

**UNIVERSITI TEKNOLOGI MARA**

**THE STUDY ON SUITABILITY OF  
PALM ESTERQUAT AND  
*PELARGONIUM GRAVEOLENS*  
ESSENTIAL OIL IN FABRIC  
SOFTENER AS MOSQUITO  
BIOREPELLENT**

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of the requirements for the degree of  
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## ABSTRACT

Insect repellent-incorporated fabric softener was produced using geraniol oil from *Pelargonium Graveolens* plant as a potential natural source of repellent agent to provide efficacy against mosquitoes, and palm based esterquat as the plant-based conditioning agent. Four series of softener formulations were experimented. Batch 4 was identified to be the most stable formulation batch to produce the fabric softener, based on the physical appearance, emulsification, and thermodynamic stability of the resultant softener. Following that, 100% cotton fabric was treated using the fabric softener of the pre-determined formulation, with different percentage of geraniol content (0.6%, 0.8%, and 0.9%) and using DEET (N, N-diethyl-3-methylbenzamide) as the comparative sample. The treated samples were tested to ascertain the repellence effect against mosquitoes by means of the Bioassay Repellence Assessment WHO Cone Test using *Aedes aegypti* mosquitoes. Some physical attributes and hand properties of the treated fabric, i.e. the fabric weight, fabric stiffness, crease recovery angle, fabric hand sensory, and fabric moisture management, were also determined to ensure the main functions of the fabric softener are retained after the treatment. The Bioassay WHO cone test result showed that the fabric softener incorporated with the geraniol oil from the *Pelargonium graveolens* plant has the ability to drive away mosquitoes from the treated fabric, with the higher percentage of geraniol content in the fabric softener demonstrated better repellent activities. Sample treated with 0.9% geraniol-fabric softener exhibited higher 'percentage of mosquitoes reduction' than sample treated with DEET. However, DEET sample demonstrated the highest 'complete protection time (CPT)' compared to other treated samples. The physical attribute tests showed that the treated samples exhibited better fabric hand properties (fabric weight, fabric stiffness, crease recovery angle fabric hand sensory, and fabric moisture management) than the untreated samples. The treated fabric resulted in an increase in mass, thickness and density, and exhibited higher softness effect in comparison with the untreated fabric. The accumulative one-way transport analysis of fabric moisture resulted in good to excellent grade.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Research Background

Textiles of different materials and design have been created to function as cover and protection barrier to the wearer's body. Treated textiles with some additional functional properties such as mosquito repellent, flame retardant and others provide extra protection barriers and comfort. Fabric treated with mosquito repellent helps to prevent and control the spreading of the mosquito borne disease such as dengue fever. However, the natural repellent need to be formulated with other component to enhance it control release property. An oil phase recipe need to be developed so that the natural repellent component could be stable in the product at formulation stage (product) and effective delivery to the receiving surface (fabric). At the final stage, the natural repellent will be released to function as mosquito repellent (target victim-mosquito). Over 3500 species of mosquitoes have already been identified in various parts of the world. Some human biting mosquitoes are vectors for several infectious diseases affecting millions of people per year. World Health Organization (WHO) stated dengue fever has re-emerged and being endemic in more than 110 countries. It has been most predominant arthropod-borne viral disease in term of morbidity and mortality. It is transmitted from female *Aedes aegypti* mosquitoes in a domestic environment (WHO, 2012). There is no available vaccine at the moment for Dengue disease and the control of the mosquito's vector initiated by the government are a good initiative but the personal protection is needed to minimize the risk of mosquito biting (Whitehorn et al., 2015).

Per a press release by Deputy Director Ministry of Health Malaysia "Dengue cases reported across the country showed a declining trend over the past three weeks. For the year of 2016 from 7 to 13 February 2016, the monitoring of the Ministry of Health (MOH) found that the number of dengue cases reported was 2,590 cases compared to 3,312 cases in the previous week with a drop of 722 cases (21.7%).