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# ENHANCING MOSQUITO REPELLENCY IN TEXTILES THROUGH OPTIMIZED NATURAL ESSENTIAL OIL FORMULATION

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## ABSTRACT
An optimized formulation combining Mentha piperita and citronella essential oils showed excellent mosquito repellency in textiles. The concentration and method of application were crucial factors. Essential oils offer a safe and sustainable alternative to synthetic repellents in textile products. This formulation has the potential to decrease the spread of mosquito-borne diseases. The study highlights the possibility of creating environmentally friendly and effective mosquito repellent textiles. Further research may refine the use of essential oils in textile products.

## INTRODUCTION
Mosquitoes and the diseases they transmit have a significant impact on global health and well-being. Repellent textiles have the potential to make a significant contribution to the global effort to control and prevent mosquito-borne diseases, and their continued development and use is an important part of a comprehensive approach to addressing this public health challenge. (Sajib et al., 2020)
Essential oils have been found to have potential as natural mosquito repellents. These oils contain compounds that have been shown to have repellent properties against mosquitoes, and their effectiveness varies depending on the concentration of the active ingredients, the duration of exposure, and the species of mosquito. (Sutthanont et al., 2022)
Several strategies have been proposed to improve the repellent effect of essential oils on textiles. Among others, the blending of essential oils with other natural or synthetic ingredients can help to improve their efficacy and longevity when applied to textiles. However, the major challenges associated with the application of essential oils to textiles as a means of insect repellency are longevity, because essential oils tend to evaporate quickly and lose their efficacy as a result and stability as they can be chemically unstable and can break down over time, reducing their effectiveness. It is important to note that the development of these strategies is ongoing, and more research is needed to determine the most effective and practical methods for improving the repellent effect of essential oils on textiles.

## RESULTS AND CONCLUSIONS
Different essential oil based formulations are developed and applied to 100% cotton fabrics. Mixtures of eucalyptus (E), mint (M) peppermint (P), tangerine (T) and free (C) and encapsulated (EC) indeterminate oils and citronella in biodegradable nanoparticles were performed. Five different blenders were optimized and used to functionalize the fabrics. A self-crosslinking polyether polyurethane was used to improve fastness in all samples. The efficacy mosquito repellence was evaluate using cage box test (Table 1). Briefly,

the test involves placing mosquitoes into a small cage that contains the test material and observing their behaviour as illustrated in Fig. 1. The number of mosquitoes that land on or bite the test subject is recorded and used to calculate a repellence score as described by Khanna e Chakraborty (2018).

**Table 1** Mosquitoes repellency results

| Samples (Number) | Mix of Essential oils in Finishing formulation (%) | Bitting (Number) | Repellency (%) | Bitting (%) | Mortality (%) |
|---|---|---|---|---|---|
| 1 | EC (8) | 120 | 40 | 60 | 1,5 |
| 2 | EC, P, C (6:1:1) | 14 | 93 | 7 | 80 |
| 3 | EC, E, T (6:1:1) | 51 | 74.5 | 25.5 | 1 |
| 4 | EC, P (5:3) | 19 | 90.5 | 9.5 | 1 |
| 5 | EC,T, E, C (5:1:1:1) | 195 | 2.5 | 97.5 | 2.5 |

**Fig.1** – Repellency cage test of sample 4 (after 9 min exposure)

The most significant results were obtained with a blend composed by Mentha piperita and citronella (free and encapsulated).

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