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# Development and Evaluation of Effervescent Mosquito Repellent Tablets Containing Lemongrass and Eucalyptus Essential Oils

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**ABSTRACT:**
Mosquito-borne diseases continue to pose a serious threat to public health, particularly in tropical and subtropical regions. Although synthetic mosquito repellents are widely used, concerns regarding their safety, environmental impact, and prolonged use have increased interest in plant-based alternatives. In the present study, effervescent mosquito repellent tablets containing lemongrass oil and eucalyptus oil were developed and evaluated as a novel herbal formulation. The tablets were prepared by the wet granulation method and assessed for their pre-compression and post-compression characteristics, including flow properties, weight variation, hardness, friability, and effervescence time. The prepared granules showed good flowability with an angle of repose of 28°, Carr's index of 16.6%, and Hausner ratio of 1.2. The tablets exhibited acceptable hardness (3.2 kg/cm²), low friability (0.29%), and uniform weight distribution. An average effervescence time of 145 seconds indicated rapid tablet dispersion and effective release of the volatile essential oils. Mosquito repellent activity was evaluated using a mosquito cage method, and the formulation demonstrated 80% repellency under laboratory conditions. The results suggest that the developed effervescent tablets possess satisfactory pharmaceutical properties and effective mosquito repellent activity. This herbal formulation may offer a convenient and environmentally friendly alternative to conventional mosquito repellent products.

**Keywords:** Effervescent tablets, Mosquito repellent, Lemongrass oil, Eucalyptus oil, Essential oils, Herbal formulation.

## I. INTRODUCTION:

Mosquito-borne diseases continue to be a major public health concern worldwide, particularly in tropical and subtropical regions where climatic conditions favor mosquito breeding and survival. Diseases such as malaria, dengue fever, chikungunya, Zika virus infection, and lymphatic filariasis affect millions of people annually and impose a substantial burden on healthcare systems and economies worldwide (1,2). The continued expansion of mosquito vectors, coupled with urbanization, globalization, and climate-related environmental changes, has further increased the risk of disease transmission in many parts of the world (2,3).

Personal protection through the use of mosquito repellents remains one of the most practical and effective approaches for reducing mosquito-human contact and preventing disease transmission (4). A wide range of mosquito repellent products, including coils, sprays, creams, vaporizers, and lotions, are commercially available. Most conventional repellents rely on synthetic active ingredients such as N,N-diethyl-meta-toluamide (DEET), which has long been considered the gold standard for mosquito repellency (5). However, concerns regarding skin irritation, unpleasant odor, environmental impact, and user preference for naturally derived products have encouraged the search for safer and more sustainable alternatives (6,7).

Among natural mosquito control strategies, plant-derived essential oils have attracted considerable attention because of their insect-repellent properties and favorable safety profile (6,8). Essential oils are complex mixtures of volatile phytoconstituents that exhibit a variety of biological activities, including antimicrobial, antioxidant, and insect-repellent effects (8). Several studies have reported that essential oils obtained from aromatic plants can effectively repel mosquitoes and other insect vectors (6,9).

Lemongrass oil (*Cymbopogon citratus*) is one of the most widely investigated plant-derived mosquito repellents. Its activity has been attributed

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primarily to the presence of citral, citronellal, geraniol, and limonene, which interfere with mosquito host-seeking behavior (6,10). Likewise, eucalyptus oil (*Eucalyptus globulus*) has demonstrated significant repellent activity owing to the presence of eucalyptol (1,8-cineole) and other bioactive terpenoids (6,11). Due to their natural origin, biodegradability, and broad availability, these essential oils have emerged as promising alternatives to synthetic mosquito repellents (6,8).

Despite their effectiveness, the practical application of essential oils is often limited by their high volatility and susceptibility to environmental degradation (6). Rapid evaporation of active constituents may shorten the duration of protection and reduce overall efficacy. Consequently, the development of suitable formulation approaches capable of enhancing the dispersion, stability, and utilization of essential oils remains an important area of pharmaceutical research (8,12).

Effervescent tablets represent a versatile and patient-friendly pharmaceutical dosage form that offers several advantages, including ease of handling, portability, accurate dosing, and rapid release of active ingredients (13,14). Upon contact with water, an acid-base reaction occurs between effervescent components, generating carbon dioxide and promoting rapid tablet disintegration and dispersion of the active ingredients (13). Although effervescent technology has been extensively utilized in pharmaceutical and nutraceutical formulations, its application in mosquito repellent delivery systems has received relatively limited attention.

