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The Effect of Storage Temperature on the Quality of Pondoh Salak Fruit *(Salacca edulis Reinw)*

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Abstract. Salak fruit is known to have many health benefits and is in great demand by the public. Fruits in Indonesia have a low shelf life, such as pondoh snake fruit. So, the temperature during the storage period of salak fruit needs to be considered. This research aims to determine the quality of pondoh salak fruit at different storage temperatures. This research was carried out at the Laboratory of the Faculty of Agriculture, Gunung Jati Swadaya University, Cirebon, West Java. The research was carried out in May – July 2024. The experimental design used was a Completely Randomized Design (CRD). This research consisted of 3 treatments and was repeated 9 times. The observation variables observed were weight loss, fruit hardness, sweetness, and vitamin C. The results showed that storage temperature significantly affected the weight loss and fruit hardness variables.

Keywords: Storage Temperature, Quality, Salak Pondoh

INTRODUCTION

Salak fruit is known to have many health benefits and is in great demand by the public. However, fruits in Indonesia have a low shelf life, such as pondoh salak (Gusrianto et al., 2018). Apart from being popular in its own country, salak fruit is also one of Indonesia's primary horticultural commodities and a mainstay of exports abroad. Some export destination countries are China, Malaysia, and Singapore (Matsuda et al., 2023).

There are quite a lot of snake fruit cultivars cultivated in Indonesia. This plant grows mainly on the islands of Java and Southern Sumatra. The main salak variety cultivated in Indonesia is Salacca zalacca var. zalacca from Java and Salacca amboinensis (Becc) from Ambon and Bali. Another species related to Salacca edulis is Salacca sumatrana Becc, distributed in Sumatra, Sleman, Madura, and Banjarnegara (Budiyanti et al., 2015).

Generally, fruit products (horticultural products) are perishable and have a short shelf life. This is because, after harvest, metabolic processes still occur, such as respiration and the product's conversion of starch into sugar. Snake fruit tastes sweet when harvested, but after being left for a few days, the flesh gradually softens and then becomes sour due to enzyme changes (Nasir, 2023).

The shelf life of fresh salak fruit under natural conditions varies between 5-10 days (Widayanti et al., 2021). Post-harvest handling techniques for salak fruit by farmers need to be innovated to maintain product quality. Various studies have shown that modified atmosphere (MA) can be applied to preserve salak fruit, with the influence of temperature and storage methods on respiration levels and fruit quality (Anoraga & Bintoro, 2020). Therefore, this research aims to study the effect of storage temperature on the quality of Pondoh salak fruit during storage.

LITERATURE

One crucial factor that influences the quality of Pondoh salak after harvest is that the storage temperature is too high, which can cause Pondoh salak to ripen quickly and rot. The lower temperature had a better impact, as observed from the total carotenoid value, respiration rate, weight loss, and vitamin C content. Storage temperatures that are too low can cause Pondoh salak to become stiff and tasteless because, after harvesting, the salak fruit still experiences physiological activities, namely ripening, senescence, transpiration, and other chemical reactions that cause a decrease in quality (Fitriani, 2022). Salak fruit, especially the Pondoh variety, can be stored at different temperatures to maintain its quality and extend its shelf life. Based on research conducted by Supapvanich et al. (2011), it is recommended that snake fruit be stored at temperatures above 15°C to prevent chilling injury. Research shows that storing pond oh salak fruit at a temperature of 25°C can help maintain its quality and extend its shelf life (Suhardi et al., 1994).

METHOD

This research was carried out at the Laboratory of the Faculty of Agriculture, Gunung Jati Swadaya University, Cirebon, West Java. The research was carried out in May – July 2024. The tools used were scissors, plastic wrap, styrofoam packaging measuring 12 x 12 x 1.8 cm, digital scales, tissue, cell phone camera, labels, pipettes, beakers, markers, rags, knife, measuring cup, grater, thermohygrometer, hand refractometer Atago PR-201, fruit hardness meter/penetrometer, Erlenmeyer cup, burette, stative, funnel, stirrer, bunsen, tripod, wire mesh, mortar and pestle (pestle), cold room.

The ingredients include snake fruit, distilled water, 0.1 N iodine, and 1% starch (cornstarch). The research method used was a Completely Randomized Design (CRD). The treatment is the storage temperature, which consists of 3 treatment levels, namely: T1 (cold temperature ±20ºC), T2 (cool temperature ±25ºC), and T3 (room temperature ±30ºC). Each treatment was repeated 9 (nine) times, so there were 27 experimental units. Consisting of 6 snake fruit (1 styrofoam packaging), observations were carried out 3 times on days 3, 6, and 9. So, the experimental unit was 81 packages.

