Development and Characterisation of a Novel Antibacterial Drug Delivery System for the Management of Bacterial Vaginosis

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Background

- **Prevalence**: Bacterial Vaginosis affects 23 – 29% of woman globally.
- **Onset**: The vaginal ecosystem gets disrupted by anaerobic bacteria, replacing the resident *lactobacillus* with *Gardnerella Vaginalis*.
- **Treatment**: The standard treatment is antibiotics, commonly Metronidazole (MTZ) or Clindamycin.
- **Problem**: Patients experience 50-80% recurrence rates within 6-12 months after standard treatment.
- **Approach**: Develop an antimicrobial agent delivered locally to enhance treatment efficacy and reduce relapse.

Methodology

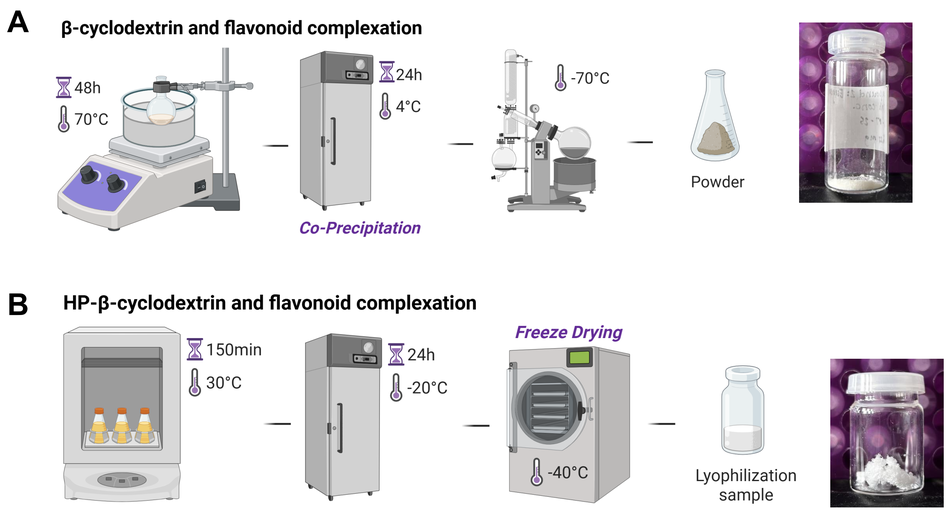


Figure 1: Cyclodextrin complexation methods, A) Co-precipitation and B) Freeze drying.

Results

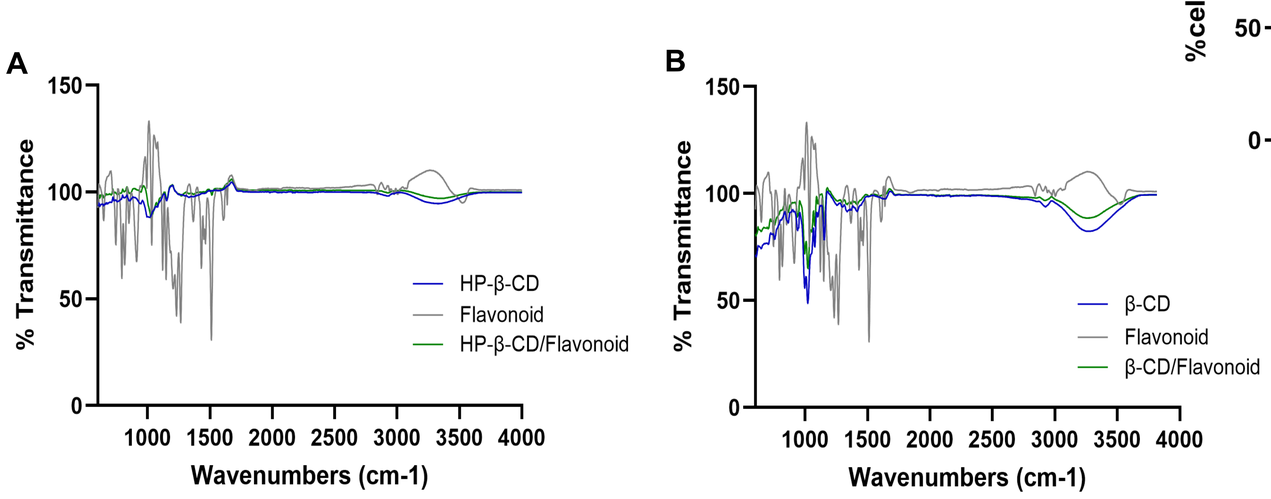


Figure 2: Complexation evaluated with FTIR. A) HP-β-CD/Flavonoid, B) β-CD/flavonoid, C) Thermal shifts of β-CD/Flavonoid shown with TGA

FTIR indicated minor spectral changes of cyclodextrin and minimal signs of flavonoid bands, while TGA showed increased thermal stability of the β-CD complex, supporting host–guest interaction; however, ^{1}H NMR showed minimal chemical shift changes and no distinct flavonoid signals.