The incorporation of essential oils into an effervescent tablet system may provide an effective strategy for achieving rapid and uniform dispersion of volatile repellent compounds while improving product convenience and user acceptability. Furthermore, such formulations may offer an environmentally friendly alternative to conventional mosquito repellents that generate smoke, require electricity, or involve direct skin application.

Therefore, the present study was undertaken to develop and evaluate effervescent mosquito repellent tablets containing lemongrass oil and eucalyptus oil as natural active ingredients. The prepared formulation was evaluated for its pre-compression and post-compression characteristics, including flow properties, hardness, friability, weight variation, and effervescence time. In addition, mosquito repellent activity was assessed under laboratory conditions to investigate the potential of the formulation as an herbal mosquito repellent dosage form.

## II. MATERIALS AND METHODS:

### 2.1 Materials

Lemongrass oil and eucalyptus oil were used as natural mosquito repellent agents. Sodium bicarbonate, citric acid, and tartaric acid were employed as effervescent agents. Polyvinylpyrrolidone K30 (PVP K30) was used as a binder, while polysorbate 80 served as a solubilizing agent. Talc and magnesium stearate were used as lubricant and glidant, respectively. All chemicals and reagents used in the study were of analytical grade.

### 2.2 Formulation of Effervescent Mosquito Repellent Tablets

The composition of the effervescent mosquito repellent tablets is presented in Table 1. The formulation consisted of lemongrass oil and eucalyptus oil as natural mosquito repellent agents, sodium bicarbonate, citric acid, and tartaric acid as effervescent components, PVP K30 as a binder, polysorbate 80 as a solubilizing agent, and talc and magnesium stearate as lubricant and glidant, respectively.

**Table 1. Composition of Effervescent Mosquito Repellent Tablets**

| Sr. No. | Ingredient | Quantity (for 50 Tablets) |
|---|---|---|
| 1 | Lemongrass oil | 1.04 mL |
| 2 | Eucalyptus oil | 0.62 mL |
| 3 | Sodium bicarbonate | 9.38 g |
| 4 | Citric acid | 6.25 g |
| 5 | Tartaric acid | 4.69 g |
| 6 | PVP K30 | 1.56 g |
| 7 | Polysorbate 80 | 1.56 g |
| 8 | Talc | 1.04 g |
| 9 | Magnesium stearate | 0.52 g |

Effervescent mosquito repellent tablets were prepared by the wet granulation method. Citric acid, tartaric acid, and sodium bicarbonate were dried separately and passed through a suitable sieve before use. The effervescent base was prepared by thoroughly blending citric acid, tartaric acid, and sodium bicarbonate. An oil phase was prepared by

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mixing lemongrass oil and eucalyptus oil with polysorbate 80 until a uniform mixture was obtained. A binder solution was prepared by dissolving PVP K30 in ethanol.

The oil phase was gradually added to the effervescent powder blend with continuous mixing, followed by the addition of the binder solution to obtain a damp mass suitable for granulation. The wet mass was passed through sieve No. 16 to produce granules and dried at 40–50°C until free-flowing granules were obtained. The dried granules were resieved through sieve No. 20 and blended with talc and magnesium stearate. The lubricated granules were then compressed into tablets using a single-punch tablet compression machine and stored in airtight containers until further evaluation.

**2.3 Evaluation of Pre-compression Parameters**

The prepared granules were evaluated for pre-compression characteristics, including angle of repose, bulk density, tapped density, Carr's index, and Hausner ratio.

**2.3.1 Angle of Repose**

The angle of repose was determined by the fixed funnel method. Granules were allowed to flow through a funnel onto a flat surface to form a conical heap. The angle of repose (θ) was calculated using the following equation:

$\tan \theta = h/r$

where $h$ is the height and $r$ is the radius of the powder cone.

**2.3.2 Bulk Density**

Bulk density was determined by transferring a weighed quantity of granules into a graduated cylinder and measuring the bulk volume. Bulk density was calculated as the ratio of mass to bulk volume.

**2.3.3 Tapped Density**

Tapped density was determined by mechanically tapping the graduated cylinder containing the granules until a constant volume was obtained. The tapped density was calculated as the ratio of mass to tapped volume.

