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Vegetable Insecticide as an Environmentally Friendly Alternative to Control *Crocidolomia pavonana* F. on Pak Choi Plants

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ABSTRACT: Pak choi plant (*Brassica rapa* L) is a type of vegetable that is popular and loved by the public. This cultivation cannot be separated from pest attacks. *Crocidolomia pavonana F.* (crop caterpillar) is an important pest that causes severe damage to Pak choi plants. Pest control with synthetic chemical insecticides leads to resistance in crop caterpillars, kills natural enemies of insect pests, and harms the environment and human health. Another environmentally friendly alternative for controlling *C. pavonana* is needed. It is necessary to use vegetable insecticides. Jengkol skin and kabau skin have the potential to serve as plant-based insecticides for controlling *C. pavonana.* This research aims to find concentrations of jengkol and kabau skin extracts (vegetable insecticides) that are effective in preventing *C. pavonana* on Pak choi plants. This research used a Completely Randomized Design (CRD). It was carried out in two stages, namely testing the effectiveness of jengkol and kabau skin extracts on *C. pavonana* in the laboratory. Laboratory tests were conducted using three treatments with varying concentrations of jengkol and kabau skin extracts at 4%, 6%, and 8%, respectively, and repeated five times. Observations were conducted over a period of one week. The variable observed was larval mortality. The laboratory test research results showed that 66% mortality occurred in kabau skin extract at a concentration of 8% and in jengkol skin extract at a concentration of 8%, resulting in 53% mortality of crop caterpillar larvae.

Keywords: jengkol skin extract, kabau skin extract, *C. pavonana*, pak choi, attack level

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INTRODUCTION

Pak choi (*Brassica rapa* L.) is a type of mustard green or Brassicaceae, a popular vegetable that is easy to cultivate and can be eaten fresh or processed. Pak choi plant originates from China and was grown in the fifth century. Currently, Pak choi plants are also being developed in the Philippines, Malaysia, Indonesia, and Thailand (Setiawan, 2017).

Pak choi plants in their cultivation cannot be separated from attacks by plant pest organisms (OPT). The pests identified as attacking Pak choi plants are seven types of pests and one type of disease. The types of pests encountered were armyworms (*Spodoptera litura*), cabbage crop caterpillar (*Crocidolomia pavonana*), leaf-destroying caterpillars (*Plutella xylostella*), green ladybugs (*Nezara viridula*), brown ladybugs (*Riptortus linearis* F), beetles (*Phyllotreta* sp.), and leafminer flies (*Liriomyza brassicae).* The type of disease encountered was *Phytophthora* sp leaf rot. The severity of attacks caused by this pest ranges from 2.5-11.25% (Asnur P. et al., 2023).

The crop caterpillar *C. pavonana* Fabricius is an essential pest on Brassicaceae plants, such as cabbage, pak choi, broccoli, mustard greens, and radishes (Kalshoven 1981; Smyth et al. 2003). Attacks by *C. pavonana* in the dry season can cause yield losses of up to 100%, and attacks by one individual *C. pavonana* larvae on 15-day-old

plants can cause economic damage if left uncontrolled (Sudarwohadi 1975; Hariza 2016; Mbogho et al., 2021).

Cabbage caterpillar (*C. pavonana*) is a pest that poses a serious threat to plants. To overcome this problem and protect pak choi plants, a control strategy using botanical (biological) insecticides has been implemented. This approach aims to preserve mustard greens (Pak choi) more effectively by controlling the crop caterpillar population, while paying attention to environmental impacts and human health (Pramushinta, 2020). Attacks by crop caterpillars can result in reduced productivity and crop failure.

In general, farmers still often use pesticides made from synthetic chemicals that are not environmentally friendly, which can cause resistance from insect pests, resurgence, and leave residue on plant products (Winarti, 2015). Control of cabbage crop caterpillars generally still uses synthetic chemical insecticides (Laoh et al., 2003; Razak et al., 2014), so the opportunity for the formation of new, more resistant strains is greater (Suharsono and Muchlish, 2010). The use of synthetic chemical pesticides on Pak choi to control crop worms has the potential to have a negative impact on human health. Therefore, it is necessary to use vegetable insecticides as a safer and more sustainable alternative (Ganul et al., 2021).

