The Effect Characteristic of Aloe Vera and Grass Jelly Leaves as Edible Coating of Shallot (*Allium Cepa L*) During Storage

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Abstract. Shallot (Allium cepa L.) is a perishable horticultural product. Several techniques, including coating, can be used to extend the shelf life of shallot. Aloe vera and grass jelly leaves are prominent plant-based substances that can be used in coatings and are safe to consume. This study aimed to determine the effect of edible coating using aloe vera and grass jelly leaves on shallots during storage. The study used a randomized block design (RBD) which consisted of 4 treatments: control (without any treatments, K); grass jelly leaves+aloe vera (ingredients 1:1, H); H+ 10% ginger extract (HJ); H+1% CMC (HC). The parameters observed consisted of weight loss, percent damage, hardness, water content, and total soluble solids (TSS). The results demonstrated that the H treatment significantly affected the treatment variables ($p<0.05$). Treatment H had lower weight loss, percent damage, hardness, and water content than other treatments, while TSS increased during storage. The best treatment was treatment H, which had a 16-week storage period, a weight loss of 55.18%, percent damage of 27.49%, a hardness of 3.54 kg/cm2, a moisture content of 85.67%, and a TSS of 11.21ºBrix.
Keyword : Shallot, Edible coating, Aloe vera, Grass jelly leaves, Shelf life extension

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1 Introduction

Shallot (*Allium cepa* L.) is a horticultural product with great potential for development in Indonesia. Shallot is a perishable commodity that can be quickly spoiled when not handled properly. Shallot is in high demand in the community since it is a spice ingredient in Indonesian dishes. Overproduction of shallot during harvest results in low farmer selling prices but high consumer selling prices. Hence, postharvest handling strategies are required to increase the shelf life of shallot. Several efforts that may be taken to maintain the quality of shallots are minimizing respiration rates, delaying the aging process and withering, minimizing the potential of shoot growth, and reducing microbial activity [1].

The freshness of shallot can be preserved by covering the surface of the bulbs, a process known as coating [2]. As an edible coating, the material utilized as a coating must form a barrier layer to protect the material while not polluting the environment [3]. Aloe vera and grass jelly leaves are two materials that can be recommended as edible coatings. This material is a natural ingredient that is safe for consumption and widely available in nature. Applying edible coatings made from natural ingredients helps reduce moisture loss, gas exchange, microbial contamination, discoloration, and appearance [4]. However, research on edible coatings on shallots is still limited, so experiments are necessary to determine the effect of coating on shallots during storage.

Aloe vera (*Aloe barbadensis* Mill.) has the advantage of containing bioactive chemicals that are antibacterial, promote healing of tissue damage, and prevent inflammation. Aloe vera is frequently used in treatments for hair, skin, and personal care products as a moisturizer. Aloe vera is used in health products as an antiseptic, antibacterial, sedative agent, detoxifier, and to improve blood circulation [1]. Applying aloe vera as a coating material can improve the quality of the film while maintaining it fresh [5]. A study on edible coatings, including aloe vera on salak pondoh, shows that aloe vera can reduce mould development during storage [6]. Edible coatings have also been used on grapes and tomatoes, with the result that edible coatings can enhance their shelf life [7,8].

Green grass jelly leaves (*Cyclea barbata* Miers) can form a gel, even though the extraction only uses cold water. Grass jelly leaves are usually used as medicine or consumed in gel form. Green grass jelly is mainly composed of pectin polysaccharide, which has the capacity to gel. Pectin polysaccharides can be used to extend the shelf life of food by avoiding surface browning, oxidative rancidity, and dehydration [9]. This gel-forming ability can protect the outer layer of shallot bulbs. Edible coating research on grapes using green grass jelly at a concentration of 30% grass jelly prevents weight loss by up to 0.0563 g/hour [10].

Edible coatings made from a single material component do not give the most significant outcomes compared to emulsions made from several constituent mixes [11]. The combination of green grass jelly leaves and aloe vera as an edible coating has never been researched. Thus, it is essential to test it on shallot bulbs to observe the effect of the edible coating. The consideration for applying this combination is the probability that the bioactive substances contained in green grass jelly with aloe vera will be able to decrease

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the rate of respiration, hence reducing withering and damage. Thus, this study aimed to determine the effect of edible coating using Aloe vera and grass jelly leaves on shallots during storage.

