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Bareg Ball: Formulation And Analysis Of Clove Use As An Insecticide And Natural Aromatherapy Ingredient

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ABSTRACT

Indonesia is a country that has quite a lot of insect species. Which is around 250,000 species. The significant abundance of insect populations poses problems that require effective solutions in their control. Currently, the public generally use camphor as an alternative to insect control to overcome these problems. There are too many artificial insecticide products circulating that will damage the environment. So, we are encouraged to make natural-based insecticides. The purpose of this research is to find out the formulation of natural insecticides that are environmentally friendly. This study uses an experimental quantitative methodology with doves and tapioca flour with a dove formulation of 2 grams and 1.5 grams of wheat flour and 0,5 grams of tapioca flour. The results of this study show that formulations with a ratio of doves and flour of 1:1 have a more significant effect among other formulations.

Keywords: Cloves, Insecticide, and Formulation

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INTRODUCTION

Insects are a group of dominant animals on earth with the number of species accounting for almost 80 percent of the total number of animal species on earth. Of the 751,000 species of insects, about 250,000 species are found in Indonesia. Some are predators, parasitoids, or natural enemies (Christian and Gotisberger, 2000). More than 7,000 new species are discovered almost every year. For this reason, insects are successful in maintaining their survival in a varied habitat, high reproductive capacity, ability to eat different types of food, and the ability to save themselves from their enemies (Borror, 1998). The easy spread of this insect makes the insect population uncontrollable. This can be treated with chemical insecticides.

Control of insect pests with chemical insecticides poses many problems, including: increasing pest resistance to chemical insecticides, explosions in secondary pest insect populations, increasing risk of poisoning in humans and livestock, declining biodiversity, and other dangers related to the environment. The emergence of these problems is a stimulant that increases interest in integrated pest control (PHT) efforts. In the 21st century, insect pest management is increasingly geared towards the use of alternative environmentally friendly methods with the aim of reducing direct contact between humans and chemical insecticides. In line with the context of the search for this method, camphor began to be researched for its potential as an insecticide ingredient.

Camphor is a solid substance in the form of white paraffin and more or less transparent with a distinctive and strong aroma. This substance is a terpenoid with the chemical formula $C_{10}H_{16}O$ and contains naphthalene. This substance is found in the wood of the camphor laurel tree (*Cinnamomum camphora*), a large tree found in Asia, especially in Sumatra, Borneo and Taiwan, as well as *the Dryobalanops aromatica tree*, a large tree that grows in the forests of Borneo. Camphor can also be tapped from other types of trees of the laurel family.

Camphor itself has a variety of benefits. In general, camphor is used to remove musty odors in clothes, bathroom deodorants, insect repellents, and air fresheners. According to the Louisiana State Department of Health, some of the chemicals in camphor such as naphthalene ($C_{10}H_8$) can cause health effects, including headaches, nausea, eye and nose irritation, and cough. Exposure to chemicals contained in camphor can cause more serious effects, namely hemolytic anemia. Therefore, the exploration of natural ingredients as a substitute for synthetic camphor becomes relevant to study, especially considering the potential of plants as a source of insecticides.

According to research, there are more than 1,500 plants that have insecticidal effects.

(Regnault et al., 2012; Suresh et al., 2018). Cloves (*Syzygium aromaticum*) (L.) stand out among plant species that produce essential oils with insecticidal potential for pest control (Han et al., 2006; Correa, 2011; Afonso et al., 2012)

Cloves (*Syzygium aromaticum*) are one of the plants that have the potential as a vegetable pesticide. Cloves contain the active compound eugenol which has antibacterial and antifungal properties (Alvionita Djauet al 2022) The use of repellent based on clove extract does not directly kill insects, but serves to resist the presence of house flies and inhibit the development of insects through their pungent smell (Mustanir and Rosnani, 2008).

Based on the description above, the researcher is interested in conducting research that aims to create aromatherapy camphor as an alternative to camphor or camphor with clove-based ingredients with the addition of tapioca flour as a substitute for synthetic camphor and reduce the harmful impact of synthetic camphor.

1. Research Methodology and Experimental Details

The formulation and analysis of the use of cloves as an insecticide ingredient and a natural aromatherapy producer is experimental quantitative research that can be used to enable the mixing of active ingredients and excipients (additives) to produce *BAREG balls* with the use as an effective insecticide ingredient, and targeted aromatherapy effects. This type of research is a combination of quantitative research with experimental methods. This research focuses on the manufacture of cloves-based aromatherapy camphor (*Syzygium aromaticum*) with excipient ingredients in the form of tapioca flour which can substitute the use of synthetic camphor. The data collection method in this study is that data is collected through independent variable manipulation and dependent variable measurement. Therefore, the researcher will explain in detail the things that exist and describe them in the results of the discussion.

