IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, October 2025
Impact Factor: 7.67

A Review On API Chrysenthemum Flower As A Herbal Mosquito Repellent

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Abstract: *Chrysanthemum flower-derived pyrethrins are plant-derived insecticidal esters widely used for insect control and as the botanical basis of many household repellents. This review summarizes the botanical source, chemical composition, extraction and standardization methods, mechanism of action against mosquitoes, formulation approaches for repellent and insecticidal products, efficacy data, safety and environmental considerations, and regulatory/practical issues for using pyrethrum as an API in mosquito repellent products. Strengths of pyrethrins include rapid knockdown and broad-spectrum action; limitations include photolability and potential aquatic toxicity. The review highlights current gaps — particularly the need for improved stabilization, standardized extraction yields, and comparative field trials — and proposes directions for research and product development.*

Keywords: Botanical insecticide, Mosquito repellent, Chrysanthemum cinerariifolium, Pyrethrum, Mosquito repellent

I. INTRODUCTION

Mosquito-borne diseases (dengue, malaria, Zika, chikungunya) represent a major global health burden. Chemical repellents and insecticides (DEET, permethrin, prallethrin, etc.) reduce human– vector contact but raise concerns about toxicity, environmental persistence, and resistance. Pyrethrins — natural insecticidal esters from the dried flowers of Chrysanthemum (Tanacetum) species — offer a botanical alternative with high insecticidal potency and relatively low mammalian toxicity when used appropriately. This review focuses on Chrysanthemum/pyrethrum as an API for mosquito control and repellent product development, emphasizing pharmaceutical-relevant aspects:
phytochemistry, methods of extraction and standardization, formulation strategies, performance metrics, safety profile, and regulatory considerations.

2.Botanical and Biological Source (chrysanthemum flowers)

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-Botanical and Biological Source (chrysanthemum flowers)
-Common name:- Pyrethrum (flowers of Chrysanthemum / Tanacetum species)
-Primary species:-Chrysanthemum cinerariifolium (syn. Tanacetum cinerariifolium), Chrysanthemum coccineum.
-Family: Asteraceae .
-Geographical cultivation:- Native to Dalmatia; major commercial cultivation in East Africa (Kenya, Tanzania, Rwanda), Japan, and parts of India (Nilgiris, Kashmir). Flower harvest timing and postharvest handling strongly influence pyrethrin yield and quality.
-Biological Source:-Dried flower heads of Chrysanthemum cinerariifolium and C. coccineum.

Phytochemistry: Active Constituents:-
Pyrethrum extract contains a family of esters known collectively as pyrethrins, typically classified into six principal components: pyrethrin I & II, cinerin I & II, jasmolin I & II. These are nonpolar, low molecular weight esters (terpenoid-derived) responsible for insecticidal activity. The relative proportions of these esters vary by species, cultivar, growth conditions, and harvesting/processing procedures, which in turn affect bioactivity. Minor constituents (other terpenoids, waxes, pigments) are typically co-extracted and may influence stability and formulation behavior.

3. Extraction & Standardization (Pharmaceutical Considerations):-
3.1 Extraction Methods:-
Solvent extraction (recommended): Non-polar solvents (n-hexane, petroleum ether) in Soxhlet or maceration are commonly used to recover pyrethrins from dried flower heads. Conditions should avoid high temperatures which degrade pyrethrins.
Supercritical CO_2 extraction: An advanced technique that yields cleaner extracts with less thermal degradation; attractive for higher-value formulations but requires specialized equipment.
Hydrodistillation: Not ideal — pyrethrins are not conventional essential oils and are more effectively recovered by solvent extraction.

3.2 Cleanup & Concentration:-
Evaporation (rotary evaporator under reduced pressure) followed by defatting or silica gel column chromatography can remove highly nonpolar waxes and concentrate pyrethrin-rich fractions. Liquid– liquid partitioning or flash chromatography allow partial purification appropriate for formulation use.

3.3 Standardization & Quality Control:-
Assays: GC–MS or GC-FID is used to identify and quantify pyrethrin components. TLC is useful for rapid checks.
Quality markers: Total pyrethrin content (expressed as % w/w) and composition of the six esters are reported. Typical total pyrethrin content in pyrethrum flowers ranges roughly from 0.5% to 2.5% (varies by cultivar).
Storage: Pyrethrum extracts must be stored cold, in amber containers, under inert atmosphere when possible, to minimize photodegradation and oxidation.

