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The Diversity of Postharvest Fungi on Sidempuan Salak (*Salacca Sumatrana* Becc.)

Rahayu Dian Oktaviani[1], Kiki Nurtjahja*[2], Rahmiati[1]

[1]Biology Study Program, Faculty of Science and Technology, Medan Area University, Jalan Kolam no.1, Medan 20223, Indonesia
[2]Study Program of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Jalan Bioteknologi no. 1 Medan, North Sumatera 20115, Indonesia

Abstract. Salak fruit in Indonesia was produced by various cultivated varieties, one of which is sidempuan salak (Salacca sumatrana). Post-harvest destroying fungi is one of the most causes yield losses on sidempuan salak. The purpose of this study was to enumerate and the pathogenicity of postharvest destroying fungi on postharvest sidempuan salak. As many as 1000 g of fresh harvested of salak fruit was used as sample. Fungal population was enumerated by dilution method followed by pour plate method. The intensity of infection each of fungal species was determined. The results showed that there were five species of postharvest fungi that caused spoilage to sidempuan salak fruit i.e., Penicillium citrinum, mycelia sterilia, Aspergillus sp. A. niger and Penicillium. sp. Among of the fungi A. niger was the highest population (7.0×10^7 CFU/g) and the most predominant with intensity of infection was 100%.

Keywords: Sidempuan salak, fungus, post-harvest

Abstrak. *Buah salak di Indonesia dihasilkan dari berbagai varietas yang dibudidayakan, salah satunya salak sidempuan (Salacca sumatrana). Cendawan perusak pascapanen merupakan salah satu penyebab utama kehilangan hasil pada salak sidempuan. Tujuan dari penelitian ini adalah untuk menghitung dan patogenisitas cendawan perusak pascapanen pada salak sidempuan pascapanen. Sebanyak 1000 g buah salak segar dipanen digunakan sebagai sampel. Populasi jamur dihitung dengan metode pengenceran dilanjutkan dengan metode cawan tuang. Intensitas infeksi masing-masing spesies jamur ditentukan. Hasil penelitian menunjukkan bahwa terdapat lima jenis jamur pascapanen yang menyebabkan pembusukan buah salak sidempuan yaitu Penicillium citrinum, miselia sterilia, Aspergillus sp. A. niger dan Penicillium. sp. Di antara jamur A. niger merupakan populasi tertinggi (7,0×107 CFU/g) dan paling dominan dengan intensitas infeksi 100%.*

Kata kunci: salak sidempuan, jamur, pasca panen

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*Corresponding author at: Departement of Biology, Faculty Mathematics and Natural Science, Universitas Sumatera Utara, Medan, Indonesia
E-mail address: kiki2@usu.ac.id

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1 Introduction

Salak (*Salacca zalacca* Gaertner) is native to Southeast Asia (Indonesia, Malaysia, and Brunei). One cultivar of salak (snake fruit) that widely cultivated in Padang Sidempuan at South Tapanuli Regency, North Sumatera is salak sidempuan (*Salacca sumatrana* Becc.). This palm tree (family Arecaceae) is local commodity that growth and distribute in North Sumatera. The main characteristic of salak sidempuan has white and red flesh with taste ranges from sour to sweet, juicy with crunchy texture. The skin of the fruit is covered with a brown skin with small pines. Most salak in Padang Sidempuan is cultivated traditionally by subsistence farmers. As a perishable horticultural product, the fruit is harvested conventionally and consumed as fresh fruit or processed as preserved food such as canned fruit, jam, syrup, and dehydrated products. High water content of flesh and physical damage during harvesting and transportation lead to the fruit has short shelf-life and spoil after six to seven days at room temperature [1]. Among microorganisms molds were the most cause spoilage. Trisnawati and Rubiyo [2] reported that *Aspergillus* sp. was the most spoilage fungi on salak fruit. Sukewijaya et al. [3] found *Fusarium* sp., *Aspergillus* sp. and *Ceratocyctis* sp. on salak bali. Whereas Soytong and Jitkasemsuk [4], Wulandari and Ahmad [5], Jamaludin [6], Dharmaputra [7] stated *Thielaviopsis paradoxa* was the main fungal pathogen on salak (*Salaca edulis*), it can cause black rot. There is a little information concerning diversity of postharvest fungi that cause rot on sidempuan salak. The purpose of this study was to enumerate fungal population and infection intensity of the postharvest fungi on sidempuan salak.

2 Materials and Methods

Determining fungal population on fruit sample

A total of 1000 g fresh harvested salak sidempuan were purchased from local traditional market in Medan, North Sumatera. Fungal enumeration was determined by serial dilution as follow: as many as 500 g of the fruit were peeled and the flesh were ground for 3 minutes using sterilized waring blender and 250 g of the ground fruit in 1000 ml flask were add sterilized distilled water until the volume up to 250 ml. The suspension was homogenized thoroughly, and 1 ml was transferred into 50 ml flask that contain 9 ml distilled water. The serial dilution was continued up to 10^7. One mililiter of each diution in petri dish (9 cm diameter) was pour-plated in potato dextrose medium. All plates were incubated for 6 days at 29±2℃. Each dilution was replicate 3 times. The other 500 g sample of fresh salak was stored for 6 days at room temperature (28±2℃) and the fungal population was determined.