**2.3.4 Carr's Index**

Carr's index was calculated from the bulk density and tapped density values using the following equation:

Carr's Index (%) = [(Tapped Density − Bulk Density)/Tapped Density] × 100

**2.3.5 Hausner Ratio**

Hausner ratio was calculated using the following equation:

Hausner Ratio = Tapped Density/Bulk Density

**2.4 Evaluation of Post-compression Parameters**

The prepared tablets were evaluated for post-compression parameters, including weight variation, hardness, friability, and effervescence time, using standard pharmacopeial procedures.

**2.4.1 Weight Variation**

Twenty tablets were selected randomly and weighed individually using a digital balance. The average tablet weight was calculated, and the individual tablet weights were compared with the average weight to determine compliance with pharmacopeial limits.

**2.4.2 Hardness**

Tablet hardness was determined using a Monsanto hardness tester. The force required to break the tablets diametrically was recorded and expressed as kg/cm².

**2.4.3 Friability**

Friability was determined using a Roche friabilator. A pre-weighed sample of tablets was placed in the friabilator and rotated at 25 rpm for 4 min. The tablets were then dedusted and reweighed. Percentage friability was calculated using the following equation:

$\text{Friability (\%)} = [(W_1 - W_2)/W_1] \times 100$

where $W_1$ is the initial weight of the tablets and $W_2$ is the final weight of the tablets after the test.

**2.4.4 Effervescence Time**

Effervescence time was determined by placing one tablet in 200 mL of distilled water at room temperature. The time required for complete dispersion of the tablet and cessation of effervescence was recorded in seconds.

All the pre-compression and post-compression parameters were evaluated according to standard pharmacopeial procedures and reported methods (13,15).

**2.5 Evaluation of Mosquito Repellent Activity**

Mosquito repellent activity was evaluated using a laboratory mosquito cage method(6,8). The tablet was dissolved in water and placed inside a mosquito cage, while plain water served as the control. The number of mosquito landings in the control and test groups was recorded, and percentage repellency was calculated using the following equation:

$\text{Repellency (\%)} = [(C - T)/C] \times 100$

where C represents the number of mosquito landings in the control group and T represents the number of mosquito landings in the test group.

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## III. RESULTS AND DISCUSSION:

### 3.1 Pre-compression Parameters

The pre-compression characteristics of the prepared granules are presented in Table 2.

**Table 2. Pre-compression Parameters of Effervescent Mosquito Repellent Granules**

| Parameter | Result |
|---|---|
| **Angle of Repose (°)** | 28 |
| **Bulk Density (g/mL)** | 0.50 |
| **Tapped Density (g/mL)** | 0.67 |
| **Carr's Index (%)** | 16.6 |
| **Hausner Ratio** | 1.2 |

The prepared granules exhibited satisfactory flow and compressibility characteristics suitable for tablet compression. The observed flow properties indicate satisfactory granule flow and efficient die filling during tablet compression.These characteristics may be attributed to the wet granulation process, which improved granule size distribution and flowability.

### 3.2 Post-compression Parameters

The post-compression characteristics of the formulated tablets are summarized in Table 3.

**Table 3. Post-compression Parameters of Effervescent Mosquito Repellent Tablets**

| Parameter | Result |
|---|---|
| **Average Weight (mg)** | 472.7 |
| **Hardness (kg/cm²)** | 3.2 |
| **Friability (%)** | 0.29 |
| **Effervescence Time (s)** | 145 |

The formulated tablets demonstrated acceptable physical quality and mechanical strength. The low friability indicated good resistance to abrasion during handling and transportation, while the hardness values were sufficient to maintain tablet integrity. Furthermore, the tablets dispersed rapidly in water, which is an essential characteristic of effervescent formulations. The observed effervescence behaviour can be attributed to the acid-base reaction between sodium bicarbonate, citric acid, and tartaric acid, resulting in the release of carbon dioxide and rapid tablet disintegration. The prepared effervescent mosquito repellent tablets exhibited a uniform appearance and satisfactory physical integrity (Figure 1).

**Figure 1: Prepared effervescent mosquito repellent tablets containing lemongrass oil and eucalyptus oil.**

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### 3.3 Mosquito Repellent Activity

The mosquito repellent activity of the formulated tablets is presented in Table 4.

