

# Repellency of Orange Peel Eco-Enzyme to Reared German Cockroaches (*Blattella germanica* L.)

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## ABSTRACT

*The German cockroach is a common pest worldwide that has developed insecticide resistance. Aromatic eco-enzyme is one alternatives to repel German cockroach population without develop insecticide resistance. This study aims to determine the repellency value and level of eco-enzyme made from orange peel. The method of this study is a Repellency test of eco-enzyme with four concentrations (100%, 50%, 25%, and 10%) to the reared resistant German cockroach. The repellency level of eco-enzyme at low concentrations (10%) to high concentrations (100%) ranges from high repellent to very high repellent at one hour of observation. The repellency decreases until 48 hours of observation and ranges from medium to high repellent. Eco-enzyme are eco-friendly, simple to make, and can use to repel Geman cockroaches population.*

**Key words:** *Repellent agent; Kitchen waste; Eco-enzyme; Pest control Indonesia.*

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## Introduction

The German cockroach (*Blattella germanica* L.) is a common pest in urban areas, and the most important species has spread globally (Nasirian, 2010; Tang et al., 2019). The German cockroach is an insect vector that causes many human diseases from pathogenic bacteria (Solomon et al., 2016). The control of German cockroaches using an insecticide is an effective method to reduce their population. However, continuous use of insecticide causes resistance in the German cockroach population. The German cockroach has been resistant to several insecticide groups in Singapore (Chai & Lee, 2010), Iran (Nasirian, 2010), America (Holbrook et al., 2003; Liang et al., 2017; Wu & Appel, 2017), and Denmark (Kristensen et al., 2005).

The German cockroach also has been resistant to several insecticide groups in Indonesia, such as Carbamate, Pyrethroid, and Phenylpyrazole (Rahayu et al., 2012). The German cockroach has also been resistant to spray commercial insecticide containing pyrethroid active ingredients (Rahayu et al., 2016). Therefore, exploring alternative insecticide agents is important to overcome the insecticide resistance problem.

Sweet orange peel has a volatile aromatic component (Dharmawan et al., 2009; Qiao et al., 2008) and effective as a repellent to maize weevil (Kidane, 2011) and mosquitoes (Gupta & Singh, 2017; Murugan et al., 2012; Prakash et al., 2019). Processing orange peel into an eco-enzyme product is a cheap and easy method to produce an aromatic liquid. Eco-enzyme is a dark brown color solution produced by

fermentation, usually using fruit waste. Eco-enzyme would help reduce fruit waste, are eco-friendly, and are economical with multipurpose applications such as floor cleaning, utensils, gardening, repellent of insect pests, Etc. (Vama & Cherekar, 2020).

This study is a preliminary investigation of the potency of eco-enzymes to repel insect pests such as German cockroaches. Eco-enzymes are widely used for purification of contaminated water (Janarthanan et al., 2020), biofertilizer and biopesticides (Arifin et al., 2009), and antimicrobial (Mavani et al., 2020). Eco-enzyme is claimed can repel insect pests based on interview with eco-enzyme practitioners. However, there are no scientific reports on its effectiveness as an insect repellent. Therefore, the present study aims to determine the effectiveness of eco-enzyme made from orange peels as alternative repellent to control German cockroach population.

## Materials and Methods

### 1. Insect

The German cockroach used in this study is female cockroaches from the Palembang population (PLZ-PLM) reared at the Animal Physiology Laboratory, Department of Biology, Universitas Andalas since 2017. The population was collected from several groceries stores in Palembang, South Sumatra, Indonesia. It was resistant to propoxur up to 1332 folds (extremely high resistance) compared to the susceptible population (Nurseha & Rahayu, 2019). The population reared in temperature of 24-28° C, and photoperiod of 12-12 (Rahayu et al., 2021).

### 2. Eco-enzyme

The repellent used in this study was orange peel eco-enzyme. Orange peels obtained from jeruk siam Gunung Omeh from Kabupaten Lima Puluh Kota, West Sumatera Province. The orange peels are rinsed with water before being cut into small pieces. The amount of 100 g of brown sugar was dissolved in one liter of

groundwater, and 0.3 kg of orange peels were added to the brown sugar solution. The solution was fermented in a plastic container for three months. The gas trapped in the plastic container is removed once a week. After the fermentation process, the solution was filtered to remove the dregs, and the solution is ready to use (Vama & Cherekar, 2020). To vary the concentration, the eco-enzyme solution is dissolved in groundwater until the desired concentration is obtained. The concentrations of the solutions tested varied from 100%, 50%, 25%, and 10%.

### 3. Repellency Test

A plastic container (15 cm in diameter and has a high of 10 cm) and filter paper divided into two equal parts were used in the repellency test. One ml of solution was dropped and evenly distributed on the entire surface of the first half of the filter paper as a treatment, while the second half received no treatment. The filter paper was ready to use after the water component of the eco-enzyme had been air-dried for 30 minutes. The filter paper's treatment and control halves were then placed in a plastic container. Cockroaches were kept from escaping during observation by smearing petroleum oil on the top of the plastic container. Ten female German cockroaches were placed in the center of the plastic container. The presence of German cockroaches was observed on each filter paper at the one, three, six, 24, and 48 hours of observation. Each treatment was replicated three times (Rahayu et al., 2021).

