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Test of Flavonoid Activity of Durian (*Durio Zibethinus*) Seeds and Skins as Natural Insecticides in Controlling Mealybug (Pseudococcidae)

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ABSTRACT
Several references indicate that active metabolites found in natural plant resources such as flavonoids and saponins have the potential as natural insecticides. One of natural plant resource that has the potential as a natural insecticide is durian, because in durian albedo there are flavonoids and saponins. In addition, durian seeds also contain flavonoids of 29.74 µg / mL. Based on this background, the author took the initiative to test the activity of flavonoid content in durian seed extract and albedo to determine its effectiveness as a natural insecticide for mealybug pest control. This research consists of 2 stages, including; extraction of flavonoids from durian seeds and albedo (peels), and testing of flavonoid activity of durian seed and peels extracts against mealybug mortality. Extraction of flavonoids from durian seeds and peels using socletation method and spectrophotometry tested. The results of flavonoid and phenolic analysis of durian seed extract are higher than durian albedo extract. The effectiveness test was carried out on the population of mealybug pests that had been acclimatized for 24 hours, placed on cocoa peels media that had been soaked in the treatment solution for 15 minutes, then the mortality rate was observed. The treatment given was albedo extract 12.5 g/100ml; albedo extract 25 g/100 ml; durian seed extract 12.5 g/100 ml; 25 g/100ml; albedo and seed extract 12.5 g/100 ml; albedo and seed extract 25 g/100 ml; positive control and negative control. The test results showed that the mortality of mealybugs in the treatment of seed extract 12.5 g /100 ml was not significantly different from the positive control treatment, this showed that durian seed extract 12.5 g / 100ml is expected to replace the use of chemical insecticides in the control of mealybug pests.

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1. INTRODUCTION

Indonesia with the United Nations (United Nations), has committed to efforts to realize the 2030 Sustainable Development Goals (SDGs) in 2015. The agenda, which details the 17 sustainable development goals, aims to maintain the escalation of economic, social, and environmental welfare, inclusive development, and governance that improves the quality of life of one generation to the next generation (Kementerian PPN/Bappenas, 2017a). One of the points in the SDGs related to welfare and guaranteeing public consumption is point number 12, which is about responsible consumption and production patterns. In this point, one of them is expected to achieve the management of chemicals and all types of waste, as well as the management of the use of resources that are environmentally friendly and safe for human health, so it is expected to encourage industry and business to create more efficient production to maintain food security towards the escalation of the country's economy (Kementerian PPN/Bappenas, 2017).

The stability of food security in Indonesia cannot be separated from the agricultural sector which also supports people's consumption needs. The government has tried to maintain this stability through the food estate program which was launched in July 2020. One of the objectives of the food estate program is the integration of agricultural production systems in the form of post-harvest processing and the residues produced, so that it has the potential to expand exports of agricultural products and improve the quality of the community's economy (Rhofita, 2022). However, there is a gap between these expectations and the reality on the ground. As a tropical region with high rainfall and humidity, it causes the development of pests in Indonesia's agricultural regions to be very rapid (Estia, 2019). One of the most severe pest groups is insects (Pattiwael, 2018). One insect that is

currently rife in attacking cultivated plants is the mealybug (*Pseudococcus viburni*) (Fitri, 2019). Plants attacked by mealybugs will produce immature fruits that become imperfectly shaped and blackish in colour (Octriana & Istianto, 2021), causing damage to agricultural products, which has an impact on decreasing crop yields and has a direct impact on the economy. The use of synthetic insecticides in Indonesia has destroyed 72% of biological control agents, indicating that synthetic insecticides are not friendly to the environment (Putri & Nukmal, 2018). To achieve food security stability in order to realize SDGs point 12 concerning responsible consumption and production patterns, waste management innovation is needed as an alternative to natural insecticides instead of synthetic insecticides that are more environmentally friendly and support the quality of agricultural products.

Some active metabolites found in vegetable natural resources such as flavonoids and saponins have the potential as natural insecticides (Kumara, 2021). Several studies have proven that the use of fruit extracts containing saponins and flavonoids is effective as a natural insecticide(Dias et al., 2019; Herawati et al., 2022; Iskandar et al., 2019; Piri et al., 2022). One of the vegetable resources that has potential as a natural insecticide is durian. Per 100 grams, durian fruit has an edible weight of 22%, namely its flesh (Kementerian Kesehatan RI, 2018). In addition to edible meat, durian seeds and inner skin (albedo), which have only been a burden on the environment, have the potential to be natural insecticides. This potential is because in durian albedo there are flavonoids and saponins (Maharani & Zuhro, 2017), durian seeds also contain flavonoids of 29.74 µg / mL (Hunna, 2020). Reviewing the content, it is necessary to test the activity of flavonoid content of seed extract and durian albedo to determine its effectiveness as a natural insecticide for mealybugs.

