International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

Development of an Herbal Mosquito Repellent Spray Using Curcumin & Neem Extract: A Review

Vinit D. Kale*[1], Swapnali R. Musmade*[2]
Wani College of Pharmacy, Ganegaon, Ahilyanagar, Maharashtra, India – [413706)
DrBabasaheb Aambedkar Technological University, Lonere, Raigad

Date of Submission: 12-10-2026 Date of Acceptance: 24-10-2026

Abstract:
Most mosquito repellents currently available are synthetic and usually contain the compound DEET, which has been associated with skin irritation, environmental harm, and the development of resistance in mosquito populations. This has prompted interest in safer, plant-based alternatives. Curcumin, the principal bioactive compound in turmeric (Curcuma longa), has reported antibacterial, insecticidal and anti-inflammatory properties that make it a promising candidate for a natural mosquito repellent. This review compiles the available literature on curcumin's repellent and larvicidal activity and proposes a formulation strategy for a curcumin-based herbal mosquito repellent spray incorporating citronella oil, aloe vera extract and neem oil. Based on the reported physicochemical properties of these constituents, the proposed formulation is expected to remain stable in pH and colour and to offer a DEET-free alternative with activity against Culex quinquefasciatus and Aedes aegypti, although this requires experimental confirmation.

Key Words: Curcumin, Mosquito, Herbal Ingredients, Spray, Neem, Repellent.

I. Introduction:

The main component responsible for the colouring of turmeric (Curcuma longa) have been deemed a promising mosquito repellent given its bioactive and larvicidal properties [1]; however, alternatives to the synthetic chemical mosquito repellent, which is commonly used today, can be found in both natural and plant-based food sources and offer a safer option [2]. For example, producing a formulation based on the use of curcumin derived from turmeric may prevent the transmission of mosquito-borne diseases whilst also alleviating the potential negative health and environmental effects that are associated with mosquitoes. [3] Mosquitoes have been identified as one of the most lethal insects in the world as many of the diseases they carry are linked to infected water and these have contaminated more than 700 million humans, leading to up to 1,100,000 deaths a year [4] with malaria in particular, is reported to be most common in Africa and Asia for children under 5 years [5] Dengue fever alone has experienced an increase in cases since the 1990s [6] as the distribution of the disease is changing alongside increases in global warming and urbanization. [7]

Mosquito Repellent Spray

Curcumin-based herbal mosquito-repellent spray refers to a topical herbal formulation that is primarily derived from turmeric (Curcuma longa), which encompasses curcumin, desmethoxycurcumin, bisdemethoxycurcumin and volatile constituents including are-turmerone, α-turmerone and β-turmerone. [8] Among these, are-turmerone and other volatile components are crucial for mosquito-repellent actions, and both curcumin and turmeric essential oil have exhibited mosquito larvicidal and biological activities and biting-deterrent effects against Aedes aegypti and Anopheles mosquitoes.[9] Turmeric essential-oil constituents interfere with mosquitoes' host-seeking behaviour at the level of chemical cues.[10]The main limitation for using curcumin is its low water solubility; thus, appropriate solvents, solubilizers, emulsions or nano formulations may be needed to prepare a stable and uniform spray, [11] and ethanol or a hydroalcoholic vehicle can be applied to dissolve or disperse the active pharmaceutical ingredient and allow the formulation to dry rapidly.[12] An alternative option may involve the addition of vanillin to prolong the time of mosquito protection through the reduction of the evaporation rate of volatile essential-oil constituents. [13]