2 Materials and methods

Shallot (*Allium cepa* L.) Batu Ijo Malang variety, green grass jelly (*Cyclea barbata*), and ginger were obtained from farmers in Kintamani, Bangli. Aloe vera leaves were purchased from PT. Aloe Vera Bali in Gianyar, Carboxymethyl Cellulose (CMC) was purchased from UD. Feny store in Denpasar, Bali. Equipment used were digital scales, washblow, tablespoon, blender, and fruit packaging net.

2.1 Sample preparation

The shallot is carried out by curing for 72 hours until used. The shallot was cleaned of soil and stalks. Shallots were cleaned and sorted before being divided at random among the various treatments to reduce variance. The shallots are dipped into the solution to create the edible coating. All coating solutions were created in a 1:1 ratio for aloe vera and grass jelly leaves. Shallots were stored after the treatment at a temperature of 24–30°C and a relative humidity of 68–82%.

2.2 Aloe vera gel preparation

Aloe vera leaves obtained from farmers are cleaned from soil and sap with tap water. Hand-filleting methods of aloe vera leaves must be processed after 36 hours of harvesting [12]. Processing of aloe vera used previous research methods [7]. The Aloe vera leaf was soaked in 200 ppm chlorine solution for 30 minutes. The aloe vera leaf was rinsed with boiled water, and then conducted trimming and filleting. The boundary of each leaf was cut away to reveal the inner leaf gel using a sharp knife. The gel fillets were blended for 10 minutes. The crude gel was obtained and filtered to remove the fibrous part using this technique. The gel was applied during the procedure.

2.3 Grass jelly leaves (Cyclea barbata) preparation

The grass jelly leaves were cleansed of dirt and sap using tap water. The leaf was blanched in boiling water for 5 minutes. The leaf was manually removed using a 1:25 water-to-leaf ratio. Extracted materials were then blended with water. Furthermore, the grass jelly was blanched for 5 minutes in boiling water. The grass jelly extracted used mixed with a ratio of 1:25 water. This method produced a filtered grass jelly and water mixture to remove the fibrous portion. The solution was applied as treatment.

2.4 Research design

The research design used a randomized block design. The shallot was of the edible coating type of 4 : 1) control (K); 2) edible coating aloe vera with grass jelly leaves (1:1) (H); 3) edible coatitreatmentsng aloe vera with grass jelly leaves (1:1) + 10% extract ginger (HJ) and 4) edible coating aloe vera with grass jelly leaves (1:1) + 1% CMC (HC). Each treatment was repeated six times. Storage sample on storehouse was equipped with air circulation. Analysis was performed every two weeks until the sample had 50% damage. The observed variables consisted of weight loss [7], % damage, hardness, water content [13], and total soluble solids (TSS) with a hand refractometer [14].

2.5 Statistical analysis

A one-way analysis of variance (ANOVA) with storage time and treatment was used to examine differences between samples. Tukey's honestly significant different test (HSD) with a 0.05 significance level was applied to find significant differences. The statistical analysis was performed using SPSS for Windows version 23.0. De Garmo analysis was used to determine the best treatment base on the variables analyzed.

3 Result and discussion

Table 1 shows the effect of various edible coatings on shallot on variables weight loss, damage, hardness, water content, and TSS is significantly different at $p < 0.05$. Edible coating with aloe vera has been tested on several fruits [15–20]. Aloe vera can be used as an edible coating since it has antibacterial qualities [21]. The ability to naturally form a gel and the presence of the polysaccharides pectin make grass jelly leaves suitable as an edible covering [22]. Aloe vera and green grass jelly were combined in a 1:1 solution with a viscosity of 408.33 cP. The increasing viscosity of the solution demonstrated that a liquid's resistance rises. [23].

