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Formulation and Evaluation of Duranta-Based Emulgel: A Natural Mosquito Repellent

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A B S T R A C T

Mosquito-borne diseases pose significant global health challenges, necessitating the development of effective, safe, and sustainable repellents. This study focuses on the formulation and evaluation of an emulgel-based mosquito repellent incorporating Duranta erecta leaf extract, known for its bioactive phytochemicals with potential insect-repellent properties. The emulgel was prepared using a suitable oil phase, gelling agent, and emulsifier system to ensure optimal consistency, stability, and ease of application. The formulated emulgel was evaluated for its physicochemical parameters including pH, spread ability, and stability. The findings suggest that Duranta erecta-based emulgel could serve as a promising alternative to synthetic repellents, combining natural efficacy with user-friendly topical application.

Keywords: Mosquito repellent; Emulgel; Topical drug delivery; *Duranta erecta*

1. Introduction

Mosquito-borne diseases remain one of the most pressing public health concerns worldwide, especially in tropical and subtropical regions. Diseases like malaria, dengue, chikungunya, Zika virus, and lymphatic filariasis are transmitted primarily by mosquitoes such as Aedes aegypti and Culex quinquefasciatus. The World Health Organization (WHO) estimates that mosquito-borne illnesses are responsible for over 700,000 deaths annually, with malaria alone accounting for 619,000 deaths in 2021. These statistics highlight the urgent need for effective mosquito control strategies to reduce the spread and impact of these diseases (WHO, 2022).

Table 1 - Types of Mosquitoes

Anopheles	Malaria, Filariasis, Arbovirus
Aedes	Dengue, Chikungunya, Yellow Fever, Hemorrhagic Fever
Culex	Encephalitis, Meningitis, Bancroftian Filariasis, Elephantiasis

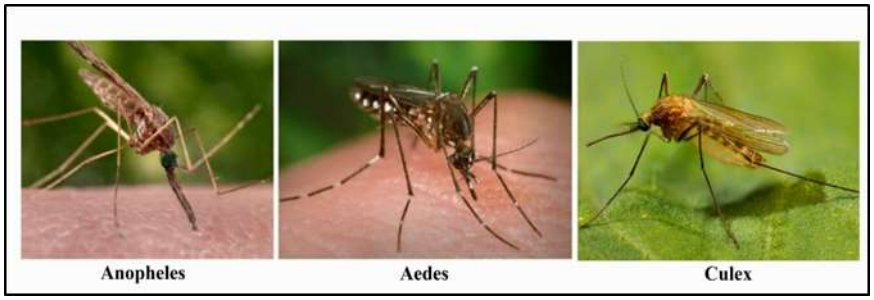

Fig. 1 - Types of Mosquitoes

Traditionally, chemical repellents such as DEET (N,N-diethyl-meta-toluamide) and permethrin have been the mainstay in personal mosquito protection. While effective, their prolonged use has raised concerns regarding skin irritation, neurotoxicity, and environmental harm. DEET, for instance, has been associated with adverse reactions in children and can degrade plastic materials, prompting both medical and consumer scrutiny. As a result, researchers and consumers alike are turning to herbal alternatives that offer safer and eco-friendly profiles.

Herbal mosquito repellents have gained popularity due to their biodegradability, low toxicity, and minimal side effects. Plant-based compounds have demonstrated promising insecticidal and repellent properties, offering a natural solution to vector control. Numerous plants, including neem (*Azadirachta indica*), citronella (*Cymbopogon nardus*), clove (*Syzygium aromaticum*), and *Duranta erecta*, have shown significant potential in repelling mosquitoes. These natural agents contain volatile oils and phytochemicals like flavonoids, terpenoids, and alkaloids that disrupt mosquito feeding behavior and reproduction.

Among these, *Duranta erecta*, a plant from the Verbenaceae family, has received particular attention for its larvicidal and repellent properties. Extracts from its leaves and flowers have demonstrated effectiveness against mosquito species like Culex quinquefasciatus and Aedes aegypti. Phytochemical analysis reveals the presence of bioactive compounds that contribute to its insect-repelling capabilities. These findings support the development of topical formulations using *Duranta erecta* as a key ingredient.

