Development, Purification and Characterization of a Novel Lipid-Polymer Hybrid Nanocarrier (Liposomes Encapsulating Polymeric Micelles or 'LipoCells')

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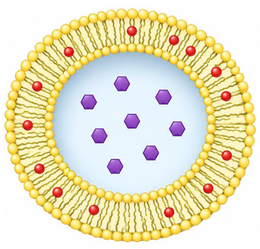
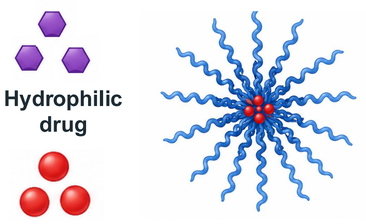
THE CHALLENGES

Two established classes of nanocarrier- Polymeric Micelles (PMs) and Liposomes solve different delivery problems, but each has limitations.



Liposome

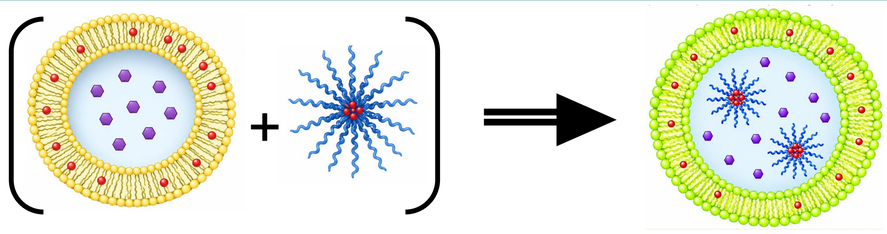
Tend to leak hydrophobic drugs



PMs

Useful for poorly soluble drugs, Difficulty loading hydrophilic drug
Vulnerable to dilution

Merging Liposome and Polymeric Micelle Hybrid 'LipoCell' as a solution



[Lipid vesicle shell + encapsulated PMs] = LipoCell

HYPOTHESIS

1 Hybrid LipoCells (HLC) may **integrate complementary advantages** of liposomes and PMs.

2. HLC will **slow down the release** of drugs than that of single nanocarrier system (liposomes and PMs)

KEY TAKEAWAY

1. Development

Post film-hydration **freeze–thaw cycles** proved to increase micelle entrapment and generate a structurally distinct hybrid nanocarrier (LipoCell)

2. Purification

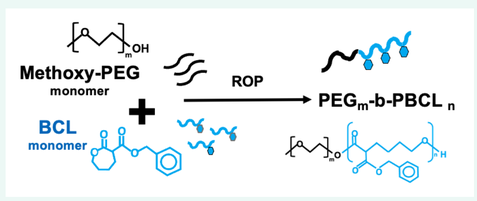
Sucrose density gradient centrifugation (SDGC) separates low-density LipoCell fractions from denser free PMs.

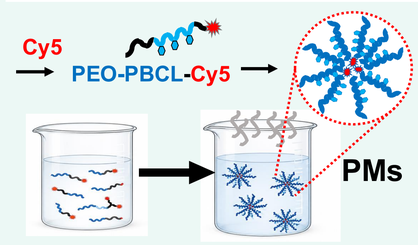
3 Structure Characterization

Correlative STEM–SEM and **CFFF** provides structural and morphological **characterization**

METHODS: FORMULATION, PURIFICATION, AND CHARACTERIZATION

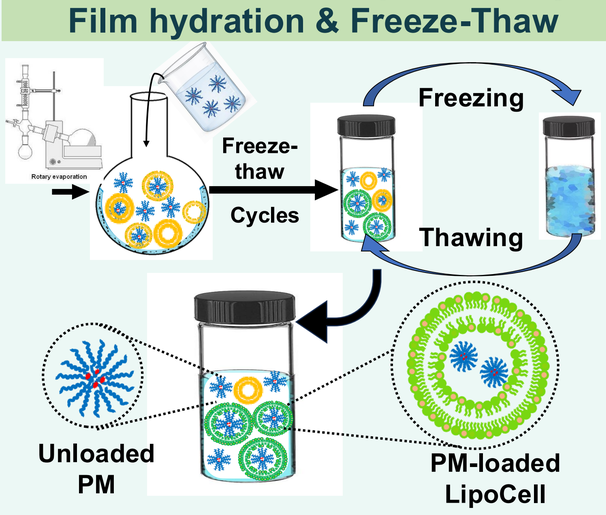
1. Formation of PEG-b-PBCL Polymeric Micelles (PMs)





