Controlling rate of release of tsetse fly repellent blend by encapsulating in β-cyclodextrin nanoparticles

Benson Wachira, PhD

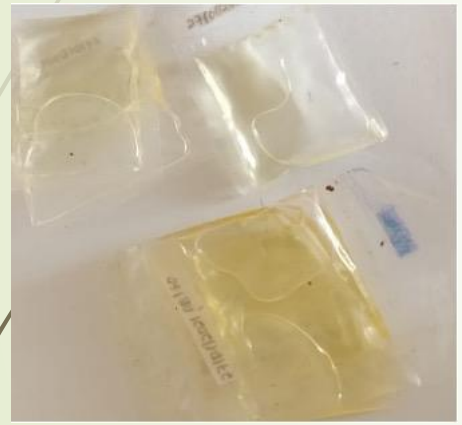
Pwani University, Kenya

Biotechnology Research Institute - Kenya Agricultural and Livestock Research Organization, Kenya

37th General Conference of the International Scientific Council for Trypanosomiasis Research and Control (ISCTRC)
Mövenpick Hotel & Residences Nairobi, Kenya, 15th – 19th September, 2025

Delivery systems

Sachet delivery technology



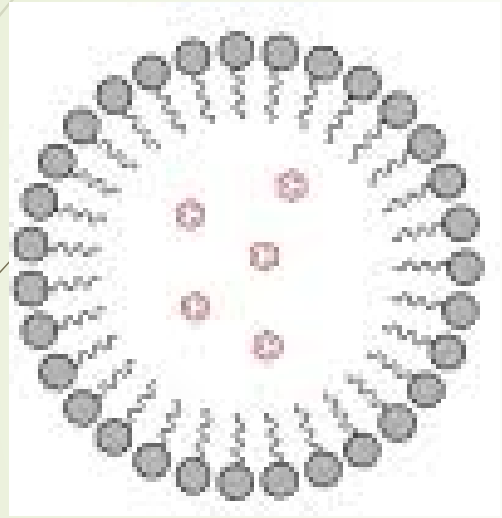
Disadvantages

- Spillages