One of the most suitable delivery systems for herbal repellents is the emulgel, a novel formulation that combines the benefits of emulsions and gels. Emulgels offer a stable medium for delivering hydrophobic compounds like essential oils. They provide enhanced drug penetration through the skin, ease of application, and better patient compliance due to their non-greasy texture and aesthetic appeal. Unlike traditional creams or ointments, emulgels ensure a sustained release of active ingredients, making them ideal for repellent applications.

Incorporating *Duranta erecta* extract along with known repellents like neem and clove oil into an emulgel base creates a multi-component formulation with synergistic repellent effects. The gel structure stabilizes the active compounds and improves their retention on the skin, thereby enhancing efficacy and duration of protection. As consumers increasingly prefer herbal-based skin applications for safety and environmental reasons, such formulations represent a promising approach to mosquito bite prevention.

2. Introduction About Duranta Erecta

Drug Profile: Duranta

Common Name: Duranta, Golden Dewdrop, Skyflower, Pigeon Berry

Botanical Name: *Duranta erecta* (syn. *Duranta repens*)

Family: Verbenaceae

Active Constituents: Alkaloids, Flavonoids, Saponins, Tannins, Steroids, Glycosides.

Nature: Shrubby plant with purple-blue flowers and yellow/orange berries

Mechanism of Action (Mosquito Control): Leaf extracts show larvicidal and pupicidal activity against Aedes aegypti, Anopheles, and Culex species, disrupts larval development and causes mortality via phytochemical toxicity.

Pharmacological Activities: Mosquito larvicidal and repellent, Antibacterial, Antifungal, Antioxidant, Anthelmintic, Antipyretic

Traditional Uses: Used in folk medicine for treating malaria, fever, and skin infections, Decoctions for intestinal worms.

3. Material and Methods

Plants materials

Fresh leaves of *Duranta erecta* were collected during the summer season in May, 2025 from the Herbal Garden of Gajanan Maharaj College of Pharmacy, Shiva Trust Campus, Nipani - Bhalgaon , Aurangabad, 431007, Maharashtra, India.

Vehicle

The vehicle used for the formulation of an emulgel should possess properties that enable effective drug deposition and uniform distribution across the application site. E.g., Water.

Aqueous phase

The aqueous phase of the emulsion is formed by using aqueous material and water are commonly used.

Oil phase

Coconut oil, neem oil & clove oil are used in oily phase to enhance the penetration.

Emulsifier

The emulsifying agent are used to reduce interfacial tension between two phases such as water oil. E.g., Span 20, Tween 80.

Gelling agent

e.g. Consistency and the gelling property can be increase by using various gelling such as Carbopol 940.

Preservative

e.g. A substance that preserves the formulation over an extended period by preventing microbial growth and maintaining its stability. E.g., Methyl paraben.

3.1 Method Of Preparation.

3.1.1. Extraction Method

25g of dried leaves sample weighed and extracted in an extracted in a Soxhlet device with 250 ml solvent at room temperature for 8 hours.

3.1.2. Method of preparation of Emulgel

Emulgel are formulated by combining a gel base with an emulsion, where both components are prepared separately and mixed. Initially, the aqueous phase is prepared, followed by the oily phase. These two phases are then combined to form the emulsion. After the emulsion is prepared, a gel base is formulated separately. Finally, the gel is incorporated into the emulsion with continuous stirring to obtain a stable emulgel formulation.

3.2.2 Preparation and Formulation

Oil Phase Preparation

Coconut oil, clove oil, and neem oil are combined in a clean beaker. Cetyl alcohol is added as a stabilizer and thickener, followed by Span 20 as a lipophilic emulsifier. The mixture is heated to 70–80°C with gentle stirring until uniform.