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

- **Ingredients**

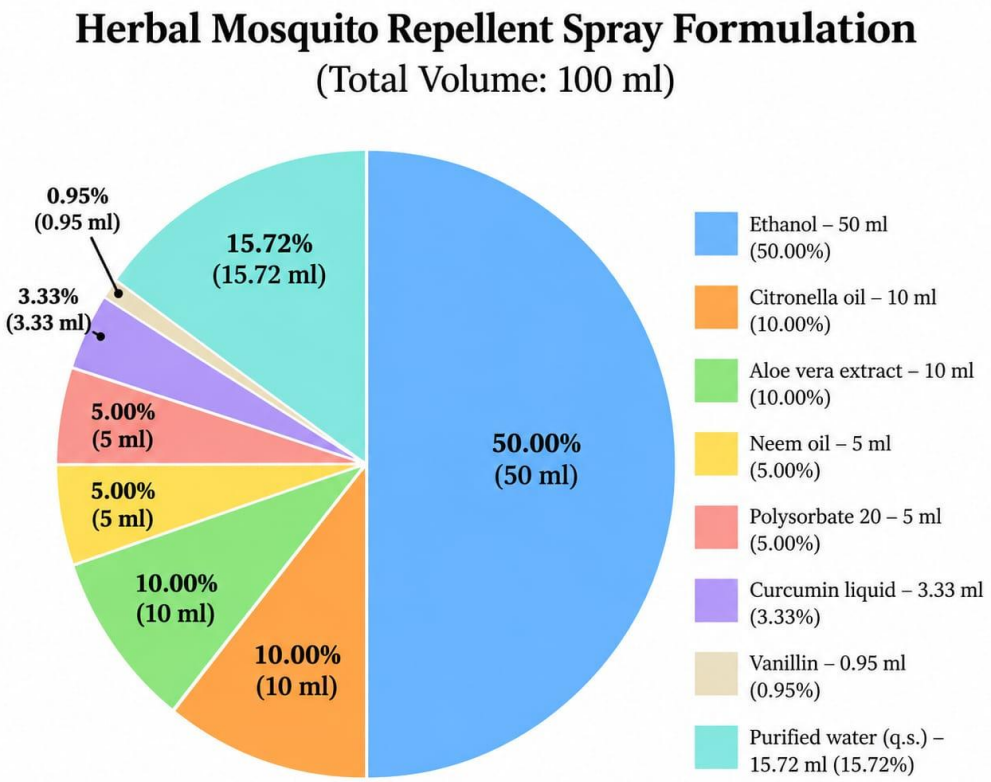

Figure 1. Composition of the spray formulation (% v/v,total volume 100 mL). Vanillin (1 g) is shown as its volume equivalent (≈ 0.95 mL); purified water is q.s. to 100 mL, so its volume is approximate.

❖ **Curcumin** [14]

Synonyms

- Curcumin
- Curcuma longa extract
- Natural yellow pigment

Biological Source

- Curcumin is obtained from dried rhizomes of curcuma longa Linn (turmeric)

Family

- Zingiberaceae

Uses

- Used as natural coloring agent in food and pharmaceutical preparations.
- Shows antioxidant activity
- Has anti-inflammatory activity.

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

Structure

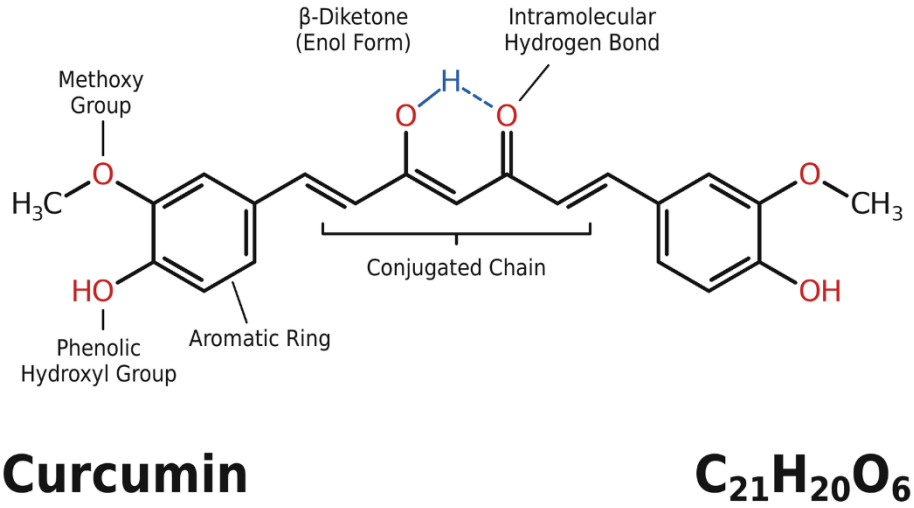

Figure 2. Chemical structure of curcumin [14].