**Table 4. Mosquito Repellent Activity of Effervescent Mosquito Repellent Tablets**

| Parameter | Result |
|---|---|
| **Number of Mosquito Landings (Control)** | 10 |
| **Number of Mosquito Landings (Test)** | 2 |
| **Repellency (%)** | 80 |

The formulation exhibited promisingmosquito repellent activity under laboratory conditions, as evidenced by the marked reduction in mosquito landings compared with the control. The mosquito cage used for evaluation of repellency and the response of mosquitoes during the experiment are shown in Figure 2. The repellent effect may be attributed to the presence of lemongrass and eucalyptus oils, which contain volatile constituents such as citral, citronellal, geraniol, and eucalyptol that are known to interfere with mosquito host-seeking behaviour. In addition, rapid dispersion of the tablet in water likely facilitated the release of these volatile compounds, contributing to the observed repellency. These findings suggest that the developed formulation has potential as a natural and user-friendly alternative to conventional mosquito repellent products.

**Figure 2:Experimental mosquito cage used for evaluation of mosquito repellent activity.**

## IV. CONCLUSION:

In the present study, effervescent mosquito repellent tablets containing lemongrass oil and eucalyptus oil were successfully formulated using the wet granulation method. The prepared granules exhibited satisfactory flow properties, while the compressed tablets demonstrated acceptable post-compression characteristics, including hardness, friability, weight uniformity, and effervescence time. The formulation also demonstrated promising mosquito repellent activity with 80% repellency under laboratory conditions.The findings suggest that the developed effervescent tablet formulation has potential as a convenient, environmentally friendly, and plant-based alternative to conventional mosquito repellent products. Further studies on stability, optimization, and field evaluation are warranted to establish its long-term efficacy and practical applicability.

## REFERENCES:

[1]. World Health Organization. Vector-borne diseases. WHO Regional Office for South-East Asia; 2014.
[2]. Vega Rúa A, Okech BA. The spread of mosquito-borne diseases: A major and global public health problem. InOlfactory Concepts of Insect Control-Alternative to insecticides: Volume 1 2019 May 17 (pp. 1-27). Cham: Springer International Publishing.
[3]. Giesen C, Roche J, Redondo-Bravo L, Ruiz-Huerta C, Gomez-Barroso D, Benito A, Herrador Z. The impact of climate change on mosquito-borne diseases in Africa. Pathogens and Global Health. 2020 Aug 17;114(6):287-301.
[4]. Debboun M, Frances SP, Strickman D. Insect repellents: principles, methods, and uses. CRC press; 2006 Oct 25.
[5]. Katz TM, Miller JH, Hebert AA. Insect repellents: historical perspectives and new developments. Journal of the American Academy of Dermatology. 2008 May 1;58(5):865-71.
[6]. Maia MF, Moore SJ. Plant-based insect repellents: a review of their efficacy, development and testing. Malaria journal. 2011 Mar 15;10(Suppl 1):S11.
[7]. Isman MB. Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annual review of entomology. 2006 Jan 7;51(1):45-66.
[8]. Nerio LS, Olivero-Verbel J, Stashenko E. Repellent activity of essential oils: a review.

Bioresource technology. 2010 Jan 1;101(1):372-8.
[9]. Govindarajan M. Mosquito larvicidal potential of medicinal plants. InHerbal Insecticides, Repellents and Biomedicines: Effectiveness and Commercialization 2016 Feb 16 (pp. 25-61). New Delhi: Springer India.
[10]. Araújo A, Oliveira JV, França SM, Navarro DM, Dutra KD. Toxicity and repellency of essential oils in the management of Sitophilus zeamais. Revista Brasileira de Engenharia Agrícola e Ambiental. 2019;23:372-7.
[11]. Asadollahi A, Khoobdel M, Zahraei-Ramazani A, Azarmi S, Mosawi SH. Effectiveness of plant-based repellents against different Anopheles species: a systematic review. Malaria journal. 2019 Dec 21;18(1):436.
[12]. Rowe RC, Sheskey PJ, Quinn ME, editors. Handbook of pharmaceutical excipients. London: Pharmaceutical press; 2006 Jan 30.
[13]. Aulton ME, Taylor K, editors. Aulton's pharmaceutics: the design and manufacture of medicines. Elsevier Health Sciences; 2013.
[14]. Allen L, Ansel HC. Ansel's pharmaceutical dosage forms and drug delivery systems. Lippincott Williams & Wilkins; 2013 Dec 23.
[15]. Lachman L, Lieberman HA, Kanig JL. The theory and practice of industrial pharmacy. Philadelphia: Lea &Febiger; 1976.