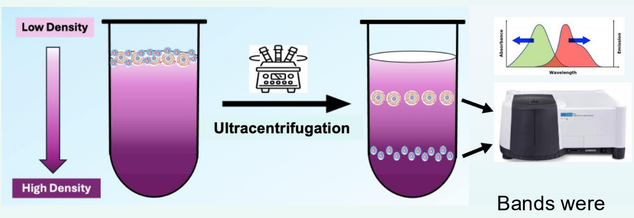
Self-assembly of PEG-b-PBCL PMs

2. Formation of LipoCells by Film hydration & Freeze-Thaw



Lipid film hydrated with PM dispersion; followed by freeze–thaw cycles

3. SDGC purification



Bands were fluorescently analyzed

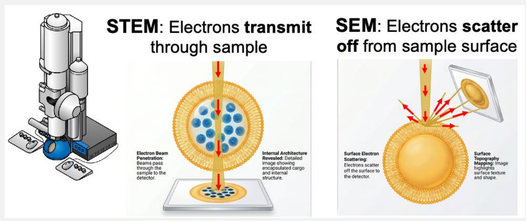
high to low sucrose density tube (bottom to top),, sample added on top and centrifuged

Unencapsulated PMs and LipoCells retained at specific sucrose layers

SDGC separates LipoCells from free PMs.

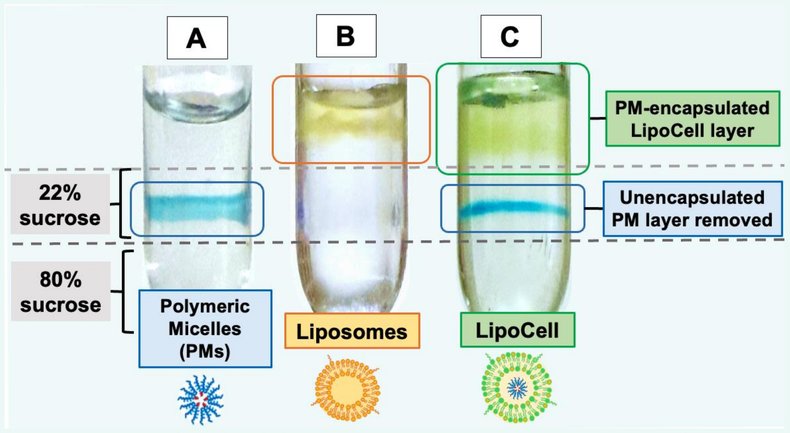
4. Characterization

Morphological Characterization by Electron Microscopy- Correlative STEM-SEM imaging



RESULTS AND CONCLUSION

1 Sucrose Density Gradient Centrifugation (SDGC) to separate LipoCell from un-encapsulated PMs



Distinct bands after SDGC show density-based separation of population

2 Freeze-thaw cycles increase PM entrapment in LipoCells

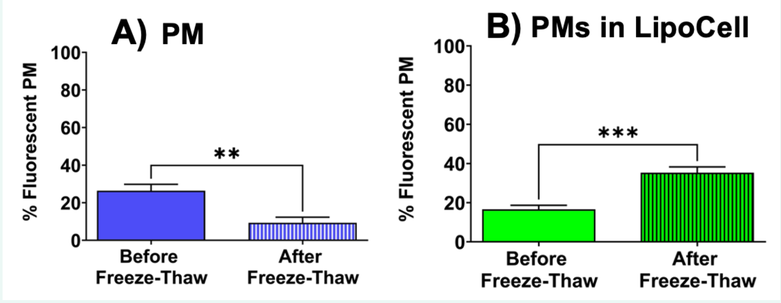
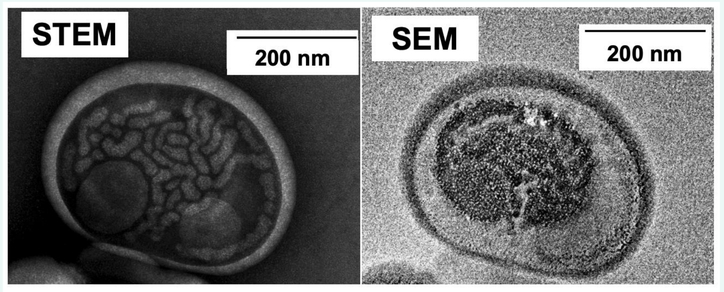
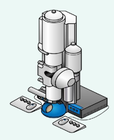