- Contamination
- Short activity

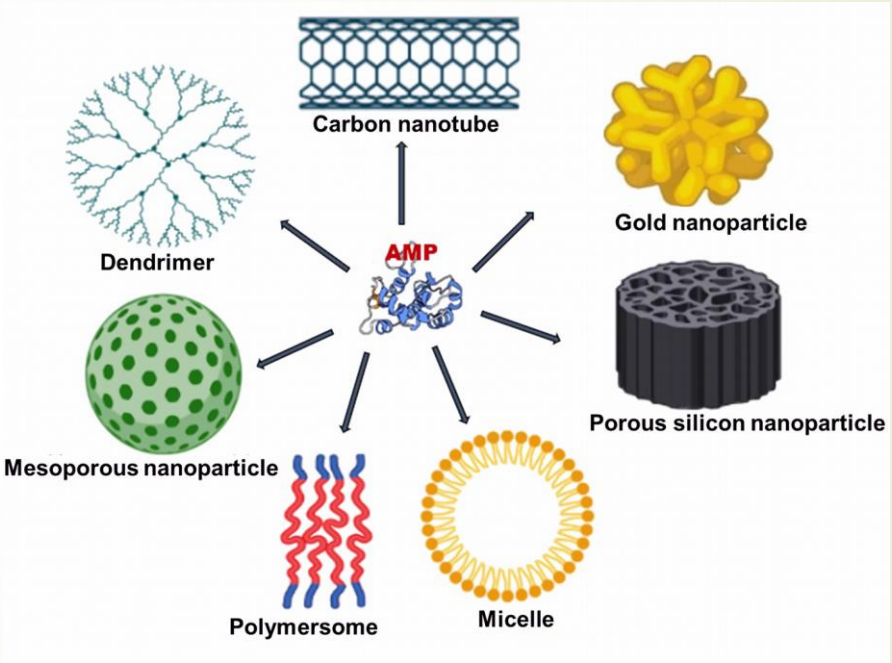


- Unstable to harsh weather
- Environmental pollution
- Uncontrolled release

Alternatives – Nano-encapsulation



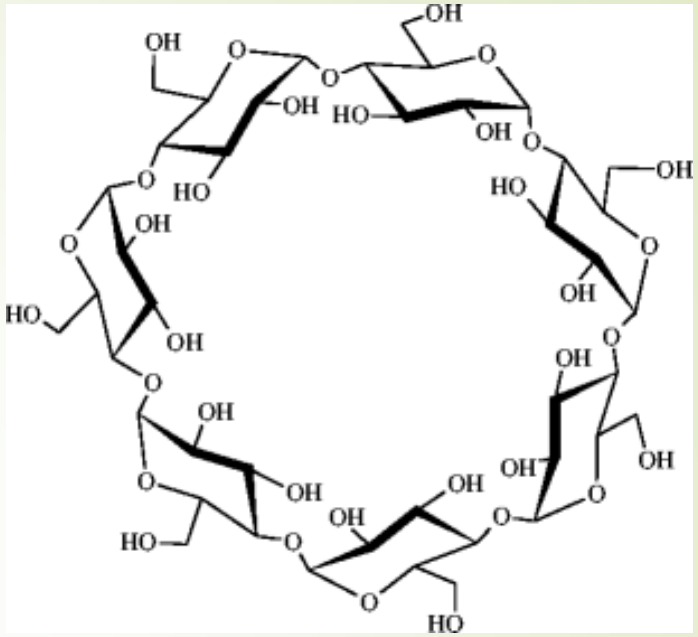
Encapsulation



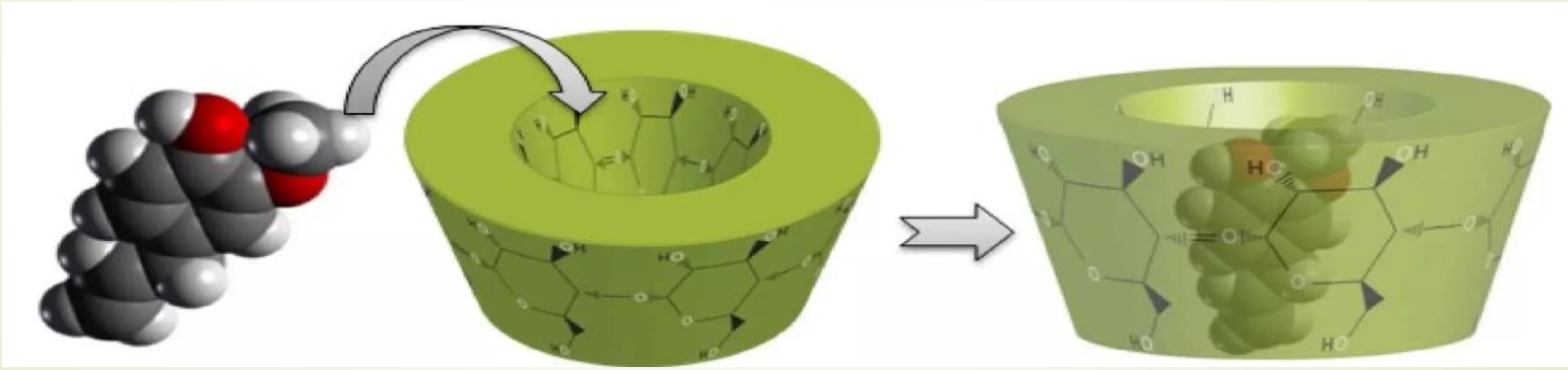
Encapsulating nanoparticles

Properties of cyclodextrin

Property	Cyclodextrin		
	α	β	γ
Molecular weight (D)	972	1135	1297
Water solubility (gm/100mL at 25˚C)	14.2	1.85	23.2
Melting range (˚C)	255-260	255-265	240-245
Cavity diameter (Å)	4.7–5.3	6.0–6.5	7.5–8.3
Outer diameter (Å)	14.6	15.4	17.5
Height (nm)	6	11	17