4. Mechanism of Action Against Mosquitoes:-
Pyrethrins target the voltage gated sodium channels in insect nerve membranes, prolonging sodium influx and causing persistent nerve depolarization. This hyperexcitation produces rapid paralysis (knockdown) and subsequent mortality. The fast knockdown effect makes pyrethrins valuable in indoor household products where rapid reduction of biting is needed. In formulations where pyrethrins act primarily as repellents, the behavioral disruption and irritant properties also reduce mosquito landing and biting.

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5. Efficacy & Duration of Action:-

5.1 Efficacy

Pyrethrins demonstrate broad-spectrum activity — effective against mosquitoes (Aedes, Anopheles, Culex), flies, and other household pests. In controlled chamber assays they cause rapid knockdown and high mortality depending on concentration and exposure duration.

When compared to synthetic pyrethroids, natural pyrethrins are often similarly potent in knockdown but are less persistent.

5.2 Duration & Limitations :-

Short residual activity: Natural pyrethrins are photolabile and oxidize rapidly in sunlight and air; residual protective activity on surfaces is typically short (hours to a day), unlike synthetic pyrethroids (permethrin, prallethrin) which are chemically stabilized for longer residual action. Stabilization strategies: Use of synergists (e.g., piperonyl butoxide) and incorporation into microencapsulation matrices can extend effective duration. Combining pyrethrins with fixatives or solvents for slow release (in vaporizers or coils) also increases practical protection time.

6. Formulation Approaches for Mosquito Repellent Products:-

6.1 Product Forms:-

-Vaporizers / Liquid refill: Pyrethrum or pyrethrin-containing liquids heated/vaporized for room fumigation.
-Coils / Incense: Pyrethrum or pyrethrin-impregnated coils for household use; protection only while burning.
-Aerosol sprays / aerosols with carriers: Rapid knockdown for spot treatments.
-Surface sprays & residual treatments: Short-term knockdown; limited wash resistance.
-Microencapsulated topical applications or fabric treatments: For treated clothing or slow-release topical platforms (note: pyrethrins are not generally applied undiluted on skin).

6.2 Important Formulation Considerations:-

-Compatibility: Pyrethrins are nonpolar; choose suitable solvents/carriers and emulsifiers for waterbased products.
-Stability: Include antioxidants, light-protective packaging, or microencapsulation to mitigate degradation.
-Safety & labeling: Avoid direct skin application of concentrated pyrethrins; provide clear usage instructions and safety warnings.

7. Safety, Toxicology & Environmental Impact:-

7.1 Human Safety:-

Pyrethrins have relatively low mammalian toxicity at typical household exposure levels; however, concentrated exposures can cause transient paresthesia, allergic dermatitis, respiratory irritation, or systemic effects in sensitive individuals. Proper formulation and labeling are necessary.

Avoid direct application on infants' skin or in enclosed spaces without ventilation. Patch testing prior to topical use is recommended for formulations intended for skin application.

Environmental Considerations:-

Aquatic toxicity: Highly toxic to fish and aquatic invertebrates; products containing pyrethrins should be used and disposed of with care to avoid water contamination.

Non-target organisms: Beneficial insects (pollinators) may be affected; use targeted, indoor, or controlled-release formats where possible.

8. Regulatory context:-

Pyrethrum extracts are regulated as insecticides in most jurisdictions; authorized concentrations, permitted product types and labeling requirements are set by national pesticide regulators. For pharmaceutical or consumer repellent products, compliance may require registration, safety dossiers, and efficacy data from standardized bioassays e.g., WHO chamber tests or nationally recognized field trials.

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9. Future directions:-

Key areas for research that enhance chrysanthemum's utility as an API include:

Stabilization technologies (microencapsulation, antioxidant systems) to prolong activity without adding harmful chemicals.

Optimization of agronomy and post-harvest processing to increase and standardize pyrethrin yields. Formulation science: safe slow-release topical systems that extend protection time while minimizing human irritation. Comparative field trials versus synthetic alternatives under realistic household conditions. Environmental mitigation strategies to reduce aquatic toxicity risk

II. CONCLUSIONS

Chrysanthemum-derived pyrethrins remain a valuable botanical API for mosquito control due to their rapid knockdown effect and broad insecticidal spectrum. Their principal limitation — short environmental persistence — can be mitigated by clever formulation (synergists, microencapsulation, fixatives). For pharmacy students and formulators, chrysanthemum offers a rich project area that bridges pharmacognosy, pharmaceutics and pharmacology: from plant cultivation and extraction to product design and efficacy testing. Responsible development must balance efficacy, human safety and environmental stewardship.

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