Fig R2: %Cy5-PM in the top 22% sucrose before and after FT treatment (A) PM density post-FT is higher, (B) PM-entrapment reduces PM retention at 22% layer than PM-only controls; proves in PM-entrapment in LipoCells

3 Correlative STEM-SEM imaging shows Proof of PM-entrapment

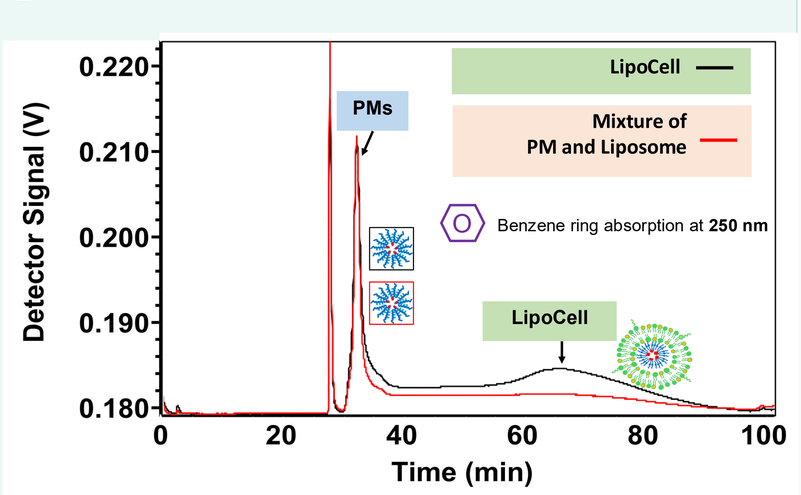


***STEM** reveals internal PMs withing LipoCell*



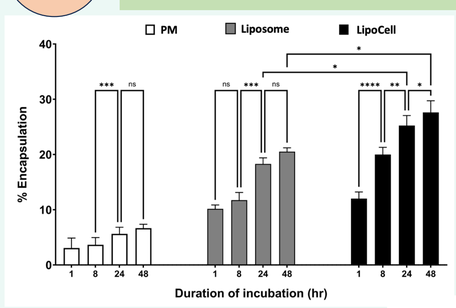
***SEM** shows surface topography from the same region*

4 Proof of PM-entrapment in LipoCells using CFFF

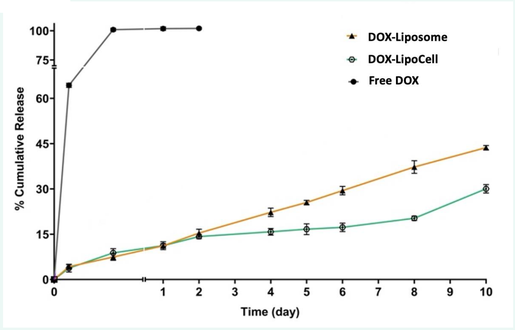


*LipoCell sample shows **absorption at UV 250** nm associated with **benzene ring containing PM-** evidence of PM-entrapment*

5 DOX Encapsulation and Release



LipoCells show higher DOX encapsulation than liposomes and PMs



LipoCells show slower DOX release than liposomes

CONCLUSIONS

Development of Hybrid Nanocarrier Combining Liposome and Polymeric Micelle (LipoCell)

Purification of unloaded PMs from the LipoCells by SDGC

Characterization and Proof of Micelle Entrapment by Correlative STEM-SEM and FFF

Distinct Drug Loading and Release Pattern

Future Direction

The developed HLCs can serve as a platform for the **co-encapsulation of drugs with contrasting hydrophilic/lipophilic** properties

ACKNOWLEDGEMENTS

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Watch a 5 min poster presentation

LinkedIn

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