DISCUSSION

Weight Loss

Observation of fruit weight loss was carried out by comparing the weight of the fruit on the nth day with the initial weight of the fruit before storage. Fruit weight loss was measured by weighing with a digital scale (Marpaung et al., 2015). Based on data from ANOVA analysis from three temperatures, the results show that storage temperature really influences weight loss. Then, the data was processed further using the 5% LSR advanced test, and the results were obtained in Table 1

Table 1. Loss of Salak Fruit Weight

No	Storage Temperatures (ºC)	Weight Loss (%)					
		3		6		9	
1	20	4,00	a	7,23	a	10,33	a
2	25	5,31	a	8,20	a	11,11	a
3	30	11,24	b	14,87	b	18,38	b

Note: Numbers in the same lowercase letters in the column indicate that they are not significantly different according to Duncan's test at the 5% level

Based on the table above (table 1), the weight loss of snake fruit in the 30ºC temperature treatment was higher than other treatments. In the observation data for the third, sixth, and ninth days, the temperature of 30 ºC had the highest average value, namely 11.24%, 14.87%, and 18.38%. In each observation, the temperature of 30 ºC was significantly different from that of 20 ºC and 25 ºC, while at temperatures of 20 ºC and 25 ºC, there was no significant difference. Treatment at a storage temperature of 30ºC significantly affects weight loss. This aligns with the statement (Putra & Setiawan, 2021) that fruit stored at room temperature will have a greater chance of losing weight due to the high evaporation process, which is influenced by temperature. Temperature affects water loss during storage, reducing weight loss, quality and causing damage. Losing large amounts of water will cause the fruit to wilt and wrinkle. According to research (Marlina et al., 2014), high weight loss at room temperature is caused by high rates of respiration and evaporation of large amounts of water.

Fruit Hardness

Hardness in fruit occurs due to pectin, which glues the cells together to make them sturdy. Softening of fruit occurs due to the enzyme protopectinase, which converts protopectin into pectin, and the pectin methyl esterase enzyme, which converts pectin into galacturonic acid so that the cell walls become weak and reduces the strength between cells. Texture changes are also caused by the conversion of starch into sugar. Insoluble starch is converted into water-soluble sugar so that the texture of the fruit becomes softer. The sugar formed will affect the taste of the fruit (Muchtadi et al., 2013).

Table 2. Average Hardness of Salak Fruit at different storage temperatures

No	Storage Temperatures (ºC)	Fruit Hardness (Kg/Cm²)					
		3		6		9	
1	20	0,80	a	0,69	a	0,60	a
2	25	0,70	a	0,60	a	0,52	a
3	30	0,59	b	0,49	b	0,40	b

Note: Numbers in the same lowercase letters in the column indicate that they are not significantly different according to Duncan's test at the 5% level

The data above shows fundamental differences between each treatment and observation period. At higher temperatures, the average hardness is the lowest. The fruit hardness value will be lower at high temperatures compared to low temperatures because, at high temperatures, the degradation process of cell wall components, such as pectin degradation by pectinolytic enzymes, causes tissue softening and results in cell wall damage (Muchtadi et al., 2013).

Fruity Sweetness

The sugar content or total soluble solids indicate a fruit's sweetness or degree of ripeness. The total soluble solids in the fruit will increase more quickly when the fruit is ripe and decrease with the length of fruit storage. (Legawa Ismaya et al., 2023).

Table 3. Average Total Soluble Density of Salak Fruit at different storage temperatures

No	Storage Temperatures (°C)	Fruity Sweetness (° Brix)					
		3		6		9	
1	20	18,22	a	17,44	a	17,33	a
2	25	18,56	a	17,67	a	17,22	a
3	30	18,67	a	18,56	a	18,33	a

Note: Numbers in the same lowercase letters in the column indicate that they are not significantly different according to Duncan's test at the 5% level

Based on table 3 shows that there is no real difference in the total dissolved solids of salak fruit. However, if we look at the storage time, the longer the storage, the total dissolved solids content will decrease by the statement that the level of dissolved solids of an ingredient indicates the sugar content contained in an ingredient. Salak is a non-climacteric fruit picked when it reaches full maturity on the tree, so the sugar content can experience changes, either increasing or decreasing. The total solids content in the fruit will increase more quickly when it reaches optimal maturity and will continue to decrease as it is stored (Zaini Miftach, 2018).

Vitamin C

Vitamin C is a compound close to a monosaccharide structure, formally derived from L-glucose, an aldohexose. This compound can be formed as L-ascorbic acid and L-dehydroascorbic acid, which are reactive as vitamins. Ascorbic acid or vitamin C can be synthesized from glucose contained in fruit. During fruit ripening, there is an increase in chemistry as the activity of several enzymes includes peroxidase activity, which accelerates fruit ripening, the activity of the amylase enzyme in converting starch into maltose, and then the maltase enzyme will convert the maltose into glucose. Furthermore, glucose, fructose, sucrose, and D-galactose in the tissue will be converted into vitamin C (Mudyantini et al., 2016).

Table 4. Vitamin C levels of Salak fruit at different storage temperatures

No	Perlakuan	Vitamin C (mg/100g)					
		3		6		9	
1	20	1,6	a	1,5	a	1,3	a
2	25	1,5	a	1,4	a	1,2	a
3	30	1,4	a	1,3	a	1,1	a

Note: Numbers in the same lowercase letters in the column indicate that they are not significantly different according to Duncan's test at the 5% level.

Based on Table 4, there are no fundamental differences in all treatments. However, vitamin C levels in each treatment and observation tend to decrease; this is by the statement (Salingkat et al., 2020). Vitamin C is a micro-nutrient that the human body needs so that all body metabolism continues. Vitamin C is water-soluble; vitamin C levels tend to decrease proportionally to high temperatures.

CONCLUSION

Snake fruit stored at varying temperatures affects the quality of the snake fruit. The qualities that are affected by storage temperature are weight loss and hardness. In the low-temperature storage weight loss variable (20º C and 25ºC), the weight loss value is lower compared to the temperature of 30º C. At low temperatures, fruit hardness (20ºC and 25ºC) the hardness value is higher than the temperature of 30ºC.

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