Larvicidal Activity and Long-Lasting Repellence of *Cymbopogon nardus* Monoterpene Fracation and its SLNs-Loaded formulation against *Ades aegypti*

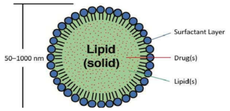
C. M. Lokuge[1,2], H. I. C. De Silva[1], H. D. Weeratunge[2], G.A S. Premakumara[3]

[1]Department of Chemistry, University of Colombo, Colombo 03, Sri Lanka

[2]Industrial Technology Institute (ITI), 363, Bauddhaloka Mawatha, Colombo 07, Sri Lanka

[3] Department of Bio Systems Technology, Faculty of Technology, Kothalawala Defence University (KDU), Colombo, Sri Lanka

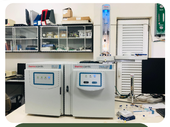
INTRODUCTION

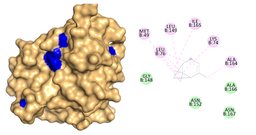


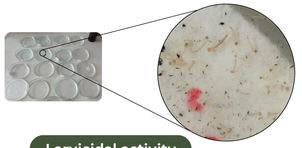
- Mosquito-Borne diseases: Global threat
- Dengu fever, Zika, chickungunya, yellow fever
- Vector: *Ades aegypti*
- High risk to health and well-beings: Tropical and subtropical countries
- Synthetic repellent and larvicide: Health, environmental issues and non-targeted organisms.
- Essential oils: Effective and natural alternative
- Monoterpene compounds: Characteristic odor, high repellency to targeted vectors
- Limitation: High volatility and Less protection time
- Solution: Development of a slow-releasing repellent

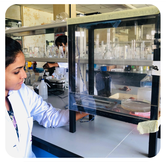
METHODOLOGY

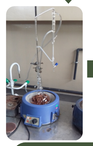
Cymbopogon nardus


GC-MS analysis

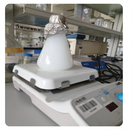

Molecular docking

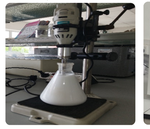

Larvicidal activity


Repellent study

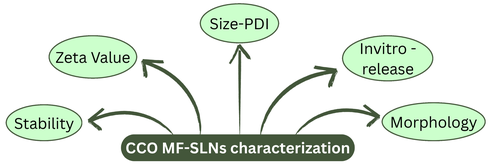

Hydro-Distillation

Fractional distillation





CCO MF-SLNs formualtion



RESULTS & DISCUSSION

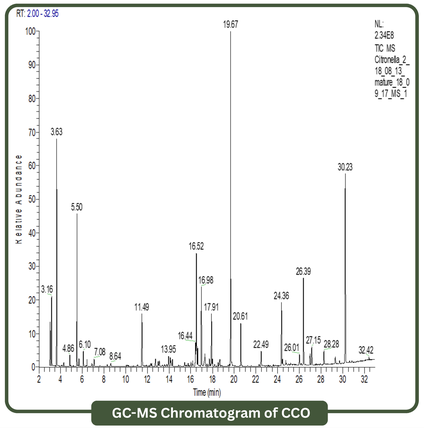
Chemical composition comparison of Ceylon citronella oil (CCO) and Ceylon citronella oil monoterpene fraction (CCO MF)

RI	Compounds	CCO w/w %	CCO MF w/w %
BP		-	150-160 ℃
1016.8	Tricyclene	1.7	6.9
1028.7	α-Pinene	3.2	15.7
1083.1	Camphene	13.8	68.0
1116.9	β-Pinene	0.2	0.6
1259.4	D-Limonene	10.6	5.8
1238.0	trans-β-Ocimene	0.5	TR
1278.1	p-Cymene	0.2	0.2
1487.0	Citronellal	1.6	TR
1552.4	β-Linalool	0.6	TR
1586.1	Bornyl acetate	1.4	ND
1707.8	endo-Borneol	6.8	TR
1728.8	α-Farnesene	1.2	ND
1762.1	Geranyl acetate	5.2	TR
1771.2	Citronellol	3.3	TR
1853.8	Geraniol	18.8	TR
1898.6	Geranyl isobutyrate	2.2	TR
1898.6	Elemol	1.6	ND
2197.3	Methyleugenol	8.7	TR