β-CD

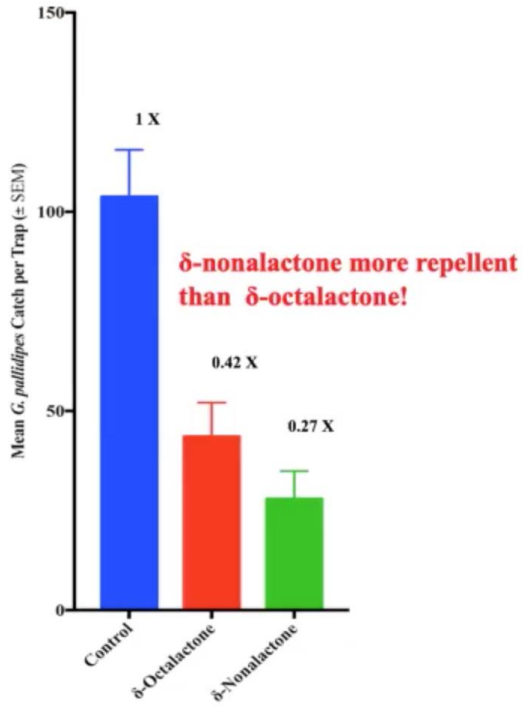


Guest Host Inclusion complex

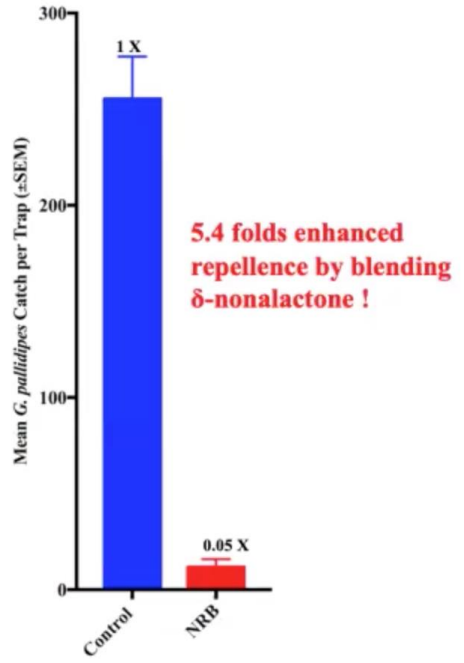
Inclusion complexes Techniques

- **Solvent-based:**
  - ✓ Co-precipitation
  - ✓ Solvent evaporation
- **Solid-state based**:
  - ✓ Kneading,
  - ✓ Spray drying
  - ✓ Freeze-drying (lyophilization)

Field responses of *G. pallidipes* to δ-nonalactone and δ-octalactone



Blending **δ-nonalactone** with **heptanoic acid, 4-methylguaiacol** and **geranyl acetone** (6:4:2:1) **(NRB)**

