20% for 1 minute. There was also a control group for comparison, consisting of uncoated shallots. After coating, the shallots were dried and then placed at room temperature

(27°C) and stored for different periods of time: 2 weeks and 4 weeks. The shallot bulbs of the three varieties can be seen in Figure 1.



(a) (b) (c)

Figure 1. Shallot samples (a) Tajuk variety, (b) Bima Brebes variety, (c) Gayo variety

2.2. Research Procedures

2.2.1. The making of aloe vera *edible coating*

The preparation of aloe vera gel concentrate is done by mixing 20 mL of aloe vera extract with 80 mL of distilled water, resulting in 1000 mL of edible coating aloe vera gel solution with a concentration of 20%. Next, the sorted shallots are coated with the edible coating by dipping them into the prepared edible coating solution. The dipping method involves immersing the entire shallot bulb in the edible coating solution for 10 minutes. The shallots that have been dipped in the edible coating solution are then dried for 30 minutes.

2.2.2. Storage of shallots

After drying, the shallots were stored at a room temperature of 27°C. Then, observations were made on the weight loss and moisture content of the shallots. Observations were made periodically at 2 and 4 weeks.

2.3 Observation Parameters

2.3.1 Weight loss

Weight loss measurement of shallot is an important parameter in assessing the quality and shelf life of the fruit during storage. Weight loss measurements were taken at the beginning and end of the treatment, namely at 0, 2, and 4 WAT. Analytical scales were used to calculate the difference in tuber weight with precision. Weight loss can be calculated using the following formula:

$$\text{Weight loss} = \frac{W0-W1}{WO} \times 100\ \%$$

Where, W0: Initial Weight (g) and W1: Final Weight (g)

2.3.2 Moisture content

Measuring the moisture content in shallots can be done using the oven method. The oven method is based on drying shallot samples at a certain temperature until they reach a constant weight. The difference in weight before and after drying reflects the amount of water contained in the sample. This process is carried out at a temperature of 100°C for 4 hours. First, the shallot samples are cut into small pieces to speed up the drying process. The prepared sample is weighed to obtain its wet weight. The sample is placed in an oven at a temperature of 100°C. Drying is carried out until the sample weight reaches a constant, which indicates that all the water has been evaporated. The sample is weighed again after being removed from the oven to obtain its dry weight.

The water content can be calculated using the following formula:

$$\text{Moisture content (\%)} = \frac{W1-W2}{W1-W0} \times 100\%$$

Where, W0: Weight of empty dish (g), W1: Weight of sample and empty dish (g) W2: Weight of dish and sample after baking (g).

3. Results and discussion

3.1. Weight loss

Weight loss is a decrease in the weight of shallot bulbs during storage that can indicate the quality of the harvest. Weight loss occurs mainly due to water loss in the bulbs and can also be influenced by variety and planting distance. Shallot varieties have a significant effect on the quality of shallot bulbs during storage, including weight loss [8]. Weight loss in shallots increases with the length of storage. The respiration process of shallots occurs during storage, producing carbon dioxide and water that escapes from the bulbs, resulting in a significant decrease in weight [9]. Varieties affect seed quality, namely weight loss. This is due to differences in the physiological characteristics of each variety in maintaining water content and resistance to storage conditions [10]. Peak weight loss usually occurs in the third to ninth week of storage, reflecting the active phase of respiration and high transpiration in shallot bulbs. The ongoing respiration process converts carbohydrate compounds into CO2 and H2O, which escape from the bulbs and cause weight loss. The results showed that weight loss in shallots increased with longer storage periods in all varieties, but the application of edible coating was able to reduce the rate of weight loss compared to the control because it acted as a barrier layer that reduced water evaporation and loss of soluble substances.

Table 1. Average weight loss (%) of uncoated shallots (control) and shallots coated with aloe vera edible coating due to variety and storage duration

Samples	Control		Edible coating	
	2	4	2	4
V1 (Tajuk)	11,77	32,47	11,47	17,03
V2 (Bima Brebes)	12,51	32,94	12,31	18,51
V3 (Gayo)	19,67	33,01	20,95	25,52

The Gayo variety tended to experience the highest weight loss in both the control and treatment groups, while the Tajuk variety showed the lowest weight loss, making it more adaptable to storage. The best treatment was obtained in the Tajuk variety with a storage period of two weeks using an edible aloe vera coating, as it was able to reduce weight loss and maintain better tuber quality compared to other treatments. [11] stated that the Tajuk and Bima Brebes varieties had the highest fresh and dry tuber weights compared to the Gayo variety, which had lower weights. The high water content in the fresh weight of the Gayo variety results in a shorter shelf life and higher potential for damage. These variations in fresh and dry weight reflect physiological differences between varieties that affect durability and storage characteristics.

