Intranasal Cannabidiol Microemulsion: Design and Characterization for Brain Delivery

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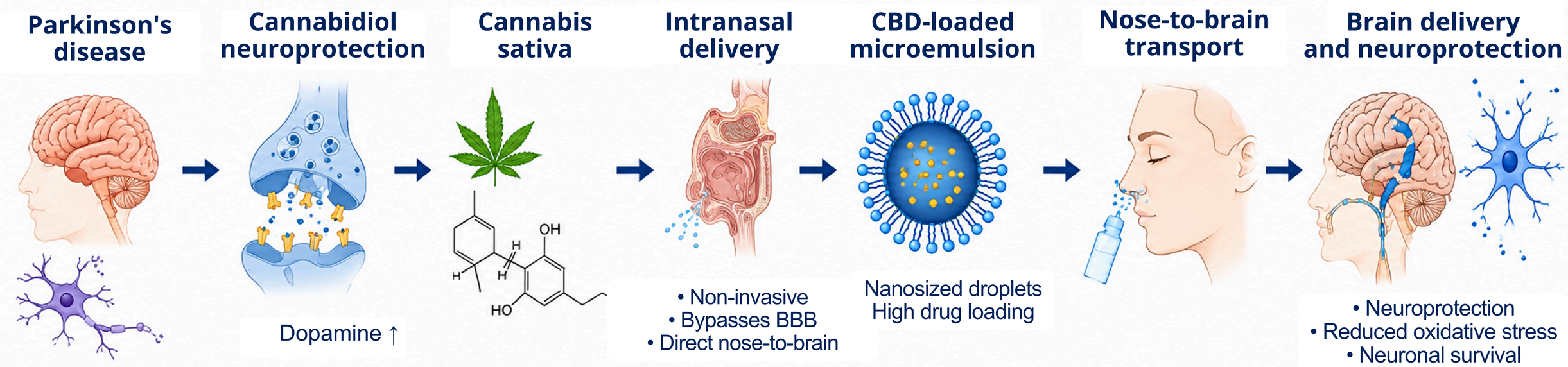
Introduction and Objective



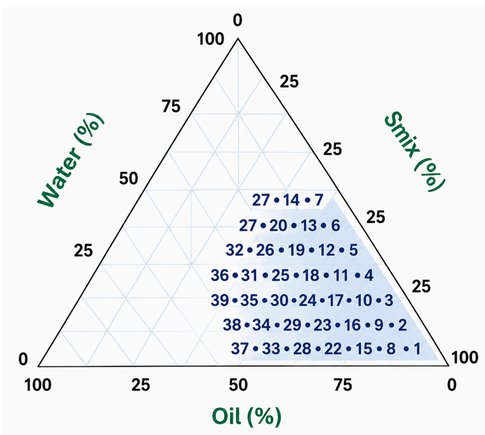
Objective: To develop and characterize a cannabidiol-loaded microemulsion for intranasal administration as a potential nose-to-brain delivery system for Parkinson's disease treatment.

KEY RESULTS

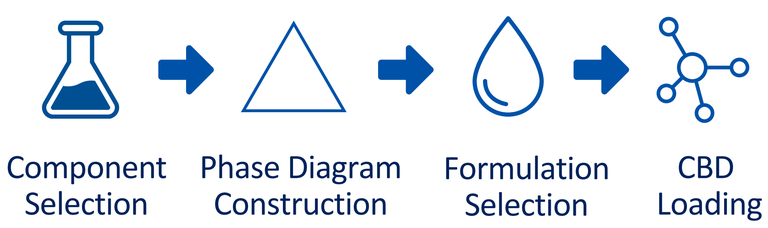
- **104 nm** — Droplet size
- **PDI 0.174** — Narrow distribution
- **-21.24 mV** — Zeta potential
- **99.1% EE** — Encapsulation efficiency

FORMULATION DEVELOPMENT

PSEUDOTERNARY PHASE DIAGRAM



FORMULATION SCHEME



SELECTED FORMULATION (ME-CBD)

20% Oill
50% Smix
30% Water
0,15% CBD (w/v)

