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Commentary

The Need for Future Research on the Impact of Essential Oil Repellents in Patch Form to Prevent Mosquito Bites

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Abstract

There exists a large body of research indicating repellent properties of various essentials oil (EO) formulations, with a particular emphasis on repellant impact on multiple mosquito species with the ability to carry and spread diseases such as dengue, malaria and Zika virus. This presents an alternative to chemical repellents such as N,N-diethyl-m-toluamide (DEET) that have been identified as effective in repelling potentially harmful mosquitos yet toxic to human and environmental health. The literature suggests EOs represent a safer and less toxic alternative for humans and the broader environment. In addition, recent research indicates diminishing effect of chemical repellents as resistance is developed. This same phenomenon has not been reported for EOs yet their widespread use is limited by their relatively short active times for repellant actions given high compound volatility. To date, microencapsulation and nanoencapsulation of EOs has been identified as a promising practice. However, additional vectors of EO application use such as the use of EO patches for commercial distribution lacks research with only one published article currently available showing promising repellent properties for mosquitos. This article emphasizes the literature supporting the use of EOs and the opportunity for future research using patch applications for tolerability, access and duration in human repellants.

Keywords

Mosquito Borne Diseases, Repellents, Non-toxic, Essential Oils, Patch

1. Introduction

Mosquito borne diseases such as Zika, malaria, and dengue present a persistent threat to human health and are commonly addressed through the use of synthetic chemical repellents such as DEET and picaridin [1]. Unfortunately, synthetic chemical repellents can cause health issues among humans and in the broader environment [2]. Essential oils, including citronella, eucalyptus, and lemongrass, have long been used as natural alternatives to synthetic chemical repellents. Researchers and scientists have developed combined delivery methods such as textile infusions and microencapsulation/nanoencapsulation to reduce the volatility of the compounds and thus extend the active time of repellent activity [3]. This processing and application procedure has been well documented and studied and presents a promising future for large-scale production and product development with the limitation of manufacturing costs. An alternative to this developing application is that of EO formulations delivered via patch. This paper argues that patch formulations may have a

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higher tolerability rating among users, higher safety and lower costs than other options on the market.

2. Existing Literature

2.1. Essential Oil Repellent Patch Literature

At the time of this publication, there is one peer-reviewed publication specifically assessing the efficacy of an EO repellent delivered in patch form [4]. The study was published in 2015 and finds significant repellent activity of the patch as compared to a synthetic commercially available patch. In addition, there were no toxic inhalation actions reported in the tested rat model. As a result, the authors of this study state, "the repellent patches developed and evaluated currently, may provide a suitable, eco-friendly, acceptable and safe alternative to the existing synthetic repellent formulations for achieving protection against mosquitoes." Yet since that time, no additional studies have been published.

2.2. Essential Oil Repellent Literature

This is in spite of the large body of work showing the repellent properties of a variety of essential oil formulations ranging from catnip to sage to geranium [5-7]. The safety data for essential oils makes it a compelling alternative to synthetic formulations. These oils are considered less harmful to the environment and human health, making them attractive options for repelling mosquitoes. Where synthetic repellents have been shown to be toxic to humans and detrimental to the broader environment, essential oils are derived from plant phytochemicals and biodegrade without harm to the environment around them [8]. There is also data suggesting that many of the more well-studied synthetics have diminished efficacy over time as mosquitos begin to develop resistance [9]. However, a major limitation of most commercially available essential oil repellants is their relatively short window of protection. As volatile organic compounds, they tend to be less stable than synthetic formulations [10]. This is particularly true for lotions or sprays that not only dissipate essential oils rapidly but can also cause skin irritation in some individuals [11]. Microencapsulation and nanoencapsulation of essential oils have been widely studied and have been demonstrated to significantly extend the window of repellent activity [11-13]. However, this process can add significant cost in commercial applications making less expensive solutions a valuable area of research.

2.3. Patch Utilization

In addition to expense and efficacy considerations, patch applications present a promising option for essential oil repellent development given the significant body of research indicating the high tolerability of medical grade patches among patients [14]. The most studied application is in the field of transdermal drug delivery in the medical setting. These studies show high levels of patient tolerability with minor potential complaints including itching and irritation [15]. Specifically, there is strong data indicating high tolerability among the pediatric patient population [16]. This is critical in the field of mosquito repellant technologies given the risk of higher morbidity and mortality in children and infants related to mosquito-borne diseases, especially recent rises in dengue-related deaths among children [17]. This makes the development of more effective and safer repellent technologies critical with patch applications offering a promising opportunity for further research.

3. Conclusions

Given the burden of mosquito-borne illnesses across the globe and the potential health and safety threats of conventional, synthetic repellents, the need for alternative repellent compounds is a critical area of research. Based on evidence from related studies of EOs as repellents, there is compelling evidence of a significant repellent effect. However, use of EOs can be limited by the duration of effect for lotions and creams and by cost for micro/nanoencapsulation processing. Patches represent a safe and tolerable opportunity to potentially eliminate the need for frequent reapplication of essential oil-based replant formulations, offering users longer-lasting protection. While preliminary studies suggest EOs in patch form may be effective in repelling mosquitoes, comprehensive research is needed to fully understand their impact and potential advantages over traditional repellents. With well-established repellant assessment protocols available and a variety of commercial formulations, this area of study presents an opportunity for researchers in the field.

Abbreviations

EO	Essential Oils
DEET	N,N-diethyl-m-toluamide

Author Contributions

Rachel Harris Blanton: Conceptualization, investigation, writing-original draft

Gary Tramer: Funding acquisition, supervision, writing-review and editing

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Data Availability Statement

No data was used.

Conflicts of Interest

The authors acknowledge that this paper was commissioned by NatPat, a commercial entity producing essential oil formulations in patch form.

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Biography

Rachel Harris Blanton is an independent public health and health systems consultant with Convergent Care Collective in Fort Collins, CO. Ms. Blanton has worked in academic research positions with National Jewish Health, Children's Hospital Colorado and the University of Colorado Health Sciences Center. In addition, she has over 10 years experience leading health systems innovation programs in local public health systems. For this work, she has been recognized as an "Emerging Leader in Public Health" by the Kresge Foundation and has been named to the Community Leaders Forum by the Federal Reserve Bank of San Francisco.

Gary Tramer is a seasoned entrepreneur with extensive experience in co-founding and managing multiple successful companies. Currently, Gary serves as Co-Founder of NATPAT since March 2020. Prior to this, Gary co-founded LeadChat, which was acquired by LegalFish in February 2023, and PoweredLocal, acquired by Hownd, Inc. in March 2021. Additional ventures include co-founding Revolver Creative in Melbourne and Searchwords, as well as founding and serving as Managing Director of Face2Face Global. Gary Tramer holds a Bachelor's degree in Behavioural Neuroscience from Monash University, earned between 2000 and 2004.

Research Field

Rachel Harris Blanton: Public health, pediatric health, behavioral health, health systems development, allergy and immunology, public health ethics, rural health

Gary Tramer: Behavioral science, product commercialization, alternative health interventions, essential oils