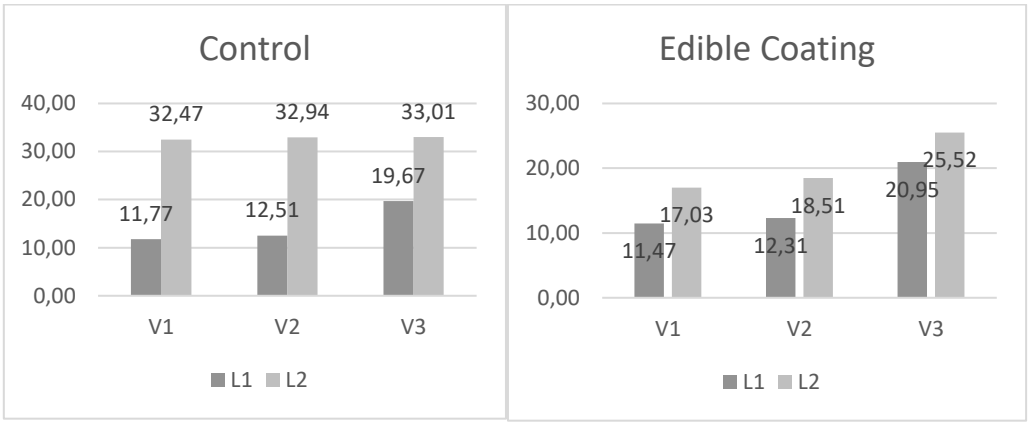


Figure 2. Average weight loss of shallots

The weight loss graph for shallots shows an increase in weight loss over time during storage. This is normal because shallots continue to respire and transpire after harvesting. Respiration converts carbohydrates into energy, producing CO_2 and water vapor that escapes from the tissue, thereby reducing the weight of the bulbs. Of the three varieties, the Gayo variety experienced the highest weight loss, both in the control and treatment groups, indicating that its physiological characteristics are more susceptible to water loss. In contrast, the Tajuk variety had the lowest weight loss, making it more adaptable to storage. The best treatment was found in the Tajuk variety with two weeks of storage using an edible coating, as it was able to maintain a more stable bulb weight compared to other varieties.

3.2 Moisture content

Moisture content is one of the important parameters that indicate the quality of shallots. Moisture content is calculated by measuring the initial weight of the shallot sample before drying, and the final weight after the sample is dried in an oven until its weight is constant. Thus, moisture content is the difference in weight before and after drying, expressed as a percentage of the initial weight. The moisture content of shallots tends to decrease over time during storage due to the ongoing respiration and transpiration processes of the bulbs during storage, causing water evaporation and weight loss.

Table 2. Average water content (%) of shallots in various varieties and storage periods

Samples	Control		Edible coating	
	2 weeks	4 weeks	2 weeks	4 weeks
V1 (Tajuk)	82,06	76,20	81,66	81,46
V2 (Bima Brebes)	81,00	77,14	80,61	79,93
V3 (Gayo)	82,78	79,03	81,30	80,32

The moisture content of shallots in various varieties is relatively stable during storage, although there are slight fluctuations between the control treatment and the edible coating. Edible coating tends to be able to maintain moisture content better because the thin layer formed on the surface of the bulb acts as a semi-permeable barrier that reduces transpiration. The differences between varieties show that Gayo has a higher water content than Tajuk and Bima Brebes, indicating that the physiological characteristics of this variety make it easier to absorb or retain water content. Meanwhile, the Bima Brebes variety tends to have a lower water content, making it more susceptible to weight changes due to storage. Overall, the use of edible coating

helps maintain the stability of tuber water content, and the Tajuk variety shows the best combination because it is able to maintain water content close to its initial condition with relatively small fluctuations.

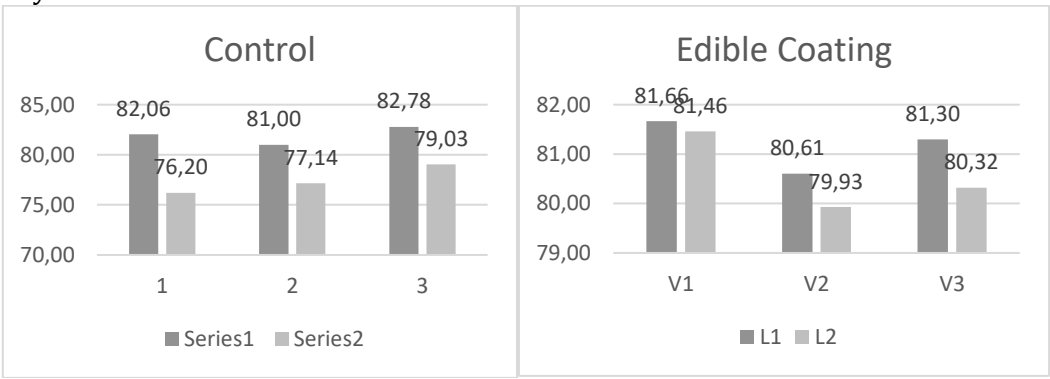


Figure 3. Average moisture content of shallots

The water content graph of shallots shows a decrease in water content during storage, both in the control and in the treatment with edible coating. This decrease occurs due to the continuous processes of respiration and transpiration, which reduce the water content in the bulb tissue. However, edible coating is able to maintain water content better than the control. The aloe vera coating serves to reduce the rate of evaporation by limiting the transfer of water vapor from inside the tissue to the environment. This condition maintains the moisture of the bulb tissue and slows down the drying process.

The differences between varieties are also clear. The Gayo variety tends to have the highest water content compared to the Tajuk and Bima Brebes varieties, which shows that its physiology is able to absorb or retain more water. However, the high water content also makes this variety more prone to damage if stored for too long. Meanwhile, the Bima Brebes variety has a lower water content, making it more prone to weight loss. The Bima Brebes variety, which tends to have a lower water content, is more susceptible to weight loss due to evaporation during storage.

4. Conclusions

Research shows that shallot varieties and storage duration significantly affect the physical and chemical properties of onions. Of the three varieties tested, the Tajuk variety showed the best performance with the lowest weight loss and more stable moisture content, indicating that this variety is more adaptable to storage and edible coating treatment. The Gayo variety had the highest weight loss, making it more susceptible to quality deterioration during storage. In addition, edible coating helps maintain the moisture content of shallots during storage, which contributes to maintaining the texture and freshness of the bulbs. Overall, the combination of using the right variety with the application of aloe vera edible coating and a storage period of 2 weeks can increase the shelf life of shallots and reduce post-harvest losses due to weight loss and deterioration in physical and chemical quality.

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