PHYSICOCHEMICAL CHARACTERIZATION

FIGURE 1. DLS - Size Distribution

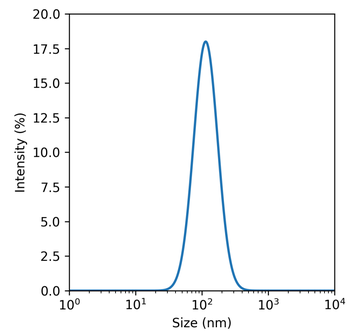


FIGURE 2. Zeta Potential

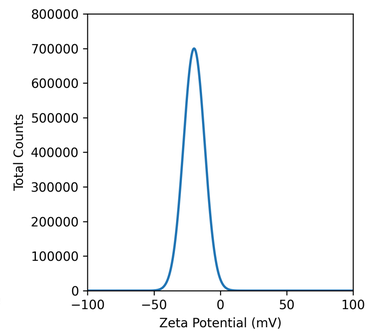
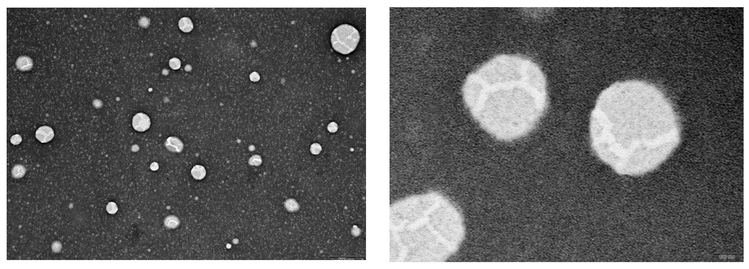
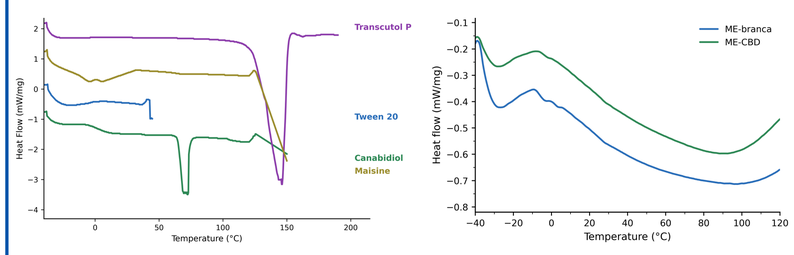


FIGURE 3. TEM Micrograph



Uniform, spherical droplets with nanoscale size.

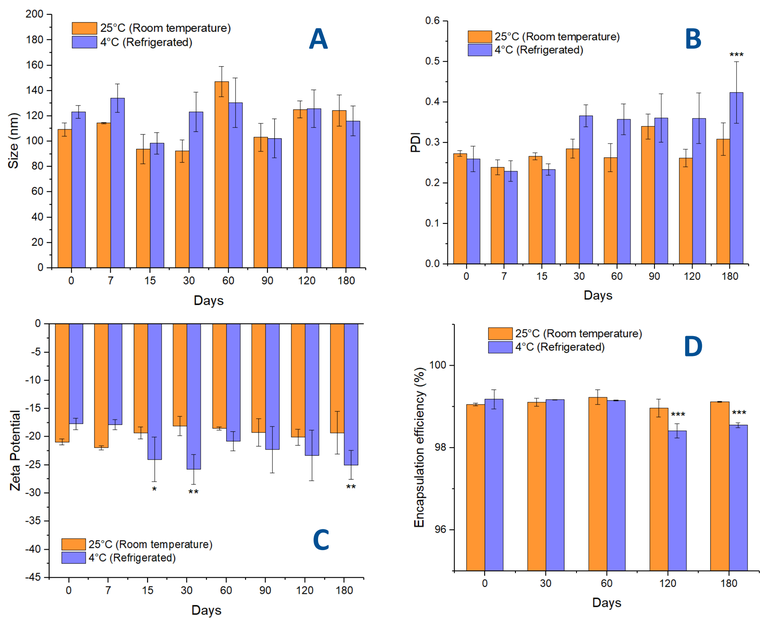
FIGURE 4. DSC Thermograms



Absence of característic CBD melting peak - Amorphous state / CBD molecular dispersion

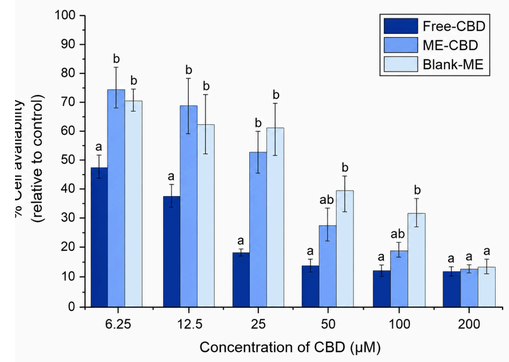
STABILITY AND BIOCOMPATIBILITY

FIGURE 5. Stability of the microemulsions during 180 days: (A) Droplet Size, (B) PDI, (C) Zeta Potential, (D) EE%.



180 days of stability - EE% > 94% - No phase separation

FIGURE 6. Cytotoxity in hCMEC/D3 Cells (24h)

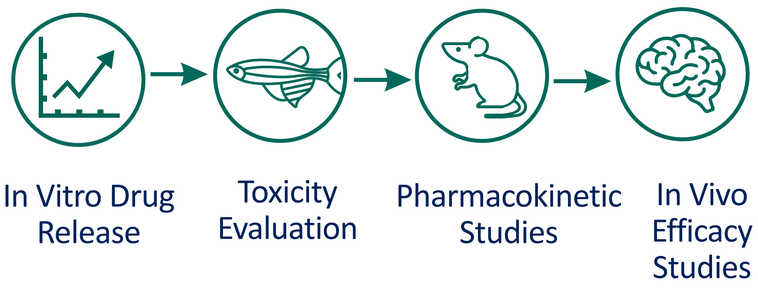


CBD-loaded microemulsion showed low cytotoxicity in hCMEC/D3 cells.

CONCLUSIONS

- Stable CBD-loaded microemulsion successfully developed.
- Mean droplet size around 104 nm with narrow distribution.
- Zeta potential around −21 mV and
- Encapsulation efficiency above 99%.
- No phase separation observed after 180 days.
- CBD remained molecularly dispersed within the formulation.
- Reduced cytotoxicity compared with free CBD.
- Promising platform for intranasal nose-to-brain delivery.

FUTURE PERSPECTIVES



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References: Wang L et al. Mol Pharmaceutics. 2025;22:4804–4818. / El Ghachi H et al. Open Medicine. 2024;19:20241075. / Nishigandha N et al. Asian J Pharm Res Dev. 2023;11:173–180.