❖ **Citronella Oil** [15]

Synonyms

- Citronella oil
- Java citronella oil
- Citronella essential oil

Biological Sources

- Citronella oil obtained from the leaves and stems of Citronella grass and Java citronella grass

Family

- Poaceae

Uses

- Natural mosquito repellent
- Used in perfume and cosmetic
- Used as fragrance
- Used in soaps

Structure

- Citronella oil (*Cymbopogon winterianus*) is a complex mixture of volatile terpenoids and therefore has no single molecular formula. Its major constituents are citronellal ($C_{10}H_{18}O$), geraniol ($C_{10}H_{18}O$) and
- citronellol ($C_{10}H_{20}O$)

❖ **Neem Oil** [16]

Synonyms

- Neem
- Nimba
- Indian lilac
- Margosa

Biological Source

- Neem is obtained from the plant Azadirachtin indica commonly known as Neem tree

Family

- Meliaceae

Uses

- Used in mosquito and insect repellent
- Used as main ingredient in herbal formulation
- Used in insect repellent sprays

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

Structure

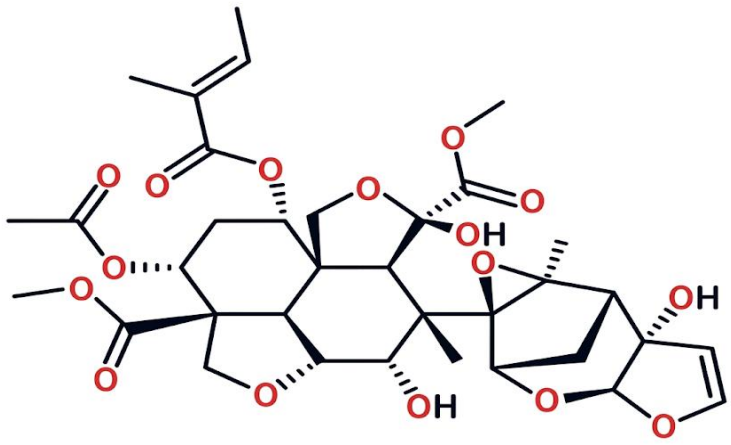

Figure 3. Chemical structure of azadirachtin, the major bioactive constituent of neem oil [16].

❖ **Aloe Vera Extract** [17]

Synonyms

- Aloe
- Aloe vera
- Indian aloe
- Ghiritkumari

Biological Source

- Aloe vera extract is obtained from the fresh leaves of aloe vera

Family

- Asphodelaceae

Uses

- Used as moisturizer and skin smoothing agent
- Used as hydrating agent
- Used in herbal cosmetics

Structure

The Structure of the Aloe Vera does not contain any specific chemical composition because it is a natural product. In general, the Structure of the Aloe Vera cream contains ace Mannan and different polysaccharides.

❖ **Vanillin** [18]

Vanillin is synthetic flavoring agent that is used to maintain the evaporation and fragrance of repellant.