BAREG balls, which are made from natural ingredients in the form of cloves and tapioca flour as the hardening material, are an effort to add more value than synthetic camphor. Researchers hope that the resulting product can be a solution to reduce the health hazards posed by synthetic camphor and as an aromatherapy. This research was conducted at MAN INSAN CENDEKIA OKI Some of the tools and materials used in manufacturing are as follows:

1. Tools: Mortar and pestle, a blender, an oven to dry *the BAREG ball*, a spoon to stir the ingredients, and a digital balance to weigh the ingredients.
2. Ingredients: Cloves (*Syzygium aromaticum*), tapioca flour, wheat flour, and hot water, as well as telang flowers as coloring

The process of making *BAREG* balls from natural ingredients that function as aromatherapy and insecticides is as follows:

Initial preparation

1. Prepare materials and tools as above.
2. Weigh cloves and tapioca flour in comparison.
3. Put the cloves in a porcelain pan.
4. Then mash the cloves until they form a powder.

Dough making

1. Put the clove powder in a container.
2. Add flour and tapioca flour in comparison.
3. Put in enough hot water.
4. Stir until smooth.
5. Shape to form a ball.
6. Dry the BAREG ball *dough* by placing it in the oven.
7. Set the oven temperature to 90°.
8. Dry *the BAREG ball* for 45-50 minutes.

Coloring *BAREG ball*

1. Wash and dry the telang flowers.
2. Put the washed and dried telang flowers into hot water.
3. After the water turns purple, put *the BAREG ball* into it for 2 seconds, do it about 2 to 3 times.
4. Then the oven returns *to the BAREG ball*

With the aim of analyzing the quality of camphor obtained, a series of analyses were carried out using the following test parameters:

A. Bioassay Test

The bioassay test is a method of testing the biological activity of the clove lime formulation against the target insect (ants) which consists of two main parameters: the repellency test and the mortality test. These two parameters provide a comprehensive overview of the effectiveness of the naturally developed insecticide. The researcher used *a BAREG ball* with two dose variations as a control variable in this study. The variables tied to this study were the response time of the ant (how long it responded and stayed away from *the BAREG ball)* and the resistance of lime and the free variables in this study, namely the dose of cloves, the dose of tapioca flour and the dose of wheat flour. Dose 1 consists of 2 grams of cloves, 2 grams of tapioca flour, and 0 grams of wheat flour, while Dose 2 consists of 2 grams of cloves, 1.5 grams of wheat flour, and 0.5 grams of tapioca flour.

1. Insect repellency test

The procedure for testing repellantic activity against insects is carried out as follows:

a. Sample collection

- Each sample was taken from a test product weighing 4 grams.
- Two samples were prepared for separate testing.

b. Test Container Preparation

- Each container contains 10 pre-adapted test insects.
- Environmental conditions were kept uniform during testing.

c. Exposure Process

- The sample is placed in a container that has been filled with the test insects.
- Exposure is carried out for 1 hour without additional intervention.

d. Observation and Data Recording

- After 1 hour, observations are made whether insects stay away from the product by time intervals:

- 15th minute
- 30th minute
- 60th minute

- The recording of test parameters is carried out by calculating the avoidance rate, or the percentage of ants that stay away from *the BAREG ball*. Recording of insect repellency data was neatly recorded for each sample.

e. Avoidance rate calculation

- The percentage is calculated by the formula:

Avoidance Rate (%) = (Number of ants that escape/evade / 10) × 100%

1. Insect mortality test

a. Sampling Each sample is taken from the tested product of 4 grams. Two samples are provided for separate testing.

b. Preparation of Test Containers Each container contains 10 test insects that have previously gone through the adaptation process. During the test, the environmental conditions are observed to keep them the same as each other.

c. The Sample Display process is placed in a container that is already filled with the test insects. The exposure process lasted for 8 hours without any additional treatment.

d. Observation and Data Recording After 8 hours, observations were made whether the insects moved away from the product at time intervals: 1 hour, 2 hours, 4 hours, 6 hours, and 8 hours after sample placement.

e. Calculation of Percentage of Insect Mortality Insects that have died in each treatment are calculated the mortality value using the equation: Mortality (%) = (Number of dead insects / Number of test insects) × 100%

The subject of this study is insects that live naturally in the MAN INSAN CENDEKIA O KI area. From this population, worker ants were selected as test organisms that have gone through an identification and characterization process based on the criteria set in this study. The selection of worker ants is carried out because this type has characteristics that are in accordance with the purpose of testing the effectiveness of the formulation of clove lime as a natural insecticide.

3. Results and Discussion

Result

The BAREG balls we made and developed basically exhibited functions comparable to or the same as synthetic camphor. However, *BAREG balls* have advantages and differences in the basic material used, namely cloves. Based on the test results, this product is able to provide aromatherapy effects while also functioning as an insecticide. The existence of aromatherapy compounds produced from cloves is considered effective as an alternative to various health problems caused by exposure to synthetic camphor gas. The test results showed that cloves-based aromatherapy camphor had significant effectiveness in suppressing insect populations in the experimental medium. These findings strengthen the potential for the use of cloves as the main raw material in the development of sustainable and environmentally friendly camphor products. A number of studies have been carried out by researchers to evaluate the performance of cloves-based aromatic camphor, including bioassay testing and insect repellency tests, with the following results:

1. Insect Repellent Test

Insect repellency testing was carried out to analyze the ability of *the BAREG ball* formulation to repel or reject the arrival of targeted ants. Observations were conducted at time intervals of 15, 30, and 60 minutes after exposure to measure the avoidance rate of ants for each formulation. The observed parameters were the number of ants that showed evasive or fuzzy behavior in the container containing the treatment sample, then the percentage of the total test ant population (10 per container) was calculated.