Aqueous Phase Preparation

Distilled water is used as the base. *Duranta erecta* extract is added for its mosquito repellent activity. Tween 80 is dissolved as a hydrophilic emulsifier, and glycerin is added as a humectant. The solution is heated to a temperature of 70–80°C with continuous stirring to ensure uniform mixing of the components.

Emulsification Process

The heated oil phase is slowly added to the aqueous phase under continuous stirring. The mixture is stirred at a constant speed while maintaining temperature, then gradually cooled to room temperature. Stirring is continued until a stable oil-in-water emulsion is formed, ensuring uniform dispersion of the oil phase within the aqueous medium.

3.3 Formulation of Emulgel

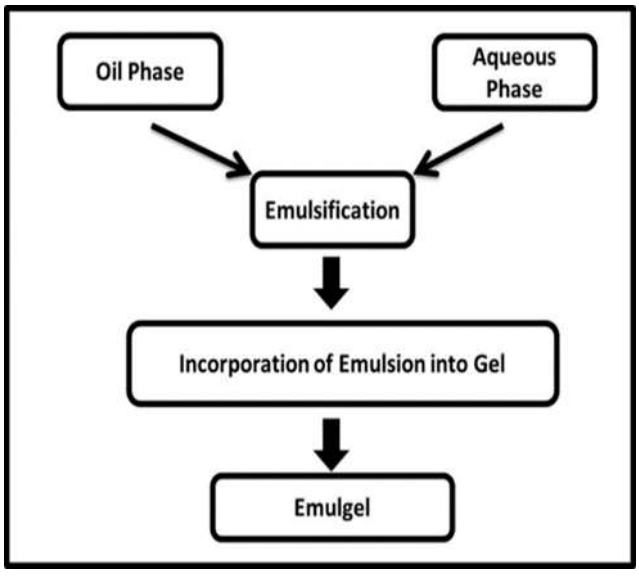

Fig. 2- Formulation of Emulgel

3.4 Formulation Table Of Emulgel

Table 2 - Formulation Table of Emulgel Preparation

Sr. No.	Name of Ingredient	F1	F2	Purpose
1	*Durant erecta* extract	2.0 ml	2.0ml	Active (mosquito repellent)
2	Coconut oil	4.0 g	6.0g	Oil phase
3	Clove oil	0.6ml	1.0ml	Active, fragrance
4	Neem oil	1ml	1.4ml	Active, insecticidal
5	Cetyl alcohol	1 g	1.4g	Emollient, thickener
6	Tween 80	0.10 g	0.20 g	Surfactant
7	Span 20	0.10 g	0.20g	Surfactant
8	Glycerin	1.0ml	1.0ml	Humectant
9	Carbopol 940	0.04g	0.06g	Gelling agent
10	Methyl Paraben	0.04g	0.04g	Preservative
11	Triethanolamine	4-6 drops	5-6 drops	Ph adjustment
12	Distilled water	q.s to 20g	q.s. to 20g	Vehicle

3.5 Evaluation Of Emulgel

3.5.1. Physical Evaluation

Measurement of pH determination

The pH of the emulgel formulations was determined using a pH meter. For each formulation,1g of emulgel was weighed and dispersed in 10ml of purified water. The dispersions were thoroughly shaken to ensure uniform mixing, and the pH was subsequently measured.

Color

The color of the formulation was evaluated against a white background, revealing a characteristic light beige appearance.

Odour

The odour of the gel was assessed by dispersing it in water and evaluating its scent. The gel was found to be odourless.

Consistency

The Consistency of the gel was evaluated by applying it to the skin, and the formulation exhibited an optimal consistency with smooth and uniform application.

Greasiness

The greasiness was checked by applying the gel on skin. The non- oily was found.

Homogeneity

The homogeneity of the formulation was tested by visual inspection after transferring it into a container. The formulation appeared uniform, indicating proper homogenization.

Spread ability

Spread ability is checked by two slides put an emulgel on first slide and cover this by second slide and these are easily spread.