Synonyms

- 4 – Hydroxy -3-methoxylbenzaldehyde Vanilla aldehyde

Biological Source

- Mainly obtained from the vanilla plant (Vanilla planifolia)

Family

- Orchidaceae

Uses

- Used as flavouring agent
- Fragrance indicator
- Fixative in formulation

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

Structure

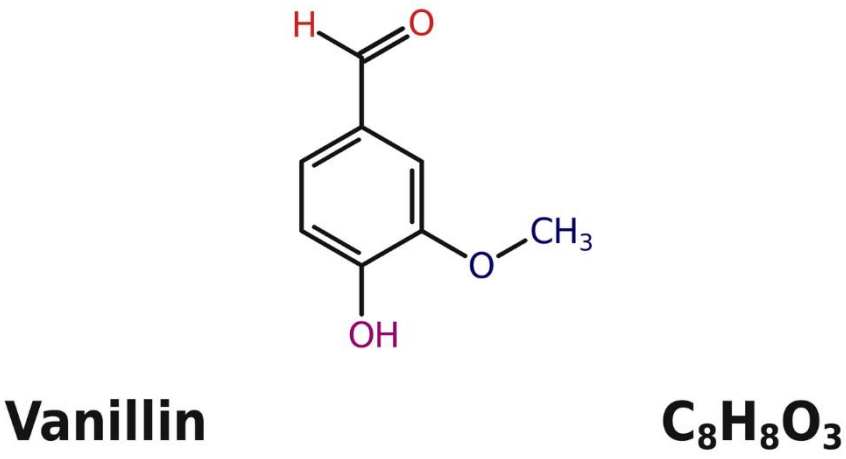

Figure 4. Chemical structure of vanillin [18].

❖ **Polysorbate** [19]

Polysorbate 20 is a synthetic emulsifier that helps mix oil and water and prevent separation.

Uses

- Prevent separation of herbal oil
- Keeps the formulation uniform and stable
- Improve spray ability of the formulation
- Acts as a non-ionic emulsifier
- Improve physical stability of spray

❖ **Purified Water** [20]

- Water as the vehicle for the spray to create the volume of the preparation up to 100 mL so that all other ingredients can be suspended or dissolved in water.
- Water is the base for the emulsion so that citronella oil is dispersed evenly thanks to the surfactant polysorbate.
- To dissolve materials that are water-soluble or partially water-soluble such as vanillin.
- Use water that's free of contaminants and impurities because tap water would disturb the stability and clarity of the formulation and could allow bacterial contamination.
- Water is the vehicle to prevent skin irritation or pain when the remaining insect repellent ingredients are applied.

- **Formulation Procedure**

Preparation of oil mixture:

Take a clean dry beaker and add 10 ml citronella oil, 5 ml neem oil and 5 ml Polysorbate 20 and then mix the ingredients slowly and continuously stirringfor 5-10 minutes until the contents are properly mixed.

Dissolving the vanillin:

Take some portion of 95% ethanol in a beaker and add 1 g vanillin slowly with continuous stirring until the complete dissolution of the substance.

Preparation of curcumin solution:

Take the remaining portion of 95% ethanol in a beaker and slowly add 3.33 ml of 15% curcumin liquid with continuous stirring for 5 minutes until the contents are properly mixed.

Preparing the mixture of curcumin and oil:

Add the mixture of citronella oil, neem oil and polysorbate 20 slowly to the curcumin and ethanol solution with stirring. Allow stirring for 10-15 minutes to get a mixed homogeneous solution.

Adding aloe extract:

Add 10 ml of aloe extract slowly to the solution with continuous stirring. Stir for 5-10 minutes until the solution is obtained.

Adding purified water:

Add purified water gradually and continuously stir the solution. Allow the addition of purified water until the volume of a solution becomes 100 ml and then continue stirring for 10 minutes.

The final mixing:

Leave the solution for 15-30 minutes to remove any foam or air bubbles. Check the appearance of the solution, for oil separation or precipitation of any material.

Filling:

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

Then transfer it into a clean and dry spray bottle, close it properly and store it in cool and dark places.

