Utilization of waste from refined lemongrass for producing mosquito repellent

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Abstract. Because of its geographical location, South Aceh Regency has many natural resources, one of which is fragrant lemongrass. As it is known, citronella is processed and produced into essential oils. In the production process, waste is produced in the form of solid waste and liquid waste. Usually, the waste is left and becomes a problem for the environment around the distillery. The purpose of this study was to make a mosquito repellent by utilizing citronella processing waste. This research is using the experimental method. This experimental method examines the effect of certain treatments on others under certain conditions. Three samples will be tested for combustion. The results of this study from each sample with a variable initial burning time. The first test kills mosquitoes. The durability of mosquito repellent is sample 3 is the best sample for making mosquito repellent from the use of citronella distillation waste seen from the burn test. The conclusion from this study, the waste produced by citronella distillation can be used as a basic ingredient in making mosquito repellent because there are active compounds contained in citronella waste capable of killing mosquitoes.

1. Introduction
South Aceh Regency is one of the regencies in Aceh Province. This area has diverse natural resources, one of which is citronella. Lemongrass plants are widely used because they contain chemicals that are beneficial to health. These contents are antibacterial, antifungal, and anti-inflammatory [1]. From the processing of fragrant lemongrass plants, essential oils are produced. Where the essential oil known as etheric oil or fly oil has volatile properties at room temperature without decomposition, has a bitter taste, smells appropriate to the smell of the producing plants, and is generally soluble in organic solvents and non-soluble in water [2].

Essential oils can be extracted from plant parts such as leaves, flowers, fruit, seeds, stems or bark, and roots. Extraction of essential oils from pieces of the plant can be done through distillation, compression, extraction using solvents, or absorption with fat, depending on the type of plant and the physicochemical properties of essential oils in it [3].

In the process of extracting citronella plants into a product, it produces waste products produced in the form of solid waste and liquid waste. Waste is goods or objects that are produced from an industrial production process or household waste. Waste can cause adverse effects on the environment if it is not treated or disposed of. Waste can harm human health, so it is necessary to handle waste [4].

Liquid waste from citronella distillation is used as fuel, while solid waste from production has not been utilized so it often becomes a pile of garbage. The solid waste contains essential oils, especially the heavy fraction (high boiling point) in a relatively small amount. It is estimated that there are still
volatile and non-volatile compounds such as terpenes used as insecticides, air fresheners and others [5]. So based on the background above, the authors researched the use of citronella refining solid waste into mosquito coils.

2. Materials and methods

2.1. Materials
The materials used to manufacture mosquito coils from solid waste from citronella distillation are as follows:

| Materials                              | Sample 1 | Sample 2 | Sample 3 |
|----------------------------------------|----------|----------|----------|
| Solid waste grounded                   | 250gr    | 300gr    | 350gr    |
| Grounded coconut shell                  | 100gr    | 100gr    | 100gr    |
| Basil leaves crumb                      | 100gr    | 100gr    | 100gr    |
| White adhesive PV Ac                    | 100gr    | 100gr    | 100gr    |
| Water                                  | 600ml    | 600ml    | 600ml    |

The utensils used in this study are as follows:

| No | Utensils |
|----|----------|
| 1  | Filter 40mesh |
| 2  | Digital Scale |
| 3  | Molding |
| 4  | Trowel |

2.2. Research method
The method used to manufacture mosquito coils from solid waste is experimental. This method is observation under artificial conditions (artificial conditioning) where the conditions are created and regulated by researchers. Thus, experimental research is research conducted by holding manipulations of control research objects [6].

2.3. Combustion test analysis
This research was conducted by analysis of the burn test. As for the variables in this burn test analysis are 1) Analysis of the initial combustion time, 2) Analysis of the initial mortality, 3) Analysis of durability, and 4) Analysis of mosquitoes’ dead-rate.