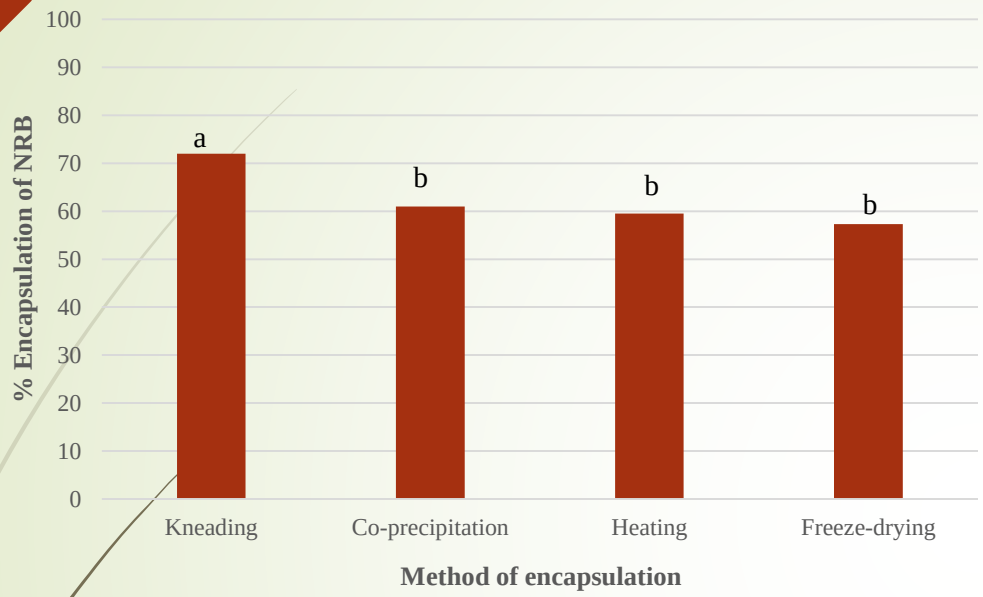


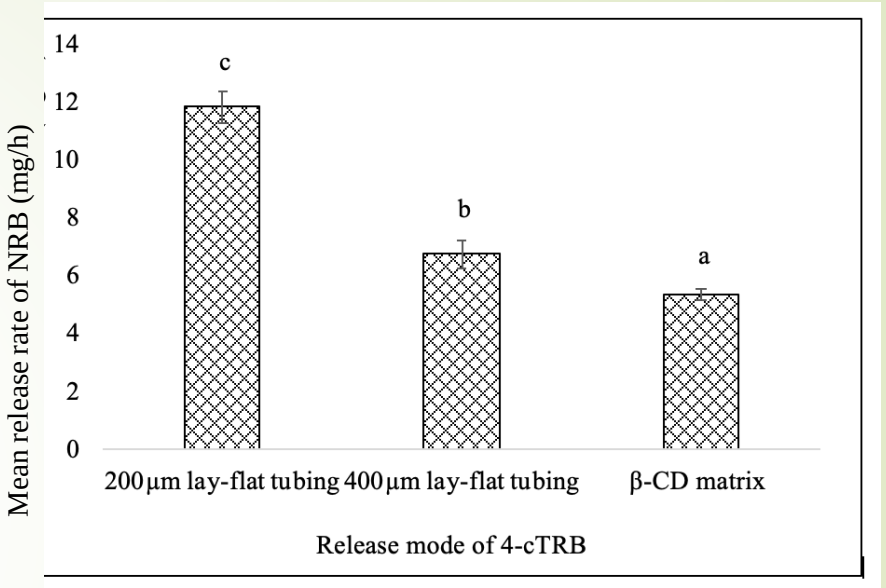
Control= Fermented Cow Urine + Acetone (FCU +A); Treatments = FCU + A + Repellent

Patent: KIPI (KE/P/2020/3617) and ARIPO (AP/P/2020/012514)

Wachira et al. (2016). *Acta Tropica*, *160*, 53–57; Wachira et al. (2020). *Acta tropica*, *211*, 105597

Encapsulation of NRB in β-CD





Mean release rate of NRB in various delivery systems

Gpd catches to baited NG2G trap in NRB

Odor blend	Mean catch ± SE	Catch index[#]
200 µm lay-flat tubing	51.22 ± 6.67[a]	0.19
400 µm lay-flat tubing	58.54 ± 9.26[a]	0.22
Encapsulated♦	64.57 ± 11.35[a]	0.24
Control[¥]	267.12 ± 21.34[b]	1.00

Note: Means followed by different letters are significantly different ($p < 0.05$, LSD post hoc analyses).
[¥]NG2G trap baited with fermented cow urine, acetone, and phenol sachets.
♦Repellent blend encapsulated with ß-cyclodextrin by the kneading process.
[#]Total mean catch expressed as a proportion of that of the blank control trap (reference value).

Conclusions

- β-CD - promising release tool for volatile molecules
- Microencapsulation of NRB in the β-CD complex improves controlled release rate of the blend, which offers prolonged protection against bites by tsetse fly
- This technology provides a potential tool for dispensing tsetse and other related arthropod vector (such as ticks and mosquitoes) repellents/attractants in control programs
- Technology alters solubility, increases stability and decreases volatility of active compounds/blends

Research team



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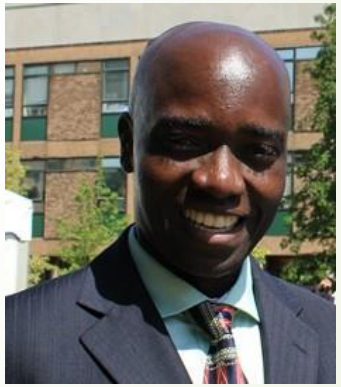
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Thank you