Effect of the type of transport packaging against the occurrence rate of rot disease on the Salak’s taper tip

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Abstract. Salak pondoh (Salacca edulis Reinw.) has perishable properties. During the distribution the Salak is very susceptible to mechanical damage and makes it easier for the fungus Thielaviopsis paradoxa to grow. The amount of damage during transportation is influenced by the type of packaging used. The purpose of this study was to examine the effect of the packaging type used in transportation on the occurrence of rot disease on the Salak’s taper tip. The salak fruit in a bamboo basket, besek, and corrugated boxes transported directly from Turi District, Sleman Regency to Dramaga District, Bogor Regency. Then stored and observed rate of incidence of taper tip disease every day for 6 days. The results showed the level of disease occurrence from day 2 to day 6 in storage has increased. The highest incidence of the disease is found in bamboo basket packaging and the lowest is in corrugated boxes.

1. Introduction

Salak pondoh is one of Indonesia's leading agricultural products. Salak pondoh is very popular with local people, characterized by the consumption of salak fruit in Indonesian society is quite high. The consumption of Indonesian salak fruits in 2008 was reported by Dimyati et al., (2009) of 1.64 kg/capita/year [1]. This consumption increased to 1.69 kg/capita/year in 2016 [2]. Yogyakarta Special Region Province, especially Sleman Regency is one of the biggest salak pondoh production centers in Indonesia.

Salak pondoh is a non-climacteric fruit which has a fairly high transpiration rate. This fruit is a perishable product and has a short shelf life. Salak pondoh has a shelf life of 6 days [3]. Salak fruit damage can come from internal and external factors. Damage to internal factors due to physiological activity of fruit, one of which is respiration. Respiration can reduce the quality and damage of fruit naturally. Each fruit after harvesting will undergo the process of ripening and decay [4]. External factors that caused damage to salak fruit are microorganisms and mechanical damage from the environment. The microorganism that causes damage to salak pondoh on the tapered tip is Thielaviopsis paradoxa [5]. Mechanical damage occurs due to mechanical force from the environment so that the fruit becomes injured, bruised, broken, and ripped fruit skin.

Transportation during the distribution of salak to markets and supermarkets is a significant contributor to damage. According to [6] damage to salak fruit in transportation ranged from 6% - 30%
depending on the type of packaging and the distance traveled. The packaging used by salak traders vary depending on their market objectives. Traders in Sleman Regency use bamboo baskets, *besek*, and corrugated boxes in distribution. The types of packaging have different characteristics, so they have different effects on salak fruits. This study aims to examine the effect of the type of packaging used in transportation on the occurrence of rot disease on the salak’s taper tip.

2. Material and Methods

2.1. Material
The material used in this study were salak pondoh fruit from Madding Fresh Fruit collectors, Turi District, Sleman Regency, Special Region of Yogyakarta. The equipment used consists of digital scales, bamboo baskets, *besek*, and corrugated boxes.

2.2. Methods
The research carried out is testing the transportation of salak fruit using the bamboo basket, *besek*, and corrugated boxes. Transportation of salak fruit directly from Turi District, Sleman Regency to Dramaga District, Bogor Regency. Transportation testing is conducted in September 2017.

Samples were packaged into a bamboo basket, *besek*, and corrugated boxes of 38 kg, 30 kg, and 10 kg, respectively. The packaging is done by the Madding Fresh Fruit packinghouse to match the actual conditions. Then the samples were distributed to the Laboratory of Food Processing Engineering and Agricultural Products of IPB. Transportation using truck cars, train delivery services, and pick up cars.

The salak fruit storage is carried out for 6 days at room temperature, 28°C. Samples are observed every day at 08.00. Observation of the sample is done by separating the fruits that are attacked by disease due to fungi and healthy fruit. The observed fruit is then weighed and the incidence rate is calculated. The incidence rate of salak taper tip rot is calculated by the following equation [7]:

\[ KP = \frac{n}{N} \times 100\% \]

Information
KP = disease incident (%)
n = the number of salak pondoh infected by the disease (kg)
N = the total number of salak pondoh fruits observed (kg)

Salak pondoh which is attacked by the disease after observation is separated and discarded. Meanwhile, healthy fruit is stored again and then observed the next day.