Table 1. Ant Avoidance Rate on BAREG *Ball Formulation*

Treatment	Composition	Avoidance rate (%)			Average
		15 minutes	30 minutes	60 minutes	(%)
Dose 1	2g cloves + 2g tapioca flour + 0g wheat flour	30%	70%	100%	66.6%
Dose 2	2g cloves + 1.5g wheat flour + 0.5g tapioca flour	40%	70%	100%	70%

2. Insect mortality test

Insect mortality testing aims to analyze the insecticide effectiveness of the *BAREG ball formulation* through the measurement of ant mortality rates at specific time intervals. Mortality observations were carried out periodically at the 1st, 2nd, 4th, 6th, and 8th hours after exposure to the sample to monitor the development of ant mortality cumulatively. The death criteria were determined based on the absence of motor responses and movement activity of ants. Mortality data is calculated as a percentage of the number of ants that die against the total population of test ants in each treatment container.

Table 2. Percentage of Cumulative Mortality of Ants

Treatment	Morality Percentage (%)				
time	1 hour	2 hours	4 hours	6 hours	8 hours
Dose 1	5%	20%	50%	70%	100%
Dose 2	10%	30%	80%	100%	

Discussion

Research on BAREG balls made from cloves proves the ability of this product to double as an insect repellent and killer. This effectiveness is due to the eugenol content in cloves, which has the characteristics of volatility, sharp aroma, and toxic to various types of insects.

1. Insect Repellency Ability Analysis

Testing of the insect repellency showed that both dose variations were able to create a rejection effect in the experimental ants. The intensity of insect avoidance increases with the duration of exposure, with a maximum of 100% achievement after 60 minutes for both formulas.

An interesting thing that was found is that the second dose formula provides a higher average rejection percentage (70%) than first dose (66.6%). This difference is most likely related to the different binding compositions between wheat flour and tapioca flour. Gluten-rich wheat flour produces a more solid structure, while tapioca flour serves as a more efficient release medium for active compounds. Optimal blending at dose 2 allows for better distribution of volatile compounds.

These findings support previous research that confirmed eugenol's role as an insect repellent compound through disruptions in the insect's respiratory and neurological systems, allowing the insects to move away from the area exposed to the scent.

2. Insect Mortality Analysis

BAREG balls not only repel but also show significant mortality effects on insects. Observations of ant mortality show a gradual increase along with the duration of extended exposure. The 1st dose formula starts with a mortality rate of 5% in the first hour and reaches 100% in the eighth hour. In contrast, dose 2 showed faster progress with 10% mortality in the first hour and 100% in the sixth hour.

This difference in the speed of the lethal effect indicates the effect of the formulation on the release rate of the active substance. The composition of dose 2 (2 grams of cloves, 1.5 grams of wheat flour, 0.5 grams of tapioca) seems to be more efficient in releasing eugenol, so the toxic effects appear faster than dose 1 which releases the active substance more gradually.

These results reinforce the theory that eugenol acts as an insecticide with a mechanism that disrupts the nervous system, causes respiratory dysfunction, and leads to the death of insects.

3. Research Relevance and Application

Comprehensively, this study strengthens the potential of cloves as the main ingredient of natural camphor products that are environmentally friendly. The main advantage of *BAREG balls* lies in its diverse functions, such as repelling insects and killing them, as well as providing beneficial aromatherapy effects.

Compared to synthetic camphor, *BAREG balls* offer a safer option because synthetic camphor contains harmful substances such as naphtalene or paradichlorobenzene which have the potential to cause respiratory problems and cancer risk. Replacing chemicals with clove-based ingredients can minimize health risks while supporting the concept of sustainability.

This research also contributes to the optimization of domestic resources. As Indonesia's leading agricultural commodity, the use of cloves in products such as *BAREG ball* can increase economic value.

4. Conclusions and Suggestions

Based on the results of the study, the innovative product BAREG ball made from cloves has been proven to be effective as an insect repellent and killer. The eugenol content in cloves shows very strong repellency, able to reach 100% within 60 minutes. Formulas with dose 2 have proven to be superior to dose 1 in terms of the speed and efficiency of releasing their active compounds. In terms of killing ability, the 2nd dose formula also showed faster results with 100% insect mortality in the sixth hour, while 1st dose took eight hours. The advantage of BAREG balls is not only in its effectiveness, but also in its safety and environmental sustainability because it is a healthier alternative to harmful synthetic lime (*naphthalene*) and (*paradichlorobenzene*). This research has great potential to optimize Indonesia's local resources, especially cloves, as raw materials for environmentally friendly products with high economic value. Thus, BAREG ball is not only a practical insect control solution,

but also supports the development of green industry, public health, environmental conservation, and increasing the competitiveness of local products domestically and internationally.

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