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Malayan High School of Science The Efficiency of Eucalyptus Oil and Citronella Oil as a Mosquito Repellent Against *Aedes aegypti* (Submitted in partial fulfilment of the requirements in Research 1) Submitted by: Francesca Magno Fay Fadul Maxine Mendoza Ariana Bacquial Darren Obligar

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CHAPTER I I. Introduction Mosquito repellents gained popularity in the Philippines because of the widespread of Dengue. It is believed to help reduce exposure to mosquito bites that may carry viruses causing serious illnesses and even death. Because of this, a lot of natural mosquito

repellents have come out in the market such as geranium oil, soybean oil and the two most famous repellents, citronella oil and eucalyptus oil. This research is conducted to determine if citronella oil and eucalyptus oil are effective in reducing exposure to mosquito bites. According to the Department of Parasitology of University of the Philippines Manila, citronella oil and eucalyptus oil are not effective as a mosquito repellent. The citronella oil is a colourless or sometimes light yellow liquid derived from a dried grassy plant called *Cymbopogon nardus*. It has been used for over 50 years as an insect repellent and an animal repellent. According to an article published by the US Environmental Protection Agency, the citronella oil “works on insects without harming or killing them. It has a distinctive odor which may make it difficult for some pests to locate a host. The length of repellency time varies with the inert ingredients and the amount of citronella oil in the product”. The eucalyptus oil is extracted from the leaves of *Eucalyptus citriodora* and is largely produced in Brazil and Australia. When oil of eucalyptus was tested against mosquitoes found in the US, it provided protection similar to repellents with low concentrations of DEET (Mountain Rose Herbs; Novak 2011; US Environmental Protection Agency 1999) II.

Statement of the problem Can eucalyptus oil be as effective as citronella oil when tested using clothing? Hypotheses: Null: There is no significant difference between the effects of citronella oil and the eucalyptus oil as a mosquito repellent. Alternative: There is a significant difference between the effects of citronella oil and the eucalyptus oil as a mosquito repellent. III.

Significance of the Study The significance of this research is to find out a more effective mosquito repellent between eucalyptus oil and citronella oil when applied on clothes and which will provide longer protection from

mosquito bites. IV. Scope and limitations The research will focus only on the eucalyptus oil and citronella oil mosquito repellents and its effectiveness depending on how long it repels the mosquitoes. This research is limited to use 350 mosquitos only because of its availability. The results of the experiment will not be affected by extraneous variables, including the health of the mosquitos after the experiment.

#### CHAPTER II I. Related Literature

**Citronella Oil** Citronella Oil has been used for over 50 years as an insect repellent. It is found in many familiar insect repellent products like sprays, gels, etc. They vary in efficiency, repel various insects and are not expected to cause harm to humans, pets and environment. It can also be used as an aromatherapy oil, anti-microbial agent, astringent and perfume oil. (US Environment Protection Agency, 1999; Mukherjee, 2011) Citronella Oil is obtained from the leaves of the oil grasses *Cymbopogon nardus* and *C. winterianus*. The oil has a wide range of use like in medicine, for perfumes, for soaps and as insect repellents. (Brown)

**Eucalyptus Oil** The most effective natural mosquito repellent at the time of writing is Repel Eucalyptus. A 2002 study in the New England Journal of Medicine compared different synthetic chemical and herbal repellents: Repel Lemon Eucalyptus Repellent provided 120. 1 minutes of mosquito protection, more than a repellent with a low concentration of the chemical DEET (Off Skintastic for Kids with 4. 75% DEET provided 88. 4 minutes of protection) and less than Off Deep Woods with 23. 8% DEET, which provided 301. 5 minutes of protection. A study by the US Department of Agriculture compared four synthetic mosquito repellents and eight natural mosquito repellents and found that Repel Lemon Eucalyptus was the most effective repellent, more so than a 7% DEET repellent. Lemon eucalyptus oil repellents, in addition to the chemicals DEET and picaridin,

have been registered with the U. S. Environmental Protection Agency (which means that the materials have been reviewed and approved for effectiveness and human safety) and recommended by the Centers for Disease Control and Prevention (CDC) for mosquitoes that may carry the West Nile virus. A June 2006 Consumer Reports article stated that after conducting their own tests, Repel Lemon Eucalyptus was the best non-DEET mosquito repellent. However, volunteers criticized its odor. (Wong 2011)