Table 1. Effect of various edible coating on shallot after 16 weeks

Variables		Treat	ment	
	K	H	HJ	HC
Weight loss (%)	76.08 ± 29.94^{b}	55.18 ± 16.66^{a}	63.58 ± 18.94^{ab}	61.05 ± 18.71^{ab}
Damaged (%)	38.45 ± 13.68^{c}	27.49 ± 9.72^{a}	28.15 ± 9.90^{a}	11.56 ± 12.49^{b}
Hardness (kg/cm^2)	3.27 ± 0.51^{a}	3.54 ± 0.38^{c}	3.42 ± 0.47^{b}	3.41 ± 0.44^{b}
ater content (%)	85.64 ± 1.18^{b}	85.67 ± 1.43^{b}	85.29 ± 1.30^{a}	85.43 ± 1.27^{ab}
TSS (^{o}Brix)	13.26 ± 2.03^{b}	11.21 ± 1.53^{a}	12.88 ± 2.02^{a}	12.73 ± 1.99^{a}

Noted: K=control (without any treatments); H= grass jelly leaves+aloe vera (ingredients 1:1); HJ= H+ 10% ginger extract; HC= H+1% CMC

3.1. Weight loss

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Compared to other treatments, the K treatment resulted in the most significant weight loss (Table 1). H treatment has the lowest loss weight of 55.18%. Weight loss is a quality parameter used to determine the freshness level of food ingredients. The quantity of weight loss is directly proportional to the temperature. The rate of weight loss will increase as the temperature rises [24, 33]. Water loss causes weight loss during storage on minimally processed shallot [25, 32]. The weight of the fresh product decreases during storage due to respiration and transpiration processes [26].

Figure 1 shows that storing shallot bulbs for 16 weeks promoted weight loss by up to 76.08% in the control (K). Edible coatings can reduce weight loss during storage by 55.18% in the H treatment, 63.58% in the HJ treatment, and 61.05% in the HC treatment. This circumstance is due to the coating's composition, which consists of polysaccharides and lipids that can inhibit water loss [27].

The weight loss of shallots increased during storage (Figure 1). The control weight loss increased by 40.08% in the 8th week, while the treatment weight loss increased by 34.08-36.32%, demonstrating that the edible coating treatment can reduce weight loss during storage by preventing water evaporation from the surface [28]. The H treatment had the smallest increase in weight loss when compared to the other treatments. The weight loss of treatment H increased to 40.77% in the 12th week and continued to increase until the 16th week (55.18%). This condition supports recent findings that black grass jelly leaf extract can decrease weight loss in black grapes by decreasing respiration [24].

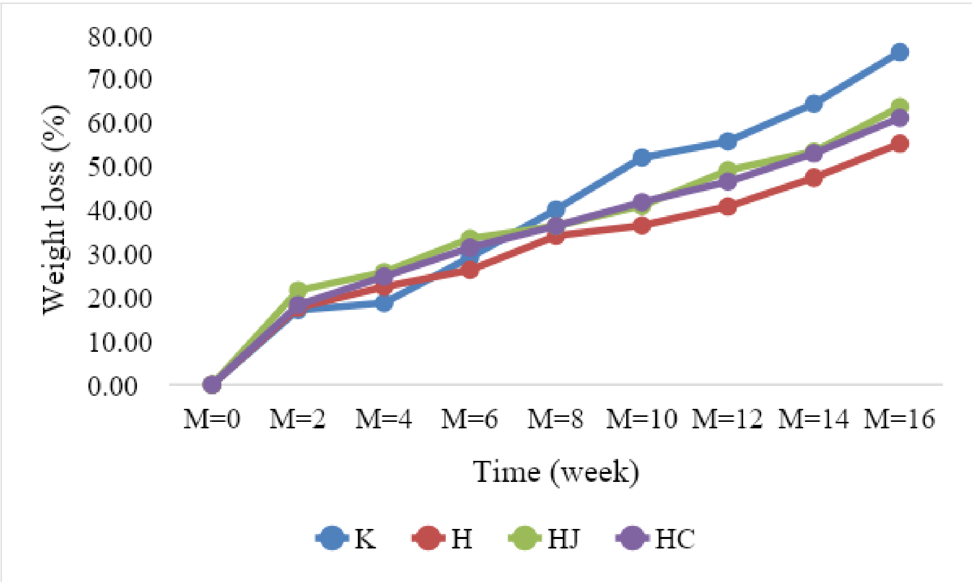

Fig 1. Weight loss changes during storage in various edible coating on shallot

3.2 Damaged

The H and HJ treatments were not significantly different but significantly different from the K and HC treatments (Table 1). Damage to shallot bulbs treated with edible coating was less than the controls. Temperature, relative humidity, air movement, and respiration all impact shallot bulb damage. Rot, soft, and empty tubers were used as damage criteria [29].

