

Palm oil-based microemulsions are used as a basis for preparing aerosol insecticides against domestic insect pests. Palm-based solvents and blended emulsifiers are renewable resources, biodegradable, non-flammable, easy to handle, and cause less/no or minimum human health problems.

Screening and partial ternary phase diagrams studies were carried out to determine suitable surfactant or mixed surfactants and/or co-surfactants for: 1) water in oil (W/O); and 2) oil in water (O/W) microemulsion (μ E) system as a base for palm-based aerosol-insecticides against insect pests for public health. The optimum compositions and concentrations for both the W/O and O/W microemulsion (μ E) systems were determined. Both systems were used to formulate W/O- μ E and O/W- μ E aerosol insecticides and their physical stability at ambient and high temperatures, particles size, viscosity and mist properties were studied. Bioefficacy tests on insects, like mosquitoes/flyes for flying insects, and cockroaches/ants/termites for crawling insects were also determined.

PROBLEM STATEMENTS

- Conventional aerosol insecticides contain petroleum-based solvents, like xylene, kerosene and toluene.
- They tend to cause medical problems (e.g, skin and eye irritation) to end-users.
- They are highly flammable, non-biodegradable, and toxic to non-target organisms.
- Prices of petroleum-based solvents increased significantly over the years.

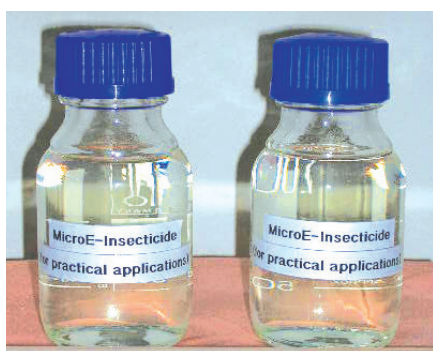
ADVANTAGES OF PALM-BASED MICROEMULSIONS (μ E) AS BASES FOR AEROSOL INSECTICIDES

- Water-based insecticides are aqueous formulations with water as the main inert ingredient (>50%). Conventional EC-insecticides, on the other hand, contain more than 90% of inert petroleum-based solvents.
- Palm-based solvents and blended emulsifiers in water-based insecticides are derived from palm oil (a renewable resource), biodegradable, non-flammable, easy to handle, and cause less or minimal health problems to users.
- Palm-based solvents in EW-insecticides have flash points higher than 150°C, whereas petroleum-based solvents in EC-insecticides have flash points of below 50°C. Thus, switching to water-based insecticides enhances safety and avoid potential fire hazards during product handling, storage and application.

NOVELTY OF PALM-BASED AEROSOL-INSECTICIDES

- Palm-based microemulsion (μ E), a nano-technology system (< 100 nm of particles size) was used instead of solvent-based or macroemulsion (>500 nm particles size).
- The bases are formulated using palm/palm kernel oil-based materials, which are renewable, biodegradable and environmental-friendly.
- The inerts are also less hazardous to end-users and aquatic organisms.
- An innovative (μ E) aerosol-insecticides technology using green palm-based materials.

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(a)



(b)

Figure 1. a) Palm-based μ E-insecticides; b) palm-based μ E as aerosol-insecticides.

TABLE 1. PHYSICO-CHEMICAL CHARACTERISATION OF PALM-BASED μ E AEROSOL INSECTICIDES

System	Optimum compositions	pH	Density (g ml ⁻¹)	Viscosity (cP)	Particle size (nm)
W/O μ E	17.5%-20% mixed nonionics (70:30);	6.5	0.974	26.13	36.8
	20%-25% PME; 50%-42.5% DH ₂ O;	to	to	to	to
	12.5%-15% 1-alkanol	6.6	0.943	19.80	75.5
O/W μ E	10%-12.5% mixed nonionics (70:30);	5.6	0.991	6.55	22.5
	7.5%-10% PME; 72.5%-67.5% DH ₂ O;	to	to	to	to
	10%-12.5% 1-alkanol	5.8	0.987	11.91	15.6

Note: PME, DH₂O, W/O μ E and O/W μ E are palm methyl ester, distilled water, water in oil and oil in water microemulsions respectively.

TABLE 2. PHYSICAL STABILITY AND MIST BEHAVIOR OF PALM-BASED AEROSOL INSECTICIDES

System	Optimum compositions	Test tube	Observation
W/O μ E as FIK*	17.5%-20% mixed nonionics (70:30); 20%-25% PME; 50%-42.5% DH ₂ O; 12.5%-15% 1-alkanol	50:50 of DME to W/O μ E	<ul style="list-style-type: none"> • Very fine mist observed • No water droplet released • Mist suspends longer in the air • No foam formation
O/W μ E as CIK**	10%-12.5% mixed nonionics (70:30); 7.5%-10% PME; 72.5%-67.5% DH ₂ O; 10%-12.5% 1-alkanol	60:40 of DME to O/W μ E	<ul style="list-style-type: none"> • Very fine mist observed • No water droplet released • Mist suspends shorter in the air • No foam formation

Note: *FIK = flying insects killer; **CIK = crawling insects killer.
DME = dimethyl ether.



Figure 2. Physical stability and mist studies.

CONCLUSION

Suitable mixed surfactants and co-surfactants for: i) W/O and ii) O/W microemulsion (μ E) system were determined as bases for the palm-based aerosol-insecticides. Their bioefficacy tests on insects, like mosquitoes/flies for flying insects, and cockroaches/ants/termites for crawling insects were also determined.

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