3. Results and discussion
Salak pondoh from Sleman Regency has been marketed to various regions and has even been exported to several countries such as Singapore, Thailand, and China. The aim of the salak pondoh domestic marketing is the modern market and traditional market. In the modern market, salak fruit is sold to the regions of Yogyakarta, Semarang, Solo, Jakarta and surrounding areas. In traditional markets, the marketing objectives are the markets of the regions of Yogyakarta, Klaten, Porong, Bali, Kalimantan, Jambi, and others. The packaging used varies depending on the destination market. Corrugated boxes packaging is used for modern market purposes such as supermarkets. Bamboo baskets and *besek* are used for traditional market purposes. Bamboo basket packaging for traditional markets in Java, while *besek* packaging for traditional markets outside Java. Packaging of bamboo baskets, *besek*, and corrugated boxes can be seen in figure 1.

Figure 1: Packaging of bamboo baskets, *besek*, and corrugated boxes.
Figure 1. The packaging used in the distribution of salak pondoh. (a) bamboo basket; (b) besek; (c) corrugated boxes.

Salak pondoh has a perishable nature. Damage can occur in transportation when distribution to the destination market. The type of packaging greatly affects the amount of damage to salak fruit. Salak fruit damage in transportation that occurs tends to be mechanically damaged. This mechanical damage caused by vibrations resulting in collisions between salak fruit and with surrounding objects. Besides, the weight of the pile can cause bruising on the fruit.

The transportation time from the Madding Fresh packinghouse to the TPPHP IPB laboratory is 21 hours. The percentage of salak pondoh infected with rot disease on the salak’s taper tip during storage after transportation is shown in Figure 2.

Figure 2. Percentage of rot disease on the salak’s taper tip in several packages during storage at 28°C after 21 hours of transportation.

Figure 2 shows that the incidence rate of disease in 3 types of packaging on storage day 2 to day 6 has increased. The increase in the incidence of this disease is caused by the physiological nature of the salak fruit which has maturation. The process of fruit ripening makes salak fruit resistance to fungus decrease. This decreased resistance is influenced by changes in physiological properties such as softening of the flesh of salak fruit. Fruit softening is caused by changes in protopectin, which is a decrease in the amount of pectin that is not soluble in water because it is converted into pectin that is soluble in water [8][4]. Protopectin is present in the intercellular layer and the first cell wall in fruit and vegetable tissue. This decrease in the amount of pectin that is not soluble in water causes cell rigidity to decrease. This condition can be used by Thielaviopsis paradoxa to penetrate salak fruit cells. Thielaviopsis paradoxa penetration can be through natural fruit holes as well as mechanical and enzymatic pressure.
On day 1 the incidence of taper tip rot is higher than on day 2. This is caused by the accumulation of rot that has occurred at the time of packing and transportation. Taper tip disease has not been seen when packing so it carries and develops during transportation.

The lowest incidence rate of taper tip rot in the three types of packaging is in corrugated boxes packaging. While the highest disease incidence rate is in bamboo basket packaging. The incidence rate of the disease is related to the degree of mechanical damage. The higher the mechanical damage to the fruit the higher the incidence rate of the disease. Corrugated boxes packaging has the property to absorb vibrations better than besek and baskets. So that on the corrugated boxes packaging the level of mechanical damage is smaller. Corrugated boxes packaging is widely used for agricultural products because it can protect from mechanical damage, vibration, impact, and compressive loads when distributed [9]. Iswahyudi et al., (2015) proved the use of corrugated boxes packaging for the distribution of guava can reduce mechanical damage by 7.70% from 20.87% [10].

4. Conclusion
The disease incidence rate in storage has increased from days 2 to 6. The highest disease incidence occurs in bamboo basket packaging and the lowest in corrugated boxes packaging. Corrugated boxes packaging shows better performance than bamboo baskets and baskets to reduce vibrations during transportation. So that the use of corrugated boxes packaging in transportation can reduce the rot disease on the salak’s taper tip.

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