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In all treatments, the damage to onion bulbs increased with storage time (Figure 2). Shallot bulb damage began in all treatments in the 4th week, with a damage percentage of 0.82-1.58%. The H and HJ treatments had lower damage rates (27.49-28.15%) than the K and HC treatments (35.13-38.45%). Previous research showed that storing shallot bulbs in net plastic packaging had a shelf life of 45 days and a damage rate of 12% [30].

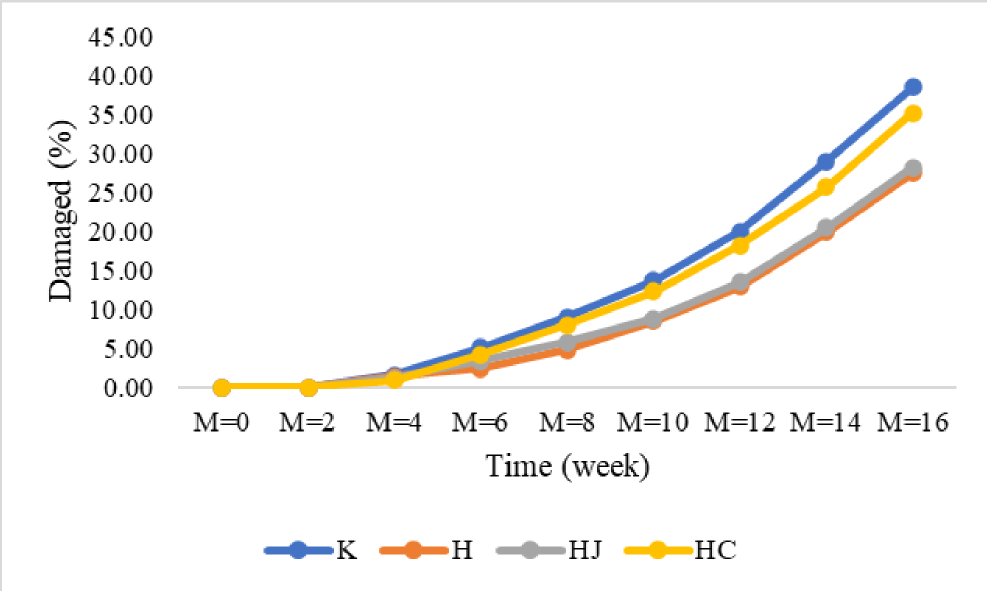

Fig 2. Damaged changes during storage in various edible caoting on shallot

3.3 Hardness

The edible coating treatment significantly affects the hardness of shallot bulbs (Table 1). The H treatment had the highest level of hardness (3.54 kg.cm2), significantly different from the HJ, HC, and K treatments. Differences in coating materials, packaging types, and storage conditions can induce variations in hardness levels. The hardness level is the most crucial factor in preserving food products [26]. This circumstance is because the hardness level can be utilized to determine the efficiency of the coating on the product [24].

Shallot bulb hardness decreases with storage time (Figure 3). The hardness level began to decline in the 2nd week, with a value of 3.74-4.08 kg.cm^2, and by the end of storage, the hardness level was 2.64-2.96 kg.cm^2. Water loss impacts the hardness of shallot bulbs because the water stored in the cells diminishes, causing the cell volume to drop and the hardness to decrease [31].

