PALM-BASED EMULSION-IN-WATER (EW) TERMITICIDE

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Termites are known to impact negatively on agriculture and construction industry imposing great damage to plantations and buildings. Financial loss due to termites infestations in Malaysia was estimated at RM 8- RM 10 million annually (Lee, 2002). The common method in termites control is by the use of emulsifiable concentrate termiticides. Such emulsifiable concentrates (EC) are petrochemicals-based and may pose risks to humans, animals, plants and ecosystem. Current EC-termiticides may cause skin and eye irritations. Recently, the pesticide industry has made a good progress in using low risk, environmental-friendly pesticide formulations. There is a growing demand for environmental-friendly water-based pesticide formulations such as palm-based emulsion-in-water (EW) (Ismail *et al.*, 2003; 2007). Palm-based EW consists of pesticides dissolved in water immiscible solvent, dispersed in oil phase droplets in the presence of surfactants.

ADVANTAGES AND NOVELTY

- EW-termiticide is water-based as such environmental-friendly.
- EW-termiticide contains green and biodegradable palm-based inerts.
- EW-termiticide is palm-based, which is renewable, biodegradable, non-flammable and easy to handle.
- The EW-termiticide cost of production is lower or comparable to the current commercial EC-termiticides.

METHODOLOGY

The development of EW-termiticide *(Figure 1)* began with the determination of suitable non-ionic surfactant or mixed surfactants. The hydrophil-lipophil balance (HLB) values of the mixed surfactants, HLB 10, 11, 12, 13 and 14 were evaluated.

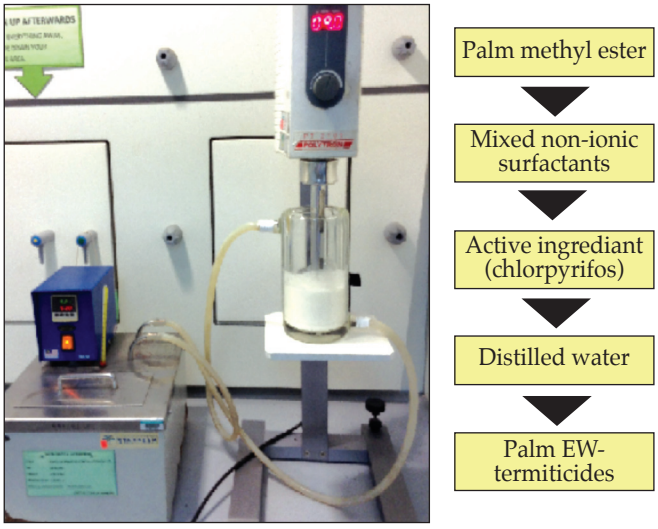

Figure 1. Laboratory scale EW-termiticides production process.

The oil phase used was palm methyl esters C_{6-10} and C_{12-18}. Emulsification process was carried out at 52 ± 2°C using a high speed homogeniser.

The physico-chemical characteristics of the emulsion, such as stability at high temperature (45°C), particle size, viscosity, conductivity, zeta potential, surface tension and pH were observed for two months. The optimum composition and concentration of the emulsion system was used to prepare emulsion with additional active ingredient. Bioefficacy of the formulation with commercial EC as the control was conducted on termites, *Captotermes curvignathus*. The experiment was conducted using Complete Randomised Design (CRD) with three replicates for each treatments. The list of seven treatments including control is listed in *Table 1*.

The results (*Table 2*) showed that HLB 11±1 gave the optimum particle size (1.970 to 2.223 μm), viscosity (124.38 to 137.71 cP), zeta potential stability (-37.91 to -38.76 mV) and surface tension (31.18 to 31.64 mN m^{-1}).

The bioefficacy test showed that palm EW-termiticide is effective in controlling termites

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TABLE 1. TREATMENTS USED IN THE EXPERIMENTS ON TERMITES

Code	Treatment	Dosage (ml/10 litres)
T1	Untreated	-
T2	Commercial EC 21.2% a.i (w/w) (control)	0.50*
T3	Palm EW-termiticides 5% a.i (w/w)	0.10
T4	Palm EW-termiticides 5% a.i (w/w)	0.25
T5	Palm EW-termiticides 5% a.i (w/w)	0.50
T6	Palm EW-termiticides 5% a.i (w/w)	0.75
T7	Palm EW-termiticides 5% a.i (w/w)	1.00

Note : * Recommended rates; a.i = active ingredient.

TABLE 2. PHYSICO-CHEMICAL CHARACTERISTICS OF PALM-BASED EW-TERMITICIDE

HLB of mixed surfactants	pH	Particle size (μm)	Viscosity (cP)	Zeta potential (mV)	Surface tension ($mN\ m^{-1}$)
10	6.08 ± 0.16	1.970 ± 0.002	124.38	-37.91 ± 0.15	31.18 ± 0.07
11	5.89 ± 0.12	2.223 ± 0.002	122.49	-38.76 ± 1.08	31.46 ± 0.10
12	5.82 ± 0.15	2.038 ± 0.001	137.71	-38.67 ± 1.24	31.64 ± 0.02
13	5.62 ± 0.31	2.096 ± 0.002	137.75	-41.46 ± 0.42	32.00 ± 0.06
14	5.70 ± 0.10	2.099 ± 0.001	148.20	-40.8 ± 0.41	32.86 ± 0.05

TABLE 3. BIOEFFICACY OF PALM EW-TERMITICIDE ON *Coptotermes curvignathus*

Treatment	Mean % mortality of termites					
	15 min	30 min	45 min	60 min	75 min	90 min
T1	0 d	0 d	0 d	0 d	0 c	0 b
T2	40.00 b	83.33 a	100.00 a	100.00 a	100.00 a	100.00 a
T3	10.00 c	23.33 c	43.33 c	66.66 c	83.33 b	90.00 a
T4	40.00 b	53.33 b	76.67 b	83.33 b	83.33 b	90.00 a
T5	33.33 b	83.33 a	100.00 a	100.00 a	100.00 a	100.00 a
T6	33.33 b	86.67 a	100.00 a	100.00 a	100.00 a	100.00 a
T7	86.67 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a

Note: Means with the same letter in the same column are not significantly different at $p<0.05$ using Duncan Multiple Range Test.

(*Table 3*). Bioefficacy of palm EW-termiticide (T5) and the commercial EC-formulation (T2) were not significantly different. In addition, lower treatment dosage did not give 100% mortality compared to commercial EC (T2). The bioefficacy test indicated that T7 gave the highest mortality to termites in the shortest time (15 min) followed by T6, T2 T5, T4, T3 and last T1 (untreated).

COST ESTIMATION

The estimated cost for the production of termiticide per litre of formulation is shown in *Table 4.*

CONCLUSION

Palm-based EW-termiticide formulation is equally effective as the commercial EC-termiticide in controlling termites.

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TABLE 4. ESTIMATED COST FOR EW-TERMITICIDE AND EC-TERMITICIDE PRODUCTION

Ingredient	EW-termiticide		EC-termiticide	
	%, w/w	RM litre^{-1}	%, w/w	RM litre^{-1}
Solvent	15 - 20	0.65 - 0.90	80 - 87.5	2.00 - 2.19
Emulsifier	3 – 5	0.69 - 0.75	10 - 15	0.55 - 0.83
Active ingredient	2.5 - 5	1.58 - 3.15	2.5 - 5	1.58 - 3.15
Thickener	0.3 - 0.5	0.90 - 0.40	-	-
Water	70 - 85	0.35 - 0.42	-	-
Total estimated cost	-	4.17 - 5.62	-	4.13 - 6.17

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