**Mosquito Repellents** Mosquitoes have complex methods of detecting their hosts. Most mosquitoes are active at dawn and dusk, but there are also mosquitoes that seek hosts during the day. You can avoid being bitten by making sure you aren't attracting mosquitoes. You can use attractants to lure mosquitoes elsewhere. Dark clothing, carbon dioxide, lactic acid and fruity fragrances are some examples of attractants. (Helmenstine)

**Attractants of Mosquitoes** Mosquitoes are attracted to socks worn by humans. They are also attracted to Limburger cheese which has a bacterium that can be found on the human foot. In field studies, the socks alone attracted a few mosquitos but when worn socks were used a significant increase of the attracted mosquitos occurred including the species of Aedes, Anopheles, Coquillettidia, Culex, Culiseta and Psorophora-major disease-transmitting mosquitos. (Kline) Research found clothing patterns, not just the color, can be a factor in mosquito attraction. Striped and floral patterns attracted the fewest mosquitos, while a solid dark-green shirt registered the highest bite accounts. The study supports the theory that mosquitos prefer dark colors. Through investigation, the impact of different cap colors and designs had no effect on mosquito bite counts. (Johnson and Surgeoner)

**Protection Time of Citronella Oil** A 2002 study found citronella oil only

protects against biting insects for about 20 minutes and needs frequent application. Other repellents last several hours. (Conville) And insect repellents with other natural ingredients usually provide less protection. For example, Citronella Oil usually provides about 20 to 30 minutes of protection. (Iannelli) II. Related Studies Natural Mosquito Repellents A variety of essential oils have been used since antiquity in the treatment of different infectious diseases, including the use of essential oil of thyme against infections caused by different microorganisms, the Melaleuca alternifolia essential oil in the treatment of infections caused by a broad spectrum of fungi, yeasts and bacteria, or essential oils from oregano, lemongrass, etc. This therapeutic use has been validated by investigations that have confirmed its biocidal effect. (In the study entitled Natural Products as Biocides conducted by Concepción Navarro-Moll and Adela Valero) Plant extracts is significant particularly against mosquito biting. It is promoted for protection against early biting cycle of mosquito in the evening before going to bed and for those exposed to early morning biting cycle. (In the study entitled Ethnobotanical Study of Some of Mosquito Repellent Plants in North-Eastern Tanzania conducted by Eliningaya J Kweka) Mosquito Repellents Repellents do not kill mosquitoes. They only make humans unattractive to mosquitoes and will avoid areas of the body that have been applied with the product. The best repellents will provide protection from bites for a long period of time from just one application. Mosquito researchers from the University of Florida tested and evaluated the effectiveness of mosquito repellents based on the amount of time the product will continue to provide protection from mosquito bites after a single application on the skin or on clothes. (In the study entitled Mosquito Repellents conducted by Fradin, M. S.

and J. F. Day) Citronella Oil Microcapsules containing citronella essential oil were prepared by complex coacervation and applied to cotton textiles in order to study the repellent efficacy of the obtained fabrics. Citronella released from treated textiles was indirectly monitored by the extractable content of its main components. Repellent activity was assessed by exposure of a human hand and arm covered with the treated textiles to *Aedes aegypti* mosquitoes. Fabrics treated with microencapsulated citronella presented a higher and longer lasting protection from insects compared to fabrics sprayed with an ethanol solution of the essential oil, assuring a repellent effect higher than 90% for three weeks. Complex coacervation is a simple, low cost, scalable and reproducible method of obtaining encapsulated essential oils for textile application. (In the study entitled Microencapsulated Citronella Oil for Mosquito Repellent Finishing of Cotton Textiles conducted by M. M. Mir<sup>3</sup> Specos, J. J. Garc<sup>3</sup>aa, J. Tornesello, P. Marino, M. Della Vecchia, M. V. Defain Tesoriero and L. G. Hermida) Eucalyptus Oil

Eucalyptus (family Myrtaceae), an Australian native, represented by around 700 species is a genus of tall, evergreen and magnificent trees cultivated world over for its oil, gum, pulp, timber, medicine and aesthetic value. Among the various wood and non-wood products, essential oil found in its foliage is the most important one and finds extensive use in food, perfumery and pharmaceutical industry. In addition, the oil possesses a wide spectrum of biological activity including anti-microbial, fungicidal, insecticidal/insect repellent, herbicidal, acaricidal and nematicidal. The present paper discusses this environmentally benign pest control using eucalyptus oils against bacteria, fungi, insects, nematodes, weeds and mites. The use of eucalyptus oil as a natural pesticide is of immense significance in view of the

