

Organic Insects Repellent from Essential Oils

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Abstract: In the market, many stores sell spray repellents that contain N, N-diethyl-meta-toluamide (DEET) for insect repellent but this chemical content can irritate the skin and give an unpleasant odor to humans. In this study, organic ingredients such as cinnamon oil, tea tree oil, thyme oil, catnip oil, and citronella oil were used. Cinnamon oil, tea tree oil, thyme oil, and catnip oil were purchased from the market while citronella oil was extracted using the Soxhlet extraction method in ethanol solvent. All of these essential oils were used to generate environmentally friendly repellents that could one day be a viable alternative to synthetic repellents due to their relative safety and low cost. The three formulations namely, Formulation 1, Formulation 2, and Formulation 3 were analysed for pH, enduring test, and long-lasting skin reactions. The results show that the pH were 4.0, 4.1 and 4.3 for Formulation 1, Formulation 2, and Formulation 3 respectively. It was also found that Formulation 3 is the best among the other two Formulations. For the enduring tests, ants, flies and mosquitoes were insects that have been used as experimental material. Ants would die directly when sprayed directly on them while flies and mosquitoes would stay away from the organic repellent spray. For long-lasting reaction on skin, most respondents stated the insect repellent liquid when exposed to the skin was in a cooling sensation for formulation 3 which is in pH 4.3. Therefore, further studies are needed to improve product function to provide optimal effectiveness to insects.

Keywords: Organic Insects Repellent, Soxhlet Extraction, Essential Oil

1. Introduction

DEET is one of the most popular compounds in insects repellent sprays on the market. It is commonly used to keep biting pests like mosquitoes and other insects at bay [1]. Due to the strong odour of chemicals, most insect repellent sprays on the market have an unpleasant stench. This has a severe impact on human health, particularly in infants. Each of the elements has its own set of advantages and disadvantages. Some of the adverse effects on human health when using DEET were

involving allergic reactions, confusion, acute manic psychosis, headache, ataxia, confusion, acute encephalopathy, seizures, convulsions, and seizures [2].

Organic insect repellent is one of the initiatives that can replace the use of insect sprays containing chemicals. In this research, cinnamon oil, tea tree oil, thyme oil, catnip oil, and citronella oil are among the natural substances that have been utilised. Plant-based repellents are thought to be safer than DEET because they are natural [3]. Natural ingredients are more effective. It not only has fewer adverse effects, but it also prevents insects bites with a better success rate [4]. Also, another side effect of DEET is skin rashes but organic ingredients do not contain harsh chemicals making it easier on our skin [5].

The main component of catnip oil is nepetalactone recently discovered to repel cockroaches and mosquitoes [6], thyme oil consists of carvacrol and thymol which are included in the monoterpenoid phenols which have widespread toxicity to insects [7], cinnamaldehyde, cinnamyl acetate, eugenol, and anethole are some of the compounds contained in cinnamon oil that are particularly efficient against mosquito larvae [8]. Others, citronella oil major's component were citronellol, citronellal, and geraniol. Citronella oil repels the target pest from killing it. It works by covering up odors that are attractive to insects [9].

Tea tree oil consists of terpinene-4-ol, γ -terpinene, 1,8-cineole, α -terpinene, α -terpineol, p-cymene, and α -pinene as the major constituents [10]. Tea tree oil has been used to determine the insect repellent properties as well as the best concentration to employ to achieve the best repellent effect. All these essential oils are mixed into one formulation to produce an effective insects repellent product.

2. Materials and Methods

2.1 Materials

Materials used were tea tree oil, thyme oil, cinnamon oil, catnip oil, citronella leaves, ethanol, and distilled water. The oils and leaves were purchased from the online market, however, the ethanol and the distilled water were provided by UTHM's laboratory. The citronella oil was extracted from citronella leaves.