Stability study

The formulation gel was filled in the container and store under varying temperature and humidity condition. Subsequently, the samples were evaluated for appearance, pH and spread ability to assess their stability.

Skin irritancy test

A specified area on the dorsal surface of the hand was marked, and the gel was applied to the designated area to check any signs of skin irritancy.

3.5.2. Type of Emulsion

Little amount of water is mixed with emulsion. If water distributes uniformly throughout the emulsion, it indicates an oil in water (O/W) type; whereas, if water separates out as a distinct layer, the emulsion is classified as water-in-oil (W/O) type. The emulsion was determined by using a dilution method.

Table 3 - Emulsion Type

Emulsion	Emulsion Type
F1	o/w
F2	o/w

3.5.3. Solubility of Duranta erecta Extract

Table 4 - Solubility of Duranta erecta in various solvents

Sr. No.	Solvent	Solubility
1.	Water	Soluble
2.	Alcohol	Soluble
3.	Acetone	Soluble

4. Results and Discussion

The formulated herbal emulgel exhibited a light brown to beige coloration and had a smooth texture with a soothing, cooling sensation upon application. The formulation maintained a translucent appearance and was aesthetically acceptable.

The pH of the gel remained stable in the range of 6 to 7 throughout the evaluation period, indicating good compatibility with the skin.

The emulgel was found to be non-greasy, non-sticky, non-irritant, and easily removable using water and cotton gauze. Spread ability tests indicated uniform application with minimal variation observed during the stability study.

After storing the formulation at room temperature for three weeks, no noticeable changes were observed in color, texture, pH, spread ability, viscosity, or phase separation, confirming the physical and chemical stability of the herbal emulgel.

Table 5 - Evaluation Parameters

Formulation	pH	Spread ability	Skin Irritation
F1	6.5	Excellent	Nil
F2	6.3	Good	Nil

Table 6 - Physical Properties of Formulation

Sr. No.	Colour	Phase Separation	Grittiness	Homogeneity	Consistency
1.	Light beige	None	-	Uniform and well mixed	Excellent
2.	Light brown	None	-	Uniform and well mixed	Good

5. Conclusion

We can conclude that emulgel is an effective and promising drug delivery system, especially for topical herbal formulations. The herbal emulgel containing Duranta erecta extract has shown potential as a mosquito repellent with excellent applicability and user compliance.

This formulation combines the benefits of both gel and emulsion, making it non-greasy, non-sticky, and easily spreadable, which enhances patient comfort and acceptance. The use of Duranta erecta, along with other herbal oils like neem and clove oil, provides natural mosquito-repelling properties without adverse effects, making it safe for regular use.

The experiment demonstrated that this herbal emulgel is convenient, effective, and eco-friendly, aligning with the growing demand for natural and safe alternatives in the market. Hence, it can be concluded that Duranta erecta-based emulgel is a novel and efficient topical formulation for mosquito repellent action, with the potential for commercial application.

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References

Rai, S., & Painuly, N. (2025). Emulgel: A novel approach for the formulation and development of mosquito repellent: Duranta erecta. International Journal of Pharmaceutical Sciences, [ISSN: 0975-4725]. Retrieved from https://www.ijpsjournal.com

Sharma, V., Singh, H., & Gupta, R. (2014). Herbal drug delivery through gels and emulgels: A review. International Journal of Pharmaceutical Sciences and Research, 5(4), 1212–1220.

Mishra, A., Tiwari, R., & Pandey, A. (2016). Formulation and evaluation of herbal mosquito repellent preparations. International Journal of Pharmaceutical and Phytopharmacological Research, 6(2), 76–81.

Patel, D. M., Patel, N. M., & Shah, R. R. (2018). Emulgel: A novel approach for enhanced topical drug delivery. International Journal of Pharmaceutical Sciences Review and Research, 50(1), 41–47.

Kumar, S., & Saini, M. (2019). Phytochemical screening and insecticidal activity of Duranta erecta against mosquito larvae. Journal of Medicinal Plants Studies, 7(2), 135–139.

