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# Toxicity of Soursop (*Annona Muricata L*) Leaf Extract and Patchouli (*Pogostemon Cablin Benth*) Leaf Extract to American Cockroach (*Periplaneta Americana*)

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**Abstract**

This study aims to determine the toxicity of soursop leaf extract *(Annona muricata L)* and patchouli leaf extract *(Pogostemon cablin Benth)* on the mortality of the American cockroach *(Periplaneta americana)*. The extract was prepared using the maceration method, using distilled water as a solvent. Soursop and patchouli leaf extracts with a concentration of 5% were sprayed as much as 2 ml on each American cockroach. The results of the study were cockroach mortality data for 1-120 hours with observations every 1, 3, 6, 12 and 24 hours. As for the results obtained, the administration of soursop leaf extract cockroach mortality at the 24th hour was 66.67% and at the 48th hour 100% cockroach mortality. Whereas in the administration of patchouli leaf extract cockroach mortality at the 96th hour was 66.67% and at the 120th hour 100% cockroach mortality. These findings hold promising prospects for future research and applications. They suggest the potential development of natural cockroach control methods, the investigation of underlying mechanisms, and the evaluation of ecological implications and safety for human use. Additionally, these extracts may have commercial applications as pest control agents or insect repellents, offering more sustainable alternatives to conventional pest control methods.

**Keywords**: American cockroach, Bioinsecticide, Cockroach mortality, Patchouli leaf extract, Soursop leaf extract.

## INTRODUCTION

Insects are one of the most dominant animal groups on earth. Hundreds of thousands of species have been identified, numbering three times the total number of known animals. Humans have been fighting insects for a long time, which often act as pests, transmit diseases and eat agricultural, forestry and plantation crops. Even so, until now humans have not been able to eradicate one type of insect. Insects are always identified as nuisance, because insects act as agents that transmit disease to humans, namely the Arthropod group (Zega & Fau, 2021). The respiratory system of insects is different from other animals. Insects do not breathe with lungs or gills, but with a special means of air exchange (ventilation). These animals do not breathe through the nose or mouth. Air enters through side holes located on the sides of the chest or abdomen (spiracles) The spiracle is connected to a tube called the trachea. The trachea of each spiracle is connected so that it will form longitudinal trunks. This channel will be further divided into small channels called tracheoles. These small channels tortuous form a network throughout the body and can reach every part of the body's organs, tissues, and cells of the body (Pracaya, 2008).

Cockroaches are one of the dangerous insects, but they are often found in residential drains. Cockroaches can act as disease vectors, because cockroaches like places that are damp, dark and dirty so they can carry disease germs that stick to their bodies. Diseases transmitted by cockroaches include dysentery, cholera, typhoid, diarrhea and others related to poor environmental sanitation conditions. Microorganisms that can be transmitted by cockroaches are Streptococcus, Salmonella, hepatitis A virus, polio and eggs with worm larvae. These organisms can come from garbage, food scraps, or dirt (Arimurti, 2017).

Cockroaches are insects that are often considered disruptive to human health, especially because they tend to approach and breed in dirty areas, such as trash cans and sewers (Ahmad & Ulfani, 2018; Ubulom et al., 2021). Cockroaches can be found in a variety of environments, especially in tropical and subtropical regions, living among dry leaves, rotting wood, and holes in trees. American cockroaches are omnivorous insects, consuming food from plants and animals (Amalia & Harahap, 2015; Hana, 2012). They undergo three stages in their life cycle: egg, nymph, and adult. Nymphs resemble adult cockroaches but are smaller in size and do not yet have fully developed wings. Female cockroaches usually lay their egg capsules in a hidden place, and one capsule usually contains 30-40 eggs. In terms of physique, cockroaches have a flat body shape, long antennae, and two pairs of wings with different characteristics between males and females. Although often considered annoying and potentially disease-carrying, cockroaches can be eradicated by using insecticides from natural ingredients (Triatmanto & Murdaningsih, 2009).

Control of insects, particularly the American cockroach (Periplaneta americana), has become a critical issue in sanitation and public health. Although conventional methods such as spray insecticides (aerosols) have become the dominant tool in cockroach control, the side effects of synthetic insecticides, including negative impacts on the environment and potential health hazards to humans, are fueling the need for more sustainable and safe alternative solutions.