2.2 Preparation and Extraction of Citronella Oil

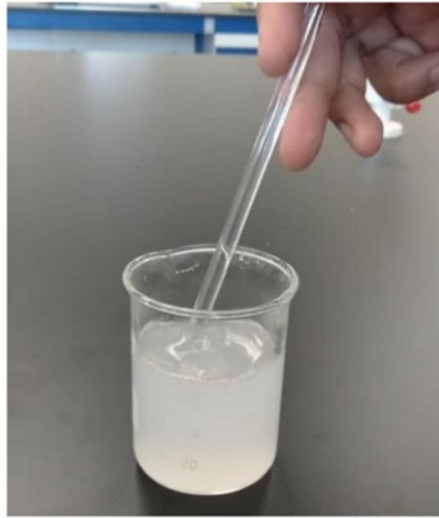
10 g of dried citronella leaves were cut into small sizes and extracted using the Soxhlet extraction method. The dried citronella leaves were put into the thimble of the extractor and the boiling flask was filled up with 150ml of ethanol solvent. The contents were pushed by a syphon into the thimble, then were transferred into a distillation flask when the solvent reached a certain level, transporting the extracts into the bulk liquid. The citronella oil was extracted with 3 extraction cycles. The extracted solvent was then put in a rotary evaporator to remove the ethanol solvent. The pressure applied to the rotating evaporator was 90 rpm and was set at 60 °C for 20 mins. The essential oil was poured into a 50 ml beaker and dried in a drying oven at 60 °C for an hour to get the exact citronella essential oil. As a result, 10 ml of citronella oil was obtained from the Soxhlet extraction.

2.3 Preparation of Organic Insects Repellent

Table 1 shows three types of formulation which were produced to inspect which formulation is the most efficient in terms of repelling insects and side effects on the skin. The first formulation consists of one drop of each essential oil, whereas additional two drops of catnip oil were added into the first beaker. The second formulation consists of five drops of each essential oil into the second beaker. Lastly, the third formulation consists of tea tree oil, thyme oil, cinnamon oil by eight drops each, catnip oil, and citronella oil were added as many water and ethanol with the same quantity. Afterwards each beaker was added 10 ml of water and ethanol with the same quantity. The solution was then mixed using a glass rod until it was fully miscible as shown in **Figure 1**. Thus every formulation of repellent was poured in a spray bottle separately.

Table 1: Number of drops of essential oil within three formulations

Types essential oil	Formulation 1	Formulation 2	Formulation 3
Tea tree oil	1	5	8
Thyme oil	1	5	8
Cinnamon oil	1	5	8
Catnip oil	2	5	12
Citronella oil	1	5	10

**Figure 1: Diluting the essential oils in water**

2.4 Preparation for the Endurance Test of Insects

To attract the flies into the trap, 1 gram of dried salted fish was placed inside a clear plastic jar. After catching the flies, the lid of the jar was opened slightly to spray the first formulation of repellent. To catch ants about 1 ml of honey, 1 gram of brown sugar and 2 ml of water was fully mixed and was pour into a small water bottle cap. As the ants swarm towards the bait, the first formulation of repellent was sprayed directly onto the ants. For trapping mosquitos, a box and ultraviolet were used to lure the mosquitos in the box and slightly opened the flap of the box to spray the first formulation of repellent. Each of these three processes is repeated using Formulation 2 and Formulation 3.

3. Results and Discussion

3.1 pH Analysis

After the final result of making organic insect repellent spray, a pH value analysis was conducted to ensure that the spray is suitable for human skin and can be used without boundaries. The analysis was conducted by testing the solution of organic repellent using a pH meter. **Table 2** shows the pH value of each formulation is between the range of 4.0 and 4.3, and is suitable for all kinds of skin conditions. For Formulations 1 and 2, the pH value is 4.0 and 4.1 respectively which is low acidic in pH value analysis. Next, based on **Figure 2**, the pH value of Formulation 3 is 4.3 which is also low acidic. Low acidic means the solutions contain fewer hydrogens ions. Therefore, the formulation is not moisturising the skin or drying the skin. On the other hand, litmus paper was used to determine whether the solution was either acidic or alkaline. **Figure 3** shows that both of the litmus paper did not change in colour, thus the acidity and alkalinity were not strong to irritate nor corrosive to the skin.