Fungal isolation

Each single separate colony was isolated on potato dextose agar (PDA, Difco Laboratories, Sparks, MD, US) for identifying field fungi. Czapek yeast agar extract/CYA (1 g KH_2PO_4, 10 mL czapek concentrate, 1 mL trace metal solution, 5 g yeast extract, 30 g sucrose, 15 g agar, 1 L distilled water) was used to identify fungal genera such as *Aspergillus* and *Penicillium*. Czapek

yeast extract agar with 20% sucrose/ CY20S (1 g KH_2PO_4, 10 mL czapek concentrate, 5 g yeast extract, 200 g sucrose, 15 g agar, 1 L distilled water) was used to identify *Eurotium*. All fungal species was determined based on the procedure of Pitt and Hocking [8].

Intensity determination of fungal infection

The intensity infection of each fungal species isolated from salak fruit was conducted by subculture each of fungal species on PDA plate in petri dish (9 cm in diameter). All plates were incubated for 7 days at 29±2℃. A total of 30 fresh harvested peeled and unpeeled salak fruit were disinfected in 70% ethanol. One ose of each fungal isolate then were inoculated to the peeled and unpeeled fruit. All inoculated fruits were incubated in closed sterilized plastic jar containing wet cotton for 7 days. Each treatment was replicate three times.

The intensity each of fungal infection at skin of the fruit with score as follows:

Score 0: no symptom 0%

Score 1: symptom > 0 – 5 %

Score 2: symptom > 5 – 10 %

Score 3: symptom > 10 – 25 %

Score 4: symptom > 25 – 50 %

Score 5: symptom > 50 %

The intensity each of fungal infection at flesh of the fruit with score as follows:

Score 0: no symptom 0 %

Score 1: symptom > 0 – 10 %

Score 2: symptom > 10 – 20 %

Score 3: symptom > 20 – 50 %

Score 4: symptom > 50 %

The intensity infection of each fungal species was determined according to Townsend and Heuberger [9] as follows:

$$I = \frac{\Sigma\,(ni \times vi)}{Z \times N} \times 100\ \%$$

I: intensity of infection

ni: number of fruits with fungal score

vi: value scale symptom

N: number of fruits observed

Z: value with the highest symptom

3 Results and Discussion

Fungal population on salak fruit

A total of five fungal species was isolated on salak fruit four days after stored (Table 1). Among of the storage fungi *Thielaviopsis paradoxa* was the most dominant species with population 7×10^7 cfu/g followed by *Aspergillus niger* (2×10^7 cfu/g). The presence of *Thielaviopsis paradoxa* on salak fruit was reported by Soytong and Jitkasemsuk [4], Wulandari and Ahmad [5]. *Thielaviopsis paradoxa* with black colony. No fungal species was found on fresh harvest fruit. Previous study by Trisnawati and Rubiyo [2] reported that *Aspergillus* sp. was the most dominant infection of on bali salak (*Salacca edulis*), the infection occurred on the base part of the fruit. We assumed that the fresh harvest fruit were contaminated by fungal spores on the field or during harvesting. Similar result was reported by Buckle et al. [10], they reported that fungal infection on salak fruit started at the base of the fruit. Physical damage of skin at the base part of the fruit might occurred during harvesting, packaging or transportation and fungal mycelia continue to grow and spoil the flesh during storage. The infection was sign by soft rot, smelly, watery, and brownish to blackish on the skin and flesh (Figure 1)

Table 1. Fungal population (cfu/g) on fresh harvest and 6 days after storage (29±2°C) of salak sidempuan

Fungal species	Fungal population (cfu/g) on salak sidempuan	
	Fresh harvest	After storage for 6 days
Penicillium citrinum	0	6.0×10^2
Mycelia sterilia	0	23.0×10^2
Thielaviopsis paradoxa	0	7.0×10^7
Aspergillus sp.	0	2.0×10^2
Aspergillus niger	0	2.0×10^7

cfu/g = colony forming unit per gram

Figure 1. The spoilage of unpeeled and peeled sidempuan salak caused by *Thielaviopsis paradoxa* after 6 days of storage (29±2°C)

Intensity of fungal infection

Among of the postharvest fungi, *Aspergillus niger* were the most predominant infection with intensity of infection at fruit skin 40% followed by *Penicillium citrinum* (20%) and *Thielaviopsis paradoxa* (20%) (Table 2). Whereas *Thielaviopsis paradoxa* was the highest infection on flesh (50%) followed by *Aspergillus niger* (30%).

Table 2. Intensity infection of fungal species isolated from sidempuan salak on flesh and skin of the fruit after 7 days of storage at 29±2℃

Fungal species	Intensity of infection (%)	
	Fruit skin	Flesh
Penicillium citrinum	20	5
Mycelia sterilia	10	5
Thielaviopsis paradoxa	20	50
Aspergillus sp.	10	10
Aspergillus niger	40	30

The presence of *Penicillium* and *Aspergillus* on skin fruit indicate both genera were able to contaminate and grow on dry food and foodstuffs with low water activity [7,11].

4 Conclusions

Fungal population contaminate on sidempuan salak fruit such as *A. niger* and *T. paradoxa* cause brown rot and accelerate spoilage during storage. The fungal propagules start contaminate skin fruit at the base of the fruit and spoilage the flesh.

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