Soursop plants, which are known to thrive in the tropics (Fikri et al., 2019), offer potential as a source of plant-based insecticides. Soursop leaves are known to contain acetogenins compounds that have cytotoxic properties (Zaenab & Hatija, 2019). Further, this compound serves as a contact poison and gastric poison for insects, which can be sprayed directly on the cockroach's body or on its food. In addition, soursop has also been explored for its potential anti-inflammatory and antioxidant effects (Ayun et al., 2020), as well as flavonoid content found in various green plants (Madaya & Ningsih, 2020), showing anticancer, antibacterial, and various other health benefits.

On the other hand, patchouli plants also show potential as natural insecticides. Patchouli leaves contain a variety of chemical compounds, including essential oils that are known to have toxic effects on insects (Tahir et al., 2017). This oil works by penetrating the outer layer of the insect, causing death (Sucipto, 2011). Patchouli leaves, petioles, and stems can all be processed to obtain essential oils, with the highest content found in leaves and petioles.

Given the potential of these two plants as natural sources of insecticides and the urgent need for sustainable insect control solutions, this study aimed to explore and evaluate the toxicity of soursop leaf and patchouli leaf extracts to American cockroaches, in hopes of identifying effective, safe, and environmentally friendly insect control methods.

## RESEARCH METHODS

The type of research used in this research is descriptive research. This research was conducted from February to March 2023 at the Microbiology Laboratory, Department of Biology. The tools used are analytical balance, autoclave, filter, funnel, stirring rod, jerry can, beaker glass, measuring cup, Erlenmeyer, blender and syringe. The materials used were soursop leaves, patchouli leaves, alcohol, n- hexane, distilled water, cotton, sample bottles, sample plastic, spray bottles, filter paper, and American cockroaches.

The study used the maceration method using distilled water as a solvent. Soursop leaves and patchouli leaves used are leaves that are not too old and not too young (4-6th sheet from the top) as much as 25 g and then dried. After that, soursop leaves and patchouli leaves are blended and then soaked in 500 ml of distilled water for 1 day. The results of the soaking are filtered using filter paper to separate the water and meserat.

Soursop and patchouli leaf extracts were sprayed as much as 2 ml with a 5% concentration on cockroaches and their food. Spraying as much as 2 ml is only done 1 time per 5 days. After 5 days, cockroach mortality was observed at 1, 3, 6, 12, and 24 hours.

Data collection techniques in this study were obtained from cockroach mortality for 1-120 hours with observations every 1, 3, 6, 12, and 24 hours, after spraying n-hexaan, distilled water, soursop leaf extract, patchouli leaf extract and soursop leaf extract+ patchouli leaf extract. The data analysis technique in this study was to calculate the number of dead cockroaches by administering soursop leaf extract and patchouli leaf extract.

## RESULTS AND DISCUSSION

Soursop and patchouli leaf extracts were sprayed as much as 2 ml on the cockroaches and their food. Spraying as much as 2 ml is only done 1 time. After that, cockroach mortality was observed at what time the cockroaches died after spraying, for 5 days of observation. Data on the average percentage of cockroach mortality after each treatment is presented in Table 1 below.

**Table 1 The Average Percentage of Cockroach Mortality at 1 Hour to 120 Hours**

| Treatment | Cockroach mortality (%) at the 2nd hour | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 3 6 12 24 | 48 | 72 | 96 | 120 | | | | | |
| n-hexane | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Aquades | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ex. D. Soursop | 0 | 0 | 0 | 0 | 66,67 | 100 | 100 | 100 | 100 |
| Ex. D. Patchouli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66,67 | 100 |
| Ex. D. Soursop + D. Patchouli | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66,67 |

Cockroach mortality (%) 1-12 hours, 1st day, 2nd day, 3rd day, 4th day and 5th day (120 hours) 1-3 repetitions in each treatment.