### 4. Data Analysis

Repellency value refers to a formula by Thavara et al. (2007). as follows:

$$\text{Repellency (\%)} = 100 - \frac{T \times 100}{N}$$

Where the T are the number of cockroaches located in the treated area and N are the number of cockroaches in control area.

The repellency level refers to Dales (1996) as follows: repellency value <0.1% is not repellent, repellency value 0.1-20%

is very low repellent, repellency value 20.1-40% is low repellent, repellency value 40.1-60% is medium repellent, repellency value 60.1-80% is high repellent and repellency value 80.1-100% is very high repellent.

**Results and Discussion**

The repellency value of orange peel eco-enzyme varies depending on the concentration tested. The repellency values at all concentrations decreased from one to the 48 hours of observation. The most decrease in repellency value was 46.7 percent at a concentration of 100%, and the smallest was 20 percent at a concentration of 50% (Table 1). A decrease in repellency

value is probably caused by the volatility of aromatic compound of eco-enzyme solution which is obtained from the components of orange peel dissolved in it. Even at the lowest concentration (10%) of the eco-enzyme solution, it is still effective as a repellent, with repellency values exceeding 50% for up to 24 hours. According to [Vama & Cherekar \(2020\)](#), there is approximately 42.25 mL of acetic acid in every 500 mL of orange peel eco-enzyme, with metabolites including flavonoids, quinones, saponins, alkaloids, and cardio glycosides. German cockroaches may dislike the aroma of the orange peel content fermented into an eco-enzyme solution.

**Table 1. The repellency value of orange peels eco-enzyme to reared female German cockroaches**

Time(hours)	RV(%) $\pm$ SD*			
	100%	50%	25%	10%
1	86.7 $\pm$ 15.3	86.7 $\pm$ 11.5	66.7 $\pm$ 20.8	76.7 $\pm$ 23.1
3	86.7 $\pm$ 11.5	86.7 $\pm$ 11.5	80 $\pm$ 17.3	73.3 $\pm$ 28.9
6	66.7 $\pm$ 11.5	80 $\pm$ 10	63.3 $\pm$ 23.1	73.3 $\pm$ 28.9
24	53.3 $\pm$ 5.8	80 $\pm$ 10	53.3 $\pm$ 11.5	56.7 $\pm$ 15.3
48	40 $\pm$ 10	66.7 $\pm$ 20.8	43.3 $\pm$ 15.3	43.3 $\pm$ 15.3

\*RV: Repellency value and SD: Standard deviation

In one hour of observation, the repellency level of the orange peel eco-enzyme at concentrations of 10% to 100% ranged from high repellent to very high repellent (Table 2). After 48 hours, the repellency level remained high, ranging

from medium to high repellent (Table 3). The repellency of the eco-enzyme remained medium repellent to German cockroaches at the lowest concentration of 10% after 48 hours.

**Table 2. The repellency level of orange peels eco-enzyme to reared female German cockroaches at one hour of observation**

Concentration (%)	RV* (%)	Repellency level
100	86.7 $\pm$ 15.3	Very High Repellent
50	86.7 $\pm$ 11.5	Very High Repellent
25	66.7 $\pm$ 20.8	High Repellent
10	76.7 $\pm$ 23.1	High Repellent

\*RV: Repellency value

The repellency level of eco-enzymes solution is low when compared to ethanolic extracts from lemongrass leaf ([Rahayu et al., 2018](#)), papaya leaf ([Rahayu et al., 2020](#)) noni leaf ([Rahayu et al., 2021](#)), citronella

grass leaf ([Jannatan & Rahayu, 2021](#)) whose level remained very high repellent after 24 hours. The rapid decrease in the repellent level of the eco-enzyme solution compared to ethanolic extract may be due

to volatile compound contain in the solution. The volatile compound dissolved in the solution may be affected by

differences in the method of making the solution and source of material used.

**Table 3. The repellency level of orange peels eco-enzyme to reared female German cockroaches at 48 hours of observation**

Concentration (%)	RV* (%)	Repellency level
100	40±10	Medium Repellent
50	66.7±20.8	High Repellent
25	43.3±15.3	Medium Repellent
10	43.3±15.3	Medium Repellent

\*RV: Repellency value

Repellent agents can be derived from synthetic substances and essential oils from plants. The fermentation process in making the orange peel eco-enzyme solution makes the substance in orange peel flavorful and can be developed into a repellent agent. The use of kitchen waste such as orange peel in the production of eco-enzymes is one method for developing repellent products that are environmentally friendly, economical and easy to make.

### Conclusion

Orange peel Eco-enzyme solution has the potential as a repellent agent to repel German cockroaches. The value and level of repellency of the eco-enzyme ranges from 66.7-86.7% and varies from high repellent to very high repellent in the first hour. The repellency value and level remained high after 48 hours, which value ranged from 40.0-66.7 % and level ranged from medium repellent to high repellent. Further research is needed to identify the eco-enzyme components that act as German cockroach repellent.

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