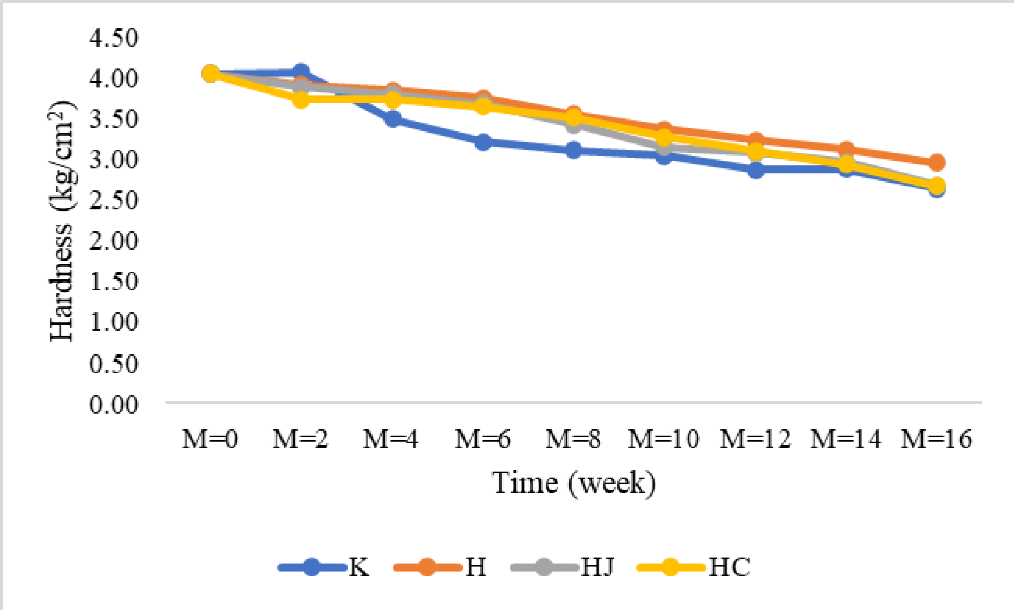

Fig 3. Hardness changes during storage in various edible coatings on shallot

The temperature of the storage warehouse also affects the level of hardness. The temperature of the storage warehouse at the time of the study was 25°C, and the relative humidity was 65%. The ideal storage temperature for shallot bulbs is 25-30°C with a relative humidity of 65-80% [30]. Changes in hardness to softness are also a result of the withering process (wrinkles) caused by the respiration and transpiration processes [16].

3.4. Water content

The HJ treatment's water content significantly differed from the H, K, and HC treatments (Table 1). Treatment HJ had the lowest water content (85.29%), while treatment H had the highest (85.67%). Edible coating treatment can inhibit water evaporation during storage by inhibiting respiration and transpiration processes (29). Water content indicates the freshness and durability of food ingredients since it affects the physical and chemical properties of the food product [29]. The moisture content of shallot bulbs decreased during storage in all treatments (Figure 4). During storage, the average moisture content ranged from 85.29-85.67%, whereas the average moisture content at the end of storage was 83.23-84.09%.

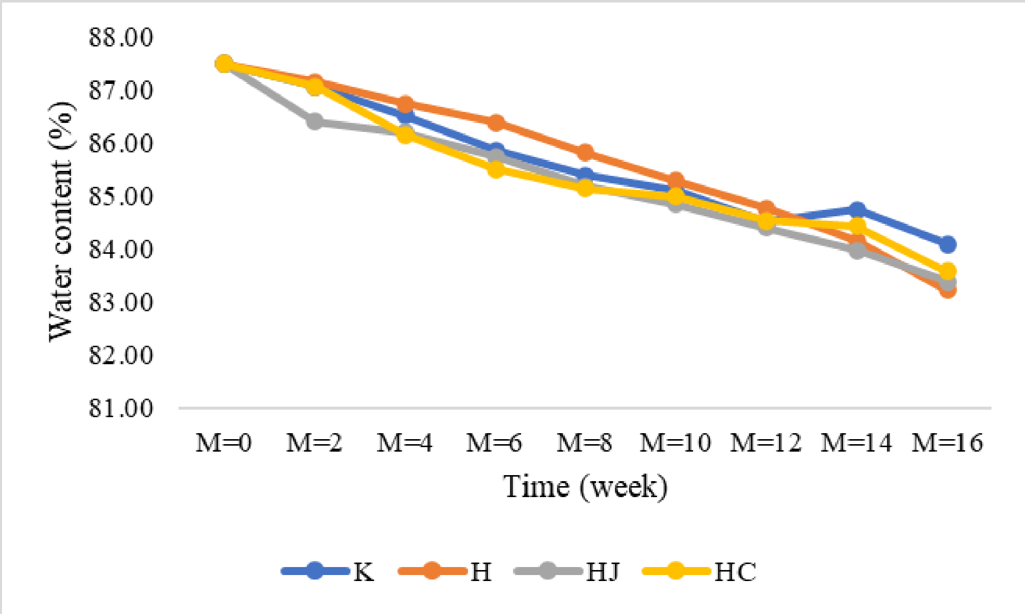

Fig 4. Water content changes during storage in various edible coatings on shallot

3.5. Total soluble solid (TSS)

The total soluble solids for the H, HJ, and HC treatments differed significantly from K (Table 1). The lowest TSS was found in treatment H of 11.21°Brix and the highest in treatment K (13.26°Brix). The TSS content is affected by temperature. The lower storage temperature will result in higher TSS content.