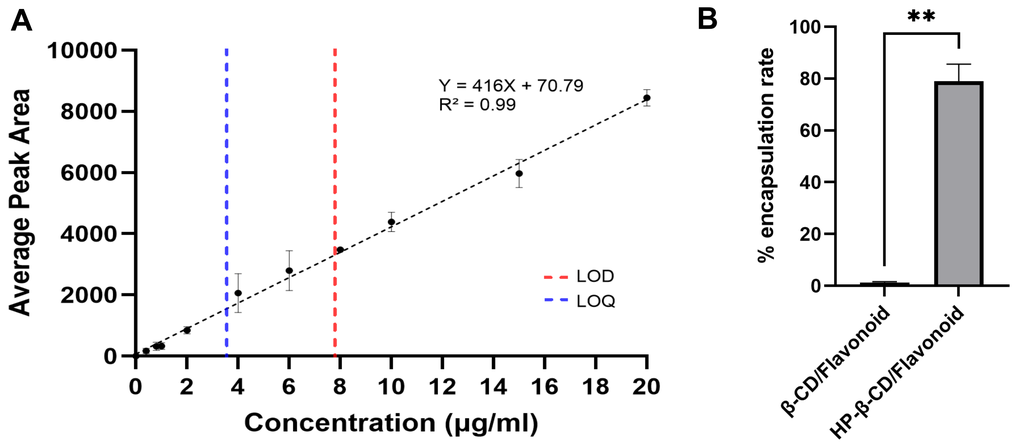
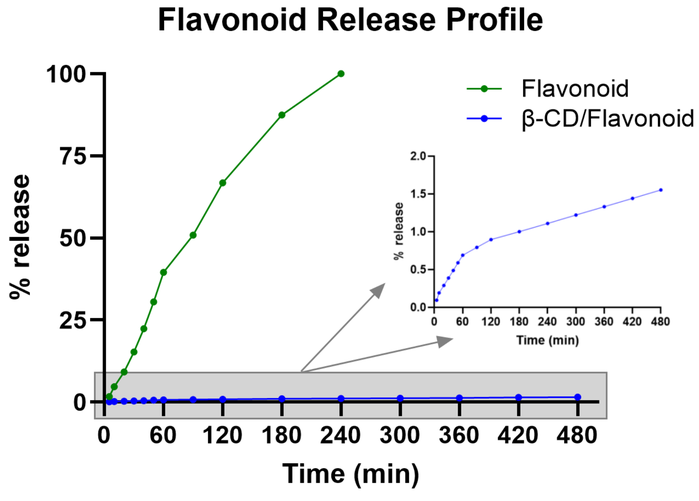


Figure 3: A) Flavonoid standard curve, B) flavonoid encapsulation rate

HPLC standard curve for flavonoid showed low LOD and LOQ with R_2 <0.99. A significantly lower encapsulation rate was observed for β-CD compared to HP-β-CD.



The release profile via a membrane model for β-CD/Flavonoid complex were significantly slower than the control, supported with the low encapsulation rate.

Figure 4: Flavonoid release profile within 4 hours and β-CD complex release over 8 hours

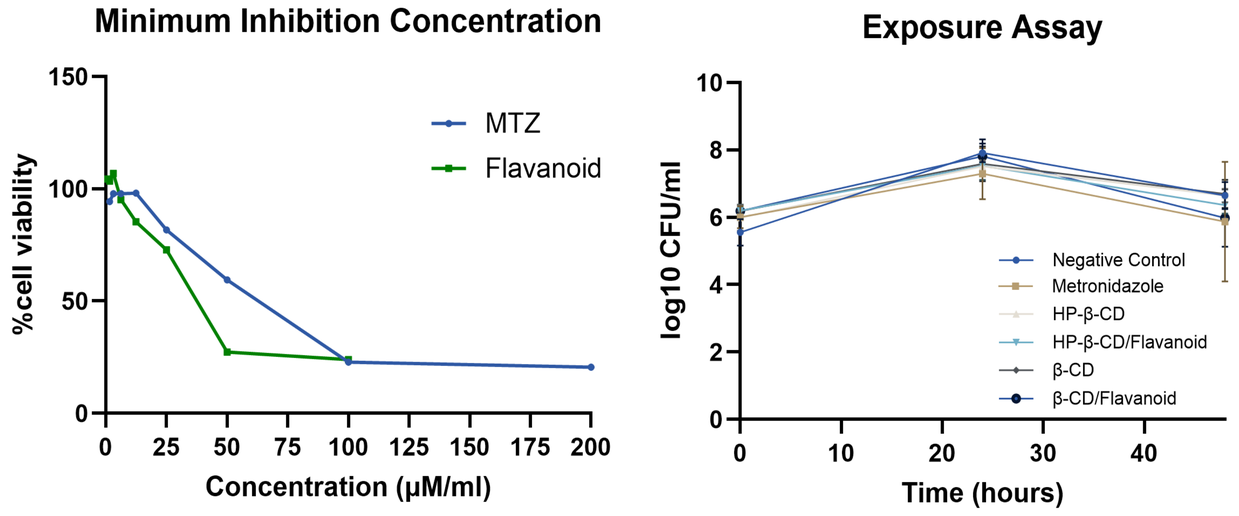
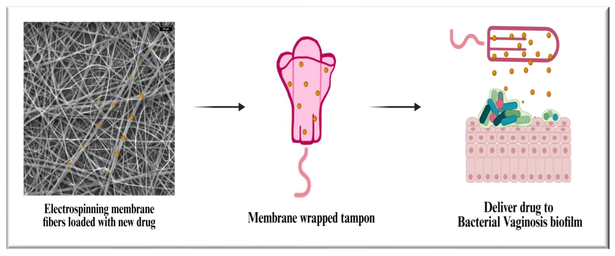


Figure 5: Antibacterial activity against strain NCTC 10287

MTZ required twice the concentration (100µM) as the flavonoid (50µM) to obtain similar bacterial inhibition. The exposure assay were performed at ~2× MIC concentration, which showed bacteriostatic activity after 48h for both complexes compared to controls. Overall, inclusion complexation showed inhibition of bacterial growth, indicating a potential role in modulating antimicrobial exposure and efficacy over time.

Conclusion and Future research

Cyclodextrin complexation enabled partial encapsulation and improved antimicrobial performance, supporting its potential for intravaginal delivery, though optimisation is required to enhance efficacy.



Acknowledgements and References

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