environmental and toxicological implications of the indiscriminate use of synthetic pesticides and overcoming/reducing the problem of increasing pest resistance. (In the study Eucalyptus Essential Oil as a Natural Pesticide conducted by D. R. Batish, H. P. Singh, R. K. Kohli, and S. Kaur) CHAPTER III Methodology A. Preparation of Samples In this process, the group will make 2 tests for each repellent which are commercially available. Cultured mosquitos will be used for the experiment which will be taken from mosquito breeders. Dark clothes will serve as a lure for the mosquitos. To maintain the health of the mosquitos, they will be given sugar solution as their food. The mosquitos will be placed in a paper cup which is caged in a customized box made of wood and tulle to make sure the mosquitos will not escape. There will be three customized boxes. The first box will be used to test the citronella oil, the second for the eucalyptus oil. The third box will serve as the controlled group which will not use any oil to observe the normal behavior of mosquitos. B. Testing of Samples According to one of the related literatures about the protection time of citronella oil, citronella oil protection lasts for 20 minutes. Using this as a basis, the samples will be exposed to mosquito for 20 minutes in their respective cages each having 50-60 mosquitos. Clothes soaked in the said repellents and will be placed on top of the cups. The mosquitoes will be observed for 20 minutes to know if eucalyptus oil protection could also last for same time. The same procedure will be done for the second test. The mosquitos will be observed until the second day for further effects. C. Analysis of Results After conducting the experiment, the results of the samples, which are the protection times of each sample, will be compared. The protection time is the time when the mosquito repellent is being effective. Using the z-test on the significance of



the difference between two independent proportions, it will help us know if there is a difference between the protection times of the two repellents in which they are effective. Time Table: Day 1- preparing of samples Day 2- testing of samples for 20 minutes Day 3- analysis of results Budget Proposal: \* \* Citronella oil- P100 \* Eucalyptus oil- P50 \* Mosquitos (350) - P1750 \* Cages- P620 \* CHAPTER IV Results A test is conducted to know which is more effective as a repellent. The protection time of each sample will determine which of the two repellents is more effective. The first sample of Citronella Oil has a protection time of 5 minutes, while the second sample has a protection time of 7 minutes. The first sample of Eucalyptus oil has a protection time of 14 minutes, while the second sample has a protection time of 13 minutes. Level of significance is 5%. Test No. | Citronella Oil (mins.) | Eucalyptus Oil (mins.) | 1 | 5 | 14 | 2 | 7 | 13 | I.  $P_1 = 5/20$   $P_2 = 14/20$   $n_1, n_2 = 20$   $Q_1 = 15/20$   $Q_2 = 6/20$  II.  $P_1 = 7/20$   $P_2 = 13/20$   $n_1, n_2 = 20$   $Q_1 = 13/20$   $Q_2 = 7/20$   $z = \frac{P_1 - P_2}{\sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}}$  I.  $\frac{5/20 - 14/20}{\sqrt{\frac{(5/20)(15/20)}{20} + \frac{(14/20)(6/20)}{20}}} = \frac{-9/20}{\sqrt{0.03320 + 0.212000}} = \frac{-0.45}{\sqrt{0.245200}} = \frac{-0.45}{0.49517106} = -0.9087632 = -0.909$  II.  $\frac{7/20 - 13/20}{\sqrt{\frac{(7/20)(13/20)}{20} + \frac{(13/20)(7/20)}{20}}} = \frac{-6/20}{\sqrt{0.0918000 + 0.0918000}} = \frac{-0.3}{\sqrt{0.1836000}} = \frac{-0.3}{0.42848692} = -0.7001632 = -0.700$  |  $|t| < |t_{tab}|$  Using the given information, the group tested the significant difference between the two repellents. The group used z-test on the significance of the difference between two correlated means. Discussion: The protection time is the time when the repellent is effective. The repellent can be called effective when more than 50% of the mosquitos react to the repellent. In the results shown above, it shows that eucalyptus oil has a longer protection time than citronella oil as a mosquito repellent. But from the z-test used, it shows that there is no significant difference between the two repellents. CHAPTER V Conclusion According to the results,

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citronella oil is more effective by a z-test difference of 0.85 because it has a longer protection time. But using the z-test, the difference of the two is not significant enough to state that citronella oil is more effective as a mosquito repellent than eucalyptus oil. In conclusion, there is no significant difference between the citronella oil and eucalyptus oil as a mosquito repellent.

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