They contain secondary metabolite compounds in the form of flavonoids, terpenoids, alkaloids, saponins, and so on. Plant parts that can be used are flowers, fruit, seeds, bark, leaves, and roots, according to Shahabuddin and Anshary (2010). Jengkol and kabau fruit are used by the Indonesian people, especially in Bengkulu, as fresh vegetables, as well as in other processed foods. The skin of jengkol and kabau fruit is not consumed/utilised by the community, so it becomes organic waste. However, several studies have reported that the compounds contained in jengkol and kabau fruit skins can be used to kill several types of pests, so that jengkol and kabau skin waste have the potential to be a vegetable insecticide.

According to Firmansyah et al. (2022), jengkol fruit skin extract at a concentration of 7 mL resulted in a 33.33% mortality rate in golden snails. Similarly, Nasution et al. (2020) found that a 10% concentration of the same extract caused 85% mortality in *Spodoptera exigua* larvae. The larval death was attributed to the presence of secondary metabolites such as alkaloids and saponins in the jengkol skin. Supporting this, a phytochemical screening conducted by Anggraeni (2021) confirmed that jengkol fruit skin extract contains alkaloids, phenols, flavonoids, saponins, tannins, and terpenoids.

The next type of fruit skin that has the potential to control pests is the kabau fruit skin. According to (Obel et al., 2020), kabau fruit skin extract, at a concentration of 0.5% can cause mortality in C. pavonana larvae, reaching 63.33%. This is classified as effective for use as a vegetable insecticide because it contains secondary metabolites in the form of phenolic compounds, saponins, flavonoids, steroids, terpenoids, and alkaloids. Based on active compound tests carried out by Rahmawati et al. (2019). Compounds contained in kabau seed coats include flavonoids, tannins, and saponins. Lemongrass leaf extract (*Cymbopogon nardu*s L. Rendle), concentration of 100 g.l-1 water, controls *Spodoptera exigua* larvae with a total mortality of 77.50% on a laboratory scale (Nopriansyah and Rustam, 2024). In field tests, single extracts of citronella and soursop leaves, each with a concentration of 8% were able to control Spodoptera litura larvae with a death rate of 60% for citronella and 53.3% for soursop leaves (Wiranata et al., 2023). Jengkol skin and Kabau skin, which have the potential as vegetable insecticides, have not been tried to control crop caterpillars (*C. pavonana)*. For this reason, it is necessary to research the concentration of jengkol skin and kabau skin, which are effective in controlling crop caterpillars. Research objective: to obtain a concentration of jengkol and kabau sin extract that is effective in controlling crop caterpillars (C. *pavonana*).

MATERIALS AND METHODS

This research was conducted from July to November 2024 at the Plant Protection Laboratory and the experimental garden of the Faculty of Agriculture, Bengkulu University. The study was carried out in two stages. The first stage involved testing extracts of jengkol skin and kabau skin at both laboratory and semi-field (polybag) scales.

In the laboratory tests, a two-factor Completely Randomized Design (CRD) was applied. The first factor was the type of botanical insecticide (jengkol skin and kabau skin), and the second factor was the concentration, consisting of six treatment levels and five replications.

The experiment used Petri dishes lined with tissue paper. Each dish contained one third-instar larva of the cabbage crop caterpillar (*C. pavonana*), requiring a total of 30 larvae plus 5 for the control group. Each Petri dish was then provided with Pak choi leaves that had been treated with either jengkol skin or kabau skin extract according to the treatment group.

The treatments tested were described in the following:
K0=Treatment control
KJ1=Jengkol skin extract 4% concentration.
KJ2=Jengkol skin extract 6% concentration.
KJ3=Jengkol skin extract 8% concentration.
KB1=Kabau skin extract 4% concentration.
KB2=Kabau skin extract 6% concentration.
KB3=Kabau skin extract 8% concentration.

Preparation of Test Insects *C. pavonana*

Collect the larvae from the field, then place them in a jar and feed them with Pak choi leaves. Maintenance is carried out until the larvae turn into imago. The imago is transferred to another jar covered with oil paper around the jar. The imago is fed with honey smeared on cotton and then hung in the middle of the jar. Moths are allowed to lay eggs on the walls of jars that have been covered with paper. The resulting eggs are then transferred into a plastic jar and covered with Pak choi leaves until the eggs hatch. After the eggs hatch into larvae, they are then reared again until they reach the third instar larvae, and this rearing is carried out until the required number of third instar larvae is met.