TSS increased among all treatments during storage (Figure 5). TSS content increased in all treatments in the second week, ranging from 6.78-7.75 °Brix. The TSS content in the K, H, HJ, and HC treatments was 13.26°Brix, 11.21°Brix, 12.88°Brix and 12.73°Brix, respectively. TSS levels rise due to maturation and aging caused by increased metabolic activity during storage [28]. The study applying edible coatings on mangoes found that TSS concentration increased during storage [19]. Similar research results were obtained when edible coatings were applied to sliced kiwi fruit, peaches, and nectarines [15,16,20].

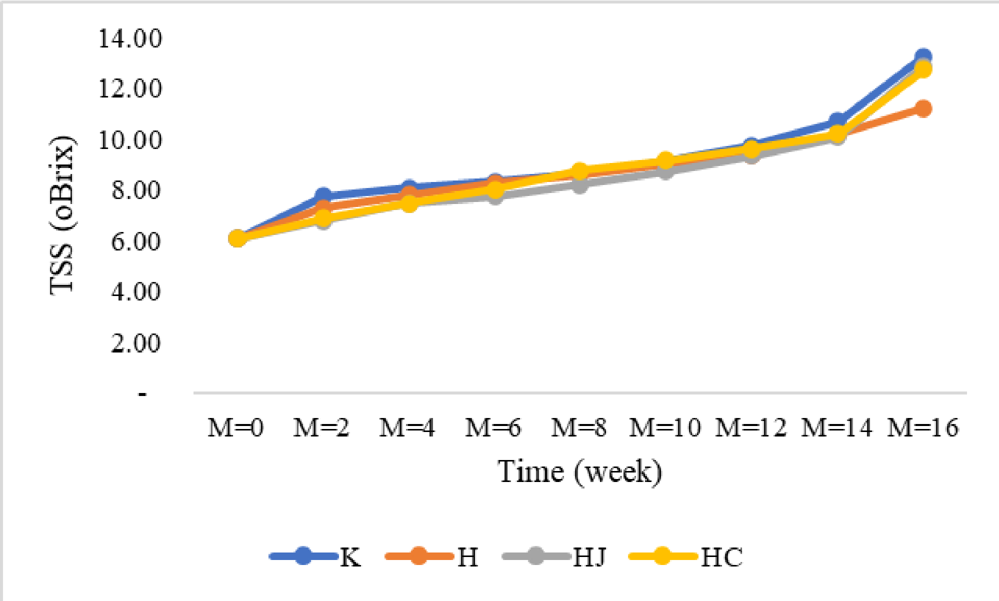

Fig 5. TSS changes during storage in various edible coatings on shallot

The De Garmo Effectiveness Index is used to determine the best method using treatment parameters (Table 2). Based on the De Garmo analysis, the best treatment was found in the H highest De Garmo value of 0,92. The determination of the best results follows the analysis results based on the observational variables weight loss, damage, hardness, water content, and TSS showing the best results compared to other treatments.

Table 2. De Garmo index value characteristic shallot with edible coating

Treatment	De Garmo index vaule
K	0.11
H	0.92
HJ	0.56
HC	0.42

4 Conclusion

This research was conducted to determine the effect of edible coating using aloe vera and grass jelly leaves on shallots during storage. The findings suggested that applying an edible coating of grass jelly leaves and aloe vera (1:1) could prolong the freshness and usability of shallot bulbs for up to 16 weeks. The edible coating on shallot bulbs produces weight loss of 55.18%, damage of 27.49%, hardness of 3.54 kg/cm^2, moisture content of 85.67%, and TSS of 11.21°Brix during storage.

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