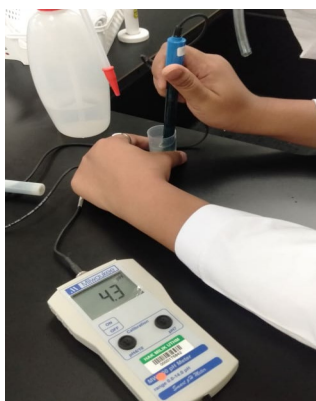


Figure 2: pH meter tested to the repellent for Formulation 3

Table 2: pH value analysis for each formulation

Formulation	pH value
1	4.0
2	4.1
3	4.3

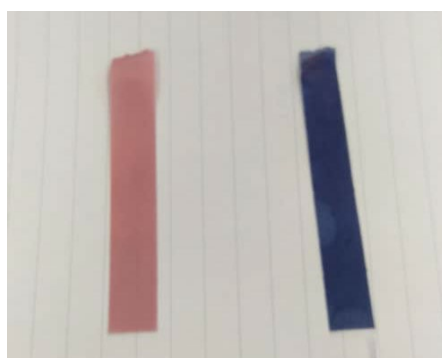


Figure 3: Litmus paper test on Formulation 3

3.2 Enduring Test of Repellent

There were three types of insects which are flies, ants and mosquitoes were tested for this organic insect's repellent. 10 insects have been caught for each type of insects. Formulations 1 and 2 do not work the best when spray on insect because it has less concentration of essential oil compared to Formulation 3. The solution that contains less concentration of essential oil was less effective because the repellency action is not strong enough to repel the insects. Moreover, Formulation 3 has a higher concentration of essential oils in the formulation thus its help into repelling the insects. The major compound that helps repellency action in this experiment is cintronella oil because it contains citronellal and cintronellol which are secondary metabolites found in essential oils. **Table 3** shows the number of alive insects left after each spray.

Table 3: Number of alive insects left after each spray

Formulations Types of insects	Spray each 5 minutes (Before)			Number of insects left		
	1	2	3	1	2	3
Flies	10	10	10	7	5	0
Ants	10	10	10	5	0	0
Mosquitoes	10	10	10	9	6	3

3.3 Long-lasting Reaction on Skin

Based on **Table 4**, the organic repellent has been tested on our 20 respondents to decide the feels of the spray after being put on the skin for 30 minutes. There were three sensations the respondent will feel which are hot and cooling sensation, cooling sensation, and normal feel. This survey was conducted to ensure that this spray formulation is suitable for every type of skin. Based on Table 4, Formulation 2 and 3 have hot and cooling sensation after wear, but no irritation and redness occur on the respondent skin which means it is good on the skin.

Table 4: Post effect of the organic repellent on skin

	Formulation 1			Formulation 2			Formulation 3		
	1	2	3	1	2	3	1	2	3
Post effect on skin after 5 minutes	0	5	15	3	8	9	9	11	0
Post effect on skin after 15 minutes	0	0	20	5	12	3	7	11	2
Post effect on skin after 30 minutes	0	0	20	0	1	19	0	17	3

*1- hot and cooling sensation

2- cooling sensation

3- normal

4. Conclusion

Organic insect repellent has been analyzed to compare the effectiveness based on the different concentrations of organic materials which is based on cinnamon oil, tea tree oil, thyme oil, catnip oil and citronella oil. It was found that Formulation 3 is the best among the other two formulations. The pH of this organic repellent was discovered to be 4.3 in this investigation, indicating that it is acceptable to use on the skin without causing any irritation as it is a cooling sensation. For the enduring tests, ants will die instantly if sprayed directly on them while flies and mosquitoes just stay away from organic repellent sprays but did not die. As a result, this organic insect formulation can help to prevent insects from our surroundings by spraying directly on insects and providing comfort to humans. This current research is sufficient, but more study is needed to improve product function and raise awareness of the benefits of utilising organic spray repellents versus chemical spray repellents among humans.

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