Making vegetable insecticide extracts

Making jengkol skin and kabau skin extract involves drying the jengkol skin and kabau skin until they can be crushed when squeezed by hand. Then, the jengkol skin and kabau skin are mashed using a blender. Once smooth, sift the powdered jengkol skin and kabau skin respectively. Jengkol and kabau skin powder are added to water in a 1:1 ratio to get a rough extract. After that, the jengkol skin and kabau skin extracts were stirred using a shaker for 24 hours at 200 rpm. The extraction results are then filtered using a filter cloth. The filtered extract is then diluted using water based on the test concentration against cabbage crop caterpillars.

RESULTS AND DISCUSSION

Preliminary test results for crop caterpillars (*C. pavonana*) in the laboratory are presented in Table 1. Crop caterpillars were tested to determine the effect of the vegetable insecticide extract from jengkol and kabau skin, as well as its effective concentration. These results will be used as a basis for further tests in screened/semi-room houses. Mortality percentage is an essential indicator in testing the effectiveness of insecticides on test insects. The results showed that the death percentage of *C. pavonana* treated with the vegetable insecticide jengkol skin extract and kabau skin extract exceeded 50%.

Table 1. Average mortality of *C. pavonana*

Treatment		Mortality (%)
K0	Treatment control	0
KJ1	Jengkol skin extract 4% concentration	26
KJ2	Jengkol skin extract 6% concentration	33
KJ3	Jengkol skin extract 8% concentration	53
KB1	Kabau skin extract 4% concentration	46
KB2	Kabau skin extract 4% concentration	46
KB3	Kabau skin extract 4% concentration	66

In jengkol skin extract with a concentration of 8%, the mortality was 53%, while for kabau skin extract with a concentration of 8%, the mortality was 66%. The use of vegetable insecticides from jengkol skin extract and kabau skin extract can control more than half of the population of *C. pavonana* larvae.

The results of this test are in line with Hakim et al. (2014 who stated that jengkol skin extract (*Pitchelobium jiringa*) can kill Culex sp larvae. In vitro, the confirmation test showed that a concentration of 20% could kill 50%. Jengkol fruit skin extract 100 g/l water is adequate in controlling armyworms, with a death time of 12.75 hours, LT50 37.5 hours, the highest mortality occurred on the second day of 37.5% and total mortality of 92.5% on the fifth day after application (Nasution and Rustam, 2020). Kabau fruit skin extract, using a concentration of 0.5% was able to cause mortality in C. pavonana larvae, reaching 63.33% (Obel et al., 2020). The kabau plant (*Archidendron bubalinum*) is a plant native to the Sumatra region that has antibacterial, antiviral, and antiparasitic properties (Rahmawati et al., 2020). Apart from that, kabau skin has extreme antioxidant activity (Riana et al., 2024). These results indicate that jengkol and kabau skin extracts are effective in reducing pest larvae populations, making them an environmentally friendly alternative for pest control.

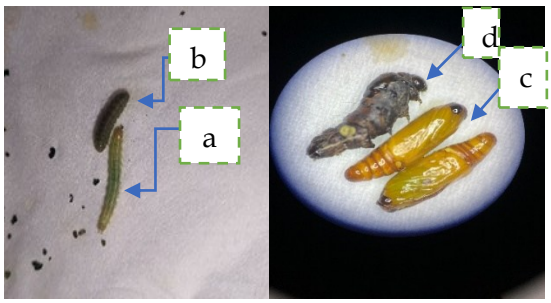

Figure 1. *Crocidolomia pavonana* F. (crop caterpillar) a. healthy *C. pavonana* larvae, b. *C. pavonana* larvae exposed to vegetable insecticides, c. healthy *C. pavonana* pupae, d. *C. pavonana* pupae are deformed.

CONCLUSION

In this test, *C. pavonana* larvae exposed to vegetable insecticides became stiff and black. In contrast, larvae that did not die could still become pupae but were deformed, preventing them from becoming imago. From these results, the concentrations of jengkol skin extract and kabau skin extract that will be used for semi-field test applications in screen houses are 20%, 30% and 40%. This research continues to test the application of jengkol skin extract and kabau skin extract in screen houses.

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