Raut, J. S., Karuppayil, S. M., & Bhagat, J. (2015). Evaluation of herbal oils for mosquito repellent activity and formulation into emulgel. Journal of Vector Borne Diseases, 52(3), 215–220.

Singh, A., & Verma, R. (2020). Advances in mosquito repellent delivery systems: A review. Asian Journal of Pharmaceutical and Clinical Research, 13(5), 25–31.

Gupta, R., Jain, D., & Bansal, V. (2021). Evaluation of herbal plant extracts for mosquito larvicidal and repellent activity. Journal of Pharmacognosy and Phytochemistry, 10(1), 182–186.

Bhattacharya, A., & Chandra, G. (2013). Mosquito larvicidal efficacy of Duranta erecta (Verbenaceae) plant extracts against Culex quinquefasciatus. Asian Pacific Journal of Tropical Biomedicine, 3(2), 123–128. https://doi.org/10.1016/S2221-1691(13)60034-1.

Kumar, R., & Sahoo, C. K. (2011). Emulgel: A Review on Topical Drug Delivery System. Pharmaceutica Analytica Acta, 2(5), 1–5. https://doi.org/10.4172/2153-2435.1000126

Singh, R. P., & Majumdar, D. K. (1999). Evaluation of anti-inflammatory activity of fatty acids of Vitex negundo Linn. Indian Journal of Experimental Biology, 37(3), 291–293.

Kaur, L. P., & Guleri, T. K. (2013). Topical Gel: A Recent Approach for Novel Drug Delivery. Asian Journal of Biomedical and Pharmaceutical Sciences, 3(17), 1–5.

Shrivastava, S., & Nema, R. (2011). Formulation and evaluation of herbal mosquito repellent preparations. International Journal of Pharmaceutical Sciences and Research, 2(7), 1781–1784.

Ali, A., Tabassum, N., & Khan, A. (2012). Evaluation of mosquito larvicidal activity of Duranta erecta and its fractions. International Journal of Mosquito Research, 2(4), 45–50.

Yadav, N., & Sandeep, K. (2011). Emulgel: A new approach for enhanced topical drug delivery. International Journal of Pharmaceutical and Biological Archives, 2(5), 1611–1616.

Sharma, R., & Sharma, M. (2014).Formulation and evaluation of herbal mosquito repellent topical preparations using neem oil. International Journal of Pharma Sciences and Research, 5(6), 312–316.

A comprehensive review on formulation and evaluation of mosquitocidal gel from Duranta erecta. IJPPR 2024; 6(2): 52-57[1].

Emulgel: A Novel Approach for the Formulation and Development of Mosquito Repellent Duranta Erecta. IJPS, 2024[2].Duranta erecta / Species Page / Plant Atlas https://florida.plantatlas.usf.edu/plant/species/1821 Duranta erecta - Wikipedia https://en.wikipedia.org/wiki/Duranta_erecta

Duranta Plant: A Tropical Broadleaf Evergreen With Many Uses https://www.thespruce.com/duranta-plant-care-and-growing-guide-4684565

Plant profile, Phytochemical and Pharmacological properties of Duranta erecta (Golden Dew Drop): A review https://www.academia.edu/116771048/Plant_profile_Phytochemical_and_Pharmacological_properties_of_Duranta_erecta_Golden_Dew_Drop_A_review

Duranta erecta Linn: A critical review on phytochemistry, traditional uses, pharmacology, and toxicity from phytopharmaceutical perspective - PubMed https://pubmed.ncbi.nlm.nih.gov/35405253/

Microsoft Word - 2402218_250866[1] https://www.ijcrt.org/papers/IJCRT2402218.pdf

Duranta erecta - Leon Levy Native Plant Preserve https://levypreserve.org/plant-listings/duranta-erecta/

Vijay. R. Mahajan and Roshan P. Goikane (2022). Formulation and evaluation of herbal anti-inflammatory Emulgel prepared from Vitex neugondo leaves extract World Journal of Biology Pharmacy and Health Sciences, 12(03), 119–124