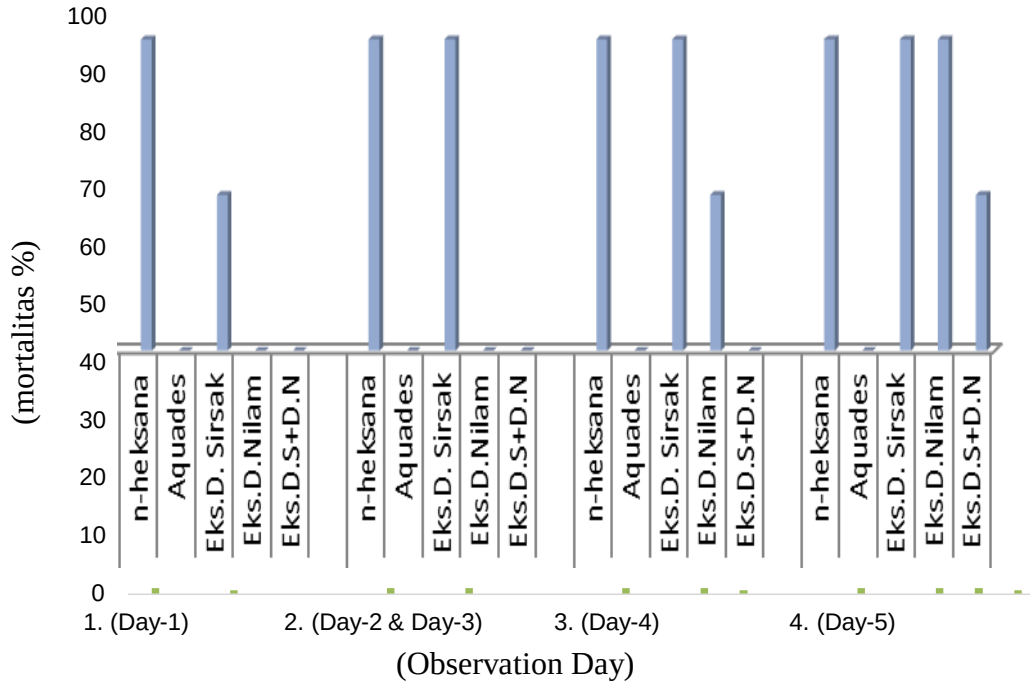


**Figure 1** Cockroach mortality (%) 1st, 2nd, 3rd, 4th and 5th day

Figure 1 shows the percentage of cockroach mortality on day 1 (hour 1, 3 hours, 6 hours and 12 hours repetition 1-3). The positive control (n-hexane) which was sprayed on cockroaches showed that cockroach mortality had reached 100% while the negative control (aquades), soursop leaf extract, patchouli leaf extract and soursop leaf extract + patchouli leaves which were sprayed on cockroaches showed 0% cockroach mortality.

At the 24th hour repeat 1-3. Positive control (n-hexane) sprayed on cockroaches showed cockroach mortality reaching 100%, negative control (aquades) 0%, soursop leaf extract 66.67%, patchouli leaf extract and soursop leaf extract+Patchouli leaves sprayed on cockroaches showed that cockroach mortality was still 0%.

At 48 hours and 72 hours repeat 1-3. Positive control (n-hexane) sprayed on cockroaches showed cockroach mortality reaching 100%, negative control (aquades) was still 0%, soursop leaf extract 100%, patchouli leaf extract and soursop leaf extract+Patchouli leaves sprayed on cockroaches showed that cockroach mortality was still 0%.

At the 96th hour repeat 1-3. Positive control (n-hexane) sprayed on cockroaches showed cockroach mortality reaching 100%, negative control (aquades) was still 0%, soursop leaf extract 100%, patchouli leaf extract 66.67% and soursop leaf extract+Patchouli leaves sprayed on cockroaches showed that cockroach mortality was still 0%.

At the 120th hour of repetition 1-3. Positive control (n-hexane) sprayed on cockroaches showed cockroach mortality reaching 100%, negative control (aquades) was still 0%, soursop leaf extract 100%, patchouli leaf extract 100% and soursop leaf extract+patchouli leaves sprayed on cockroaches showed 66.67% cockroach mortality.

Soursop leaf extract is sprayed as much as 2 ml on cockroaches and their food. Spraying as much as 2 ml is only done 1 time. After that, cockroach mortality was observed at what time the cockroaches died, this study was conducted for 5 days. At the 24th hour the cockroaches died as much as 66.67% and the 48th hour as many as 100% of the cockroaches died and this all happened in repetitions 1-3, this was often the case with Astuti's research (2014) the

percentage of American cockroach mortality after administration of soursop leaf extract as much as 2 ml at the 24th and 48th hours the cockroaches died as much as 40%.