- **Marketed Herbal Mosquito-Repellent Products**

Product	Dosage form	Key ingredients	Pack size	Nature
Mantra Herbal Mosquito Repellent [21]	Liquid, water-based spray	Lemongrass oil, citronella oil, basil oil, nilgiri oil, neem oil, excipients & preservatives q.s.	100 mL	DEET-free herbal formulation
Om Roots Herbal Dhoop Stick [22]	Solid fumigating preparation	Cow dung, neem, lemongrass, camphor and natural essential oils	40 units	Bambooless, marketed as chemical-free
Softsens Natural Mosquito Repellent Gel [23]	Gel	Citronella, eucalyptus, lemongrass, lavender	50 g	Natural, DEET-free, non-sticky
Good Knight Fabric Roll-On [24]	Apply 4 dots on clothing	Citronella oil, eucalyptus oil, excipients	8 mL	Plant-based mosquito repellent

Table 1. Comparison of marketed herbal mosquito-repellent products.

- **Advantages**
  - It is entirely natural and not very harsh to the skin.[25]
  - It repels mosquitoes by disrupting their sensory system confusing them and preventing them from landing on you. [26]
  - Can also destroy mosquito larvae thus eliminating their breeding grounds.[27]
  - Easy and cheap to get hold of since turmeric is grown in a lot of places. [28]
  - Has a more natural smell than traditional sprays with their chemical smells. [29]
  - It is eco-friendly since it is biodegradable.[30]
  - Very easy and cheap to make so can be used in small-scale production. [31]
  - It does not leave a greasy or sticky feeling on the skin after applying.[32]

- **Disadvantage**
  - It does not contain chemicals for it to be a long-term solution [33]
  - The results may differ from situation to situation due to the variability of the production process.[34]
  - It has not been put to the test on as many scientific experiments as the average mosquito repellents on the market.[35]
  - The yellowness of turmeric can stain white clothing and other light surfaces for good.[36]
  - It can induce light allergic reactions in people sensitive to the ingredients.[37]
  - It can yield a weaker outcome in places with an exceedingly high number of mosquitoes.[38]
  - Due to the heat, the natural smelling potential of the product may not be perceivable.[39]
  - Manufacturing at home can be problematic and lengthy [40]

II. Conclusion

Most mosquito repellents on the market remain chemical-based and rely on DEET, which carries environmental concerns and is subject to growing mosquito resistance. This review compiled the evidence for, and proposed the formulation of, a natural alternative. Oils of turmeric (curcumin), citronella and neem, together with aloe vera extract, were combined into a single spray formulation. Based on the reported properties of these constituents, the formulation is expected to remain stable in pH and colour and to offer repellent activity against common vector species such as Culex quinquefasciatus and Aedes aegypti, while being low-cost and more sustainable than conventional repellents.

Potential drawbacks include staining of light-coloured fabric by turmeric and the possibility

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 5, Sep.-Oct.2026, pp:1061-1068 www.ijprajournal.com ISSN:2456-4494

of mild allergic reactions in sensitive users. The optimal ratios of individual components, along with experimental validation of stability and repellent efficacy, remain to be established. Overall, the formulation represents a promising, low-cost starting point for further development of a natural alternative to commercial repellents.