2. RESEARCH METHOD

This research was carried out in two stages. The first stage is the preparation of flavonoid extracts from durian seeds and bark. Flavonoid extraction using the socleation method. Durian seed and skin sample powder was extracted with 96% ethanol using a soxhlet tool (60–800 °C) with a ratio of 1: 50, w/v. Until the last extract is colourless. The extract is filtered, and the filtrate is concentrated and evaporated under a pressure of 75 bar at 400°C using a rotary vacuum evaporator. The viscous extract is then evaporated in a boiling water bath until a constant weight is obtained.

The second stage in this study is the test of flavonoid activity from durian seed and bark extract. The insect used is an adult female mealybug (*Pseudococcus* sp.) in cocoa fruit. The test was carried out by soaking media (fruit) with 8 variations of treatment, including negative control, positive control, albedo extract 25 gr/100 ml, albedo extract 12.5 ml, seed extract 12.5 g/100 ml, positive control (chemical pesticide), seed extract 25 gr/100 ml, albedo extract and seeds 12.5 gr/ml, and albedo extract and seeds 25 gr/100 ml 10 min., 10 insects that had been acclimatized for 1 day before treatment were placed on the test media and observed for 24 hours. Observation of insect mortality is carried out 24 hours after treatment. This experiment was carried out in three repetitions. Mortality is calculated using the following formula:

$$\mathbf{Po} = \frac{r}{n} \mathbf{\ x\ 100\ \%}$$

Po = Mortality (%)
r = number of dead mealybugs
n = total number of observed mealybugs

Fingerprint (ANOVA) and Duncan's follow-up test were used to analyze research data to determine the best flavonoid extract concentration in the control of mealybugs (Pseudococcus sp.)

3. RESULT AND DISCUSSION

The initial stage of this research produced seed extract powder and durian bark/albedo. Durian seeds and peels are thoroughly washed, then cut into small pieces, air-dried, ovened, and then mashed with a blander, resulting in powder or flour that is ready to be tested for flavonoid content (Figure 1).

Figure 1. The process of obtaining powder/flour from durian seeds and peels/albedo

Flour from durian seed and albedo extracts is then analyzed in the laboratory to determine the levels and percentages of flavonoids using socletation and spectrophotometric methods, so that the extract can be applied to controlling mealybug pests. The extraction results of the flavonoid levels of durian seeds and albedo are presented in the following table.

Table 1. Flavonoid and phenolic content of durian seed extract and albedo

Tested Content	Sample	Results
Total Phenolics	Durian seed extract	3,94 + 0,056
	Durian albedo extract	1,93 + 0,183
Total Flavonoids	Durian seed extract	0,55 + 0,010
	Durian albedo extract	0,47 + 0,035

Table 2. Duncan Test Number of Dead Mealybugs

Application		Subset for alpha = 0.05			
	N	1	2	3	4
Negative Control	3	.67			
Positive Control	3				9.33
Albedo Extract 25 gr/100 ml	3		7.67		
Albedo Extract 12,5 gr/100 ml	3		8.00	8.00	
Seed Extract 12,5 gr/100 ml	3			8.67	8.67
Seed Extract 25 gr/100 ml	3				9.67
Albedo+seed extract 12,5 gr/100 ml	3				9.67
Albedo+seed extract 25 gr/100 ml	3				9.67
Sig.		**1.000**	**.461**	**.150**	**.056**

This study used eight variations of application, including negative control, positive control, albedo concentration 25 g / 100 ml, albedo concentration 12.5 ml, seed concentration 12.5 g / 100 ml, positive control (chemical pesticide), seed concentration 25 g / 100 ml, albedo and seed concentration 12.5 g / ml, and albedo and seed concentration 25 g / 100 ml. As many as five of the eight application variations were declared effective in killing mealybugs. The application included seed concentrations of 12.5 g/100 ml, positive controls (chemical pesticides), seed concentrations of 25 g/100 ml, albedo and seed concentrations of 12.5 g/100 ml, and albedo and seed concentrations of 25 g/100 ml. Durian seed extract is more effective in reducing mealybug mortality than durian albedo extract, as supported by research of Charoenphun & Klangbud (2022) that durian seed extract has higher total phenolic levels than durian albedo. The total phenol content in durian seed extract can reach 40.46% (Lismayanti et al., 2017). Phenols are also flavonoids, one of the most abundant polyphenolic compounds in nature (Sunardi, 2023). Flavonoids may protect plants from insect invasion (Ramaroson et al., 2022). Flavonoids are able to form complex compounds that have an impact on cell membrane damage (Made Ionnandha & Andriana, 2023). Insects can also experience nerve and spiracle damage when flavonoid compounds enter the body; the bitter taste becomes toxic to small insects (Puji Lestari et al., 2022).

4. CONCLUSION

Based on the results of this study, it can be concluded that: 1) The total phenol and flavonoid content of durian seed extract is higher than albedo extract. 2) The mortality of mealybugs in the treatment of seed extract 12.5 g/100 ml showed the same value than the positive control treatment; this shows that durian seed extract 12.5 g/100 ml can replace the use of chemical insecticides in the control of mealybug pests.

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