3. Results and discussion

3.1. Results
The three samples were tested with different compositions, making mosquito coils with the following steps: 1) grind or refinement of the materials that have been prepared, 2) filtering using a 40 mesh filter to get grounded lemongrass solid waste, 3) after ground it becomes crumb and then weighted according to measure in table 1, 4) then all the ingredients are mixed into one dough, 5) after mixing evenly done printing and allowed to stand for 15 minutes until it feels ready to be removed, 5) then dried in the sun for about 2 days, and 7) lastly, insect repellent ready for use and tested.
Figure 1. Mosquito coils from the utilization of fragrant citronella distillation.

3.2. Initial combustion analysis
Initial combustion analysis is done by burning at the tip of each mosquito repellent sample and then calculating the initial time of burning the mosquito coils. This analysis aims to find out the time needed for initial combustion in insect repellent. The analysis results for the three samples are as below:

| Name | Waktu   |
|------|---------|
| Sampel 1 | 00.00.13,20 |
| Sampel 2 | 00.00.13,37 |
| Sampel 3 | 00.00.12,59 |

From the table above we can see that Sample 3 has a faster initial combustion time compared to sample 1 and sample 2.

3.3. Analysis of the initial mortality
Test to find out the first time mosquitoes die. Observations were made after initial combustion on each mosquito repellent sample, then the mosquito repellent was put into the experimental media. The number of mosquitoes tested is 10. The results of this analysis can be seen in the following table:

| Name | Time   |
|------|--------|
| Sampel 1 | 00.09.50,23 |
| Sampel 2 | 00.05.43,13 |
| Sampel 3 | 00.03.32,41 |

From the test results, obtained sample 3 is faster than the first time the mosquito died than Sample 1 and Sample 2. This time difference is influenced by differences in the composition of the mosquito repellent especially on the composition of the fragrant lemongrass solid waste.

3.4. Analysis of durability
Analysis of the durability of mosquito coils was also carried out on three samples simultaneously and in the same experimental media. This endurance test is calculated by using a stopwatch to get the accuracy of the endurance of the mosquito repellent. This analysis aims to find out how long the mosquito repellent durability to ashes. The test results are as follows:
Table 5. Durability

| Name   | Time       |
|--------|------------|
| Sample 1 | 05.11.15,53 |
| Sample 2 | 05.13.59,24 |
| Sample 3 | 05.16.21,17 |

From the above table, it can be seen that sample 3 has a longer endurance compared to mosquito repellent sample 1 and sample 2. The time difference in this endurance test is influenced by the weight of each different sample.

3.5. Analysis of mosquitoes’ dead-rate

Analysis of the number of dead mosquitoes is done after all the processes are analysed for other variables. In mosquito repellent testing it was found that mosquitoes died in each experimental medium containing 10 mosquitoes. The test results are as follows:

Table 6. Mosquitos’ dead-rate

| Name       | Init | killed |
|------------|------|--------|
| Sample 1   | 10   | 8      |
| Sample 2   | 10   | 6      |
| Sample 3   | 10   | 9      |

From the above analysis that the number of mosquitoes killed from the same experimental media, obtained sample 3 is more effective to kill mosquitoes than sample 1 and sample 2. 10 mosquitoes found 9 mosquitoes killed in the experiment.

4. Conclusions

The research concludes that solid waste from citronella distillation can be processed and used as a basic compound of mosquito coils with the addition of other mixed ingredients because they contain citronella and geraniol which can repel mosquitoes. From the three mosquito repellent samples, the best sample to be used was sample number 3. Where the results of the analysis of all variables can be seen on the table below:

Table 7 Final conclusions of analysis

| Variables      | Sample 1       | Sample 2       | Sample 3       |
|----------------|----------------|----------------|----------------|
| Initial Combustion | 00.00.13,20    | 00.00.13,37    | 00.00.12,59    |
| Initial Mortality   | 00.09.50,23    | 00.05.43,13    | 00.03.32,41    |
| Durability           | 05.11.15,53    | 05.13.59,24    | 05.16.21,17    |
| Dead-rate            | 8              | 6              | 9              |

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