Reference

[1]. Evaluation of naturally occurring curcuminoids and related compounds against mosquito larvae. Acta Tropica.
[2]. Bio-sourced mosquito repellents: a review. Frontiers in Ecology and Evolution. 2020.
[3]. Pros and cons of curcumin as a bioactive phyto-compound for effective management of insect pests [Internet]. ResearchGate. Available from:
[4]. World Mosquito Program. World Mosquito Day 2025 – a global health crisis [Internet]. 2025.
[5]. World Health Organization. Malaria [Internet fact sheet].
[6]. Dengue as a growing global health concern [Internet]. PubMed Central. Available from:
[7]. United Nations Office for Disaster Risk Reduction (UNDRR). Dengue (BI0207)
[8]. Levels of curcuminoid and essential oil compositions in turmerics (Curcuma longa L.) grown in Korea. Applied Biological Chemistry.
[9]. Ali A, Wang YH, Khan IA. Larvicidal and biting deterrent activity of essential oils of Curcuma longa, Ar-turmerone, and curcuminoids against Aedes aegypti and Anopheles quadrimaculatus (Culicidae: Diptera). Journal of Medical Entomology. 2015;52(5):979-986.
[10]. Molecular insights on ar-turmerone as a structural, functional and pharmacophoric analogue of synthetic mosquito repellent DEET. Scientific Reports. 2022.
[11]. Enhancing the therapeutic efficacy of curcumin in topical applications through nanoformulations
[12]. Koleva IZ, et al. Water-soluble formulations of curcumin and eugenol produced by spray drying. Pharmaceuticals. 2025;18(7):944.
[13]. In vitro characterization and mosquito (Aedes aegypti) repellent activity of essential-oils-loaded nanoemulsions
[14]. A current review on Curcuma longa Linn. plant. International Journal of Pharmaceutical, Chemical and Biological Sciences. 2018.
[15]. Advances in mosquito repellents: effectiveness of citronellal derivatives in laboratory and field trials
[16]. Azadirachtin from the neem tree Azadirachta indica: its action against insects. Anais da SociedadeEntomológica do Brasil.
[17]. Aloe vera: the miracle plant – its medicinal and traditional uses in India
[18]. Vanilla planifolia – an overview
[19]. Polysorbate 20 – an overview
[20]. U.S. Food and Drug Administration. Water for pharmaceutical use – inspection technical guide
[21]. Mantra Herbal. Mosquito repellent – nilgiri, citronella, neem
[22]. Om Roots. Herbal mosquito repellent dhoop sticks (bambooless, cow dung & neem)
[23]. Softsens. Natural mosquito repellent gel [Internet]. Product page.
[24]. Good Knight. Fabric roll-on mosquito repellent
[25]. Hewlings SJ, Kalman DS. Curcumin: a review of its effects on human health. Foods. 2017;6(10):92.
[26]. Tawatsin A, Wratten SD, Scott RR, Thavara U, Techadamrongsin Y. Repellency of volatile oils from plants against three mosquito vectors. Journal of Vector Ecology. 2001;26(1):76-82.
[27]. Matiadis D, Liggri PGV, Kritsi E, et al. Curcumin derivatives as potential mosquito larvicidal agents against two mosquito vectors, Culex pipiens and Aedes albopictus. International Journal of Molecular Sciences. 2021;22(16):8915.
[28]. Kew Science. Curcuma longa L. [Internet]. Plants of the World Online.
[29]. Development of herbal mosquito-repellent formulations and their comparative evaluation
[30]. Senthil-Nathan S. A review of resistance mechanisms of synthetic insecticides and botanicals, phytochemicals, and essential oils as alternative larvicidal agents against mosquitoes. Frontiers in Physiology. 2019;10:1591.
[31]. Development and evaluation of herbal mosquito repellent spray [Internet]. Zenodo; 2025.

[32]. A novel approach for development and characterization of effective mosquito repellent cream formulation containing citronella oil. BioMed Research International. 2014.
[33]. Comparison of repellency effect of mosquito repellents for DEET, citronella, and fennel oil [Internet]. PubMed Central
[34]. Curcuma longa L. rhizome essential oil from extraction to its agri-food applications: a review. Plants. 2021;10(1):44.
[35]. Maia MF, Moore SJ. Plant-based insect repellents: a review of their efficacy, development and testing. Malaria Journal. 2011;10(Suppl 1):S11.
[36]. Persil. How to remove turmeric stains [Internet]. Available from:
[37]. Chaudhari SP, Tam AY, Barr JA. Curcumin: a contact allergen. Journal of Clinical and Aesthetic Dermatology. 2015;8(11):43-48.
[38]. Fradin MS, Day JF. Comparative efficacy of insect repellents against mosquito bites. New England Journal of Medicine. 2002; 347:13-18.
[39]. Microencapsulation of Citrus grandis peel oil using interfacial precipitation chemistry technique for repellent application
[40]. Variation in yield, chemical composition and biological activities of essential oil of three Curcuma species: a comparative evaluation of hydrodistillation and solvent-free microwave extraction methods [Internet]. PubMed Central.