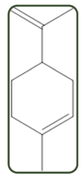
TR-Trace
ND-Not detected

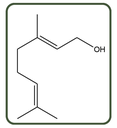
α-Pinene

Camphene

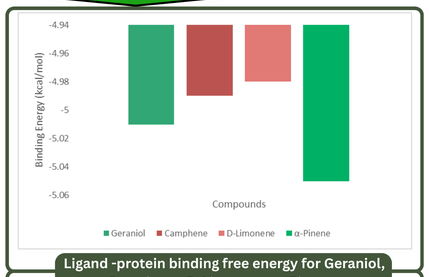


GC-MS Chromatogram of CCO

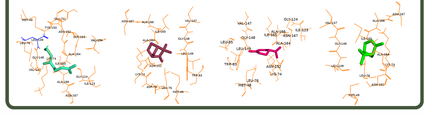

D-Limonene



Geraniol



Ligand -protein binding free energy for Geraniol, Camphene, D-Limonene, α-Pinene

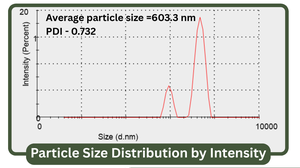


Larvicidal Effect of CCO MF against the Third Stage Larva of *A. aegypti*

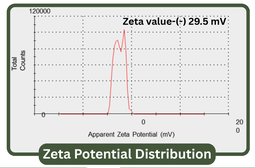
Name of mosquito species	Time	Concentration of CCO MF (ppm)	% Mortality	LC_{50} (ppm)	LC_{90} (ppm)
A. aegypti 3rd stage	24 hrs	25	19.17 ± 3.2[e]	56.39	150.66
		50	36.67 ± 2.7[d]		
		75	52.50 ± 5.7[c]		
		100	70.83 ± 3.2[b]		
		125	92.50 ± 5.7[a]		

Composition of CCO MF-SLNs and Encapsulation efficiency

Formulation	Stearic acid/g	CCO MF/g	Tween 20	Span 80	EE%
CCO MF-SLNs	0.4	0.3	0.7	0.1	69.21±1.28

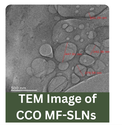


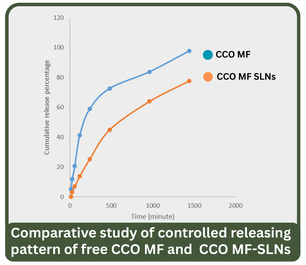
Particle Size Distribution by Intensity



Zeta Potential Distribution

CCO MF-SLNs


TEM Image of CCO MF-SLNs



Comparative study of controlled releasing pattern of free CCO MF and CCO MF-SLNs

Repellency test (BG-cage test)

CONCLUSION

- CCO MF is promising naturally derived, eco-friendly larvicide
- CCO MF-SLNs are suitable for use as a long-lasting repellent in mosquito repellent

REFERENCES

Balasubramani, S., et al., Evaluation of the leaf essential oil from *Artemisia vulgaris* and its larvicidal and repellent activity against dengue fever vector *Aedes aegypti*—an experimental and molecular docking investigation. ACS omega, 2018. 3 (11): p. 15657-15665.

Kelidari, H.R., et al., Solid-lipid nanoparticles (SLNs) containing *Zataria multiflora* essential oil with no-cytotoxicity and potent repellent activity against *Anopheles stephensi*. Journal of Parasitic Diseases, 2021. 45: p. 101-108.

ACKNOWLEDEMENT

Sri Lanka Treasury Grant No. TG 21-202