Giving patchouli leaf extract cockroaches died at the 96th hour as much as 66.67% and at the 120th hour as many as 100% of the cockroaches died and this all happened in repetitions 1-3. In this study, after being treated, the cockroaches experienced an orientation disorder, then their bodies turned upside down and eventually died. In general, the cockroaches used were of the same age.

The positive control cockroach mortality value (n-hexane) at 1 hour to 120 hours (day 5) was higher than the negative control (aquades) because n-hexane is a non-polar solvent, a chemical from oil. raw. Pure N-hexane (positive control) is a colorless liquid with a slightly pungent odor, is flammable and an explosive vapor. While distilled water (negative control) is distilled water that is free from impurities so that it is pure in the laboratory. Aquades is clear, odorless and tasteless (Petrucci, 2008).

Administration of soursop leaf extract had better mortality than the negative control (aquades) because the active compounds contained in soursop leaves were acetogenins and flavonoids. According to Lestari et al (2016), the presence of acetogenin compounds contained in soursop leaf extract can inhibit the formation of ATP in the respiration process, causing the formation of energy to be hampered and then the body volume will shrink which is characterized by shrinking of the body which then causes death.

Soursop leaves are one of the leaves that contain high phenols and apart from that they also contain steroid/terpenoid compounds, flavonoids, alkaloids and tannins (Yanti et al., 2020). The bioactive components found in soursop leaves can be obtained through an extraction process (Yuliantari et al., 2017). Flavonoids are one of the compounds contained in soursop leaf extract that function as respiratory inhibitors, in other words, they can reduce the rate of chemical reactions so that the respiratory system of these pests is disrupted (Muta'ali & Purwani, 2015).

Giving soursop leaf extract shows a change in behavior, namely a decrease in activity, the movement becomes weak or passive. But when compared to the positive control (n-hexane) the mortality of cockroaches by giving soursop leaf extract is lower because n-hexane is a non-renewable compound originating from earth with a pungent and flammable odor and explosive vapors.

The administration of patchouli leaf extract had better mortality than the negative control (aquades) because the active compounds contained in patchouli leaves were essential oils, flavonoids, saponins, tannins and steroids. Patchouli oil can also be used to control insect populations because it acts as a repellent and inhibits insect growth. Atmadja's research (2011) states that patchouli oil with a concentration of 10 cc/l is effective in controlling Spodoptera litura in chili plants with an effectiveness level of up to 74.96%.

Patchouli leaves contain essential oils that function as aromatherapy and repellent. Patchouli leaves also contain saponins and flavonoids (Rusli & Rerung, 2018). Flavonoids as active ingredients in making vegetable insecticides. Flavonoids also function as respiratory inhibitors and inhibit the insect's respiratory system (Dinata, 2008). Tannin can reduce the ability to digest food by reducing the activity of digestive enzymes (protease and amylase) and disrupting intestinal protein activity. Insects that eat plants with high tannin content will get little nutrition in their food, as a result there will be a decrease in growth and the insects will die (Suyanto, 2009). The active glycoside compound acts as an antibacterial compound by penetrating the cell wall and damaging cell wall components (Widowati et al., 2022).

Wardhana & Husein, (2005), stated that the absorption of insecticides which have stomach toxic effects mostly takes place in the digestive system of insects. Insecticides that are sprayed directly on the cockroach's body function as contact poison, while those that are sprayed on the cockroach's food act as stomach poison if ingested (Pangaribuan et al., 2012).

Compounds contained in soursop leaf and patchouli leaf extracts did not directly cause the death of adult American cockroaches. However, soursop leaf extract was more effective than patchouli leaf extract because in this study cockroaches died faster, namely at 24 hours.

## CONCLUSION

Based on the results of the discussion that has been described the toxicity of soursop leaf extract and patchouli leaf extract is effective on American cockroach mortality, the time needed to kill American cockroaches using soursop leaf extract is at least 24 hours as much as 66.67% and 48 hours 100% cockroach mortality while leaf extract patchouli at least 96 hours as much as 66.67% and 120 hours 100% cockroach mortality. It suggests the potential development of natural cockroach control methods, the investigation of underlying mechanisms, and the evaluation of ecological implications and safety for human use. Additionally, these extracts may have commercial applications as pest control agents or insect repellents, offering more sustainable alternatives to conventional pest control methods.

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