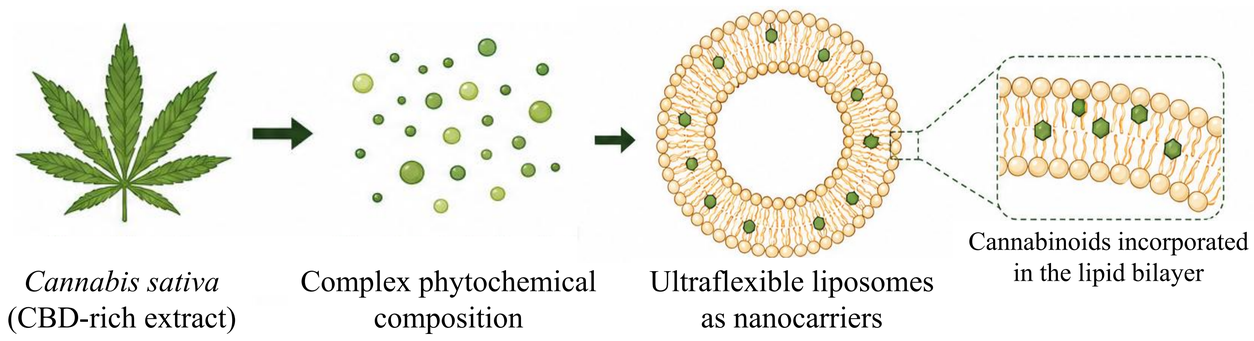
Development of liposomes loaded with *Cannabis sativa* extract using a quality-by-design approach

Luiza Aparecida Luna Silvério[1]; Nicole Ferrari de Carvalho[1]; Janaína Artem Ataide[1,2]; Priscila Gava Mazzola[1]
[1]Faculdade de Ciências Farmacêuticas, Universidade de Campinas (UNICAMP), Campinas, São Paulo, Brazil. [2]School of Pharmaceutical Sciences of Ribeirão Preto, University of São Paulo (USP), Ribeirão Preto, Brazil.
E-mail: luiza_luna_silverio@hotmail.com

1 Introduction



Cannabis sativa (CBD-rich extract) → Complex phytochemical composition → Ultraflexible liposomes as nanocarriers

Why does this matter?

- Natural extracts are increasingly used as therapeutics
- Their complexity challenges conventional nanocarrier design
- QbD provides a predictive framework for reproducible manufacturing

Aim: How do formulations variables affect encapsulation and size?

2 Methods

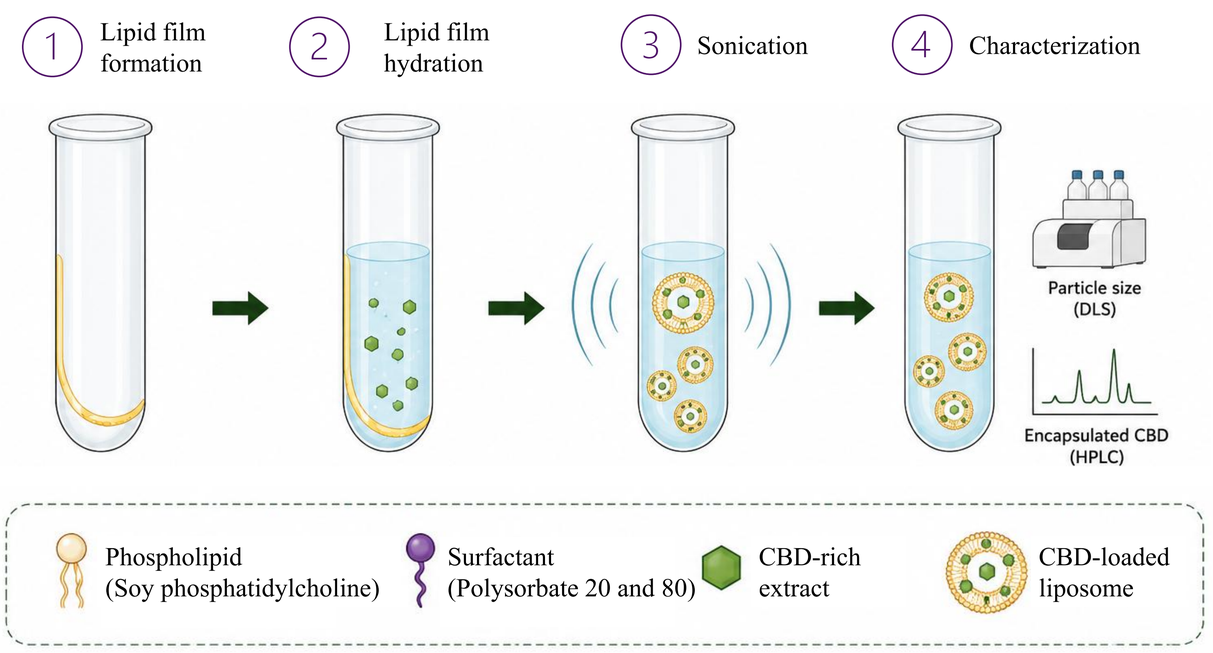


Table 1: Independent and Dependent Variables of the 2^3 Factorial Experimental Design

Independent variables	Levels		
	Low (-1)	High (+1)	Central point
A: Ratio PC:EA (%)	10	20	15
B: Sonication time (min)	5	30	17,5
C: Ratio extract:lipids (%)	10	50	30
Dependent variables	**Goal**		
Mean size (nm)	Minimize		
CBD encapsulated (µg/mL)	Maximize		

3 Results

Figure 1: Pareto chart showing the effects of phosphatidylcholine-to-surfactant ratio (A), sonication time (B), extract-to-lipid ratio (C), and their interactions on encapsulated CBD and mean vesicle size for formulations containing polysorbate 20 (I and II) and polysorbate 80 (III and IV). Bars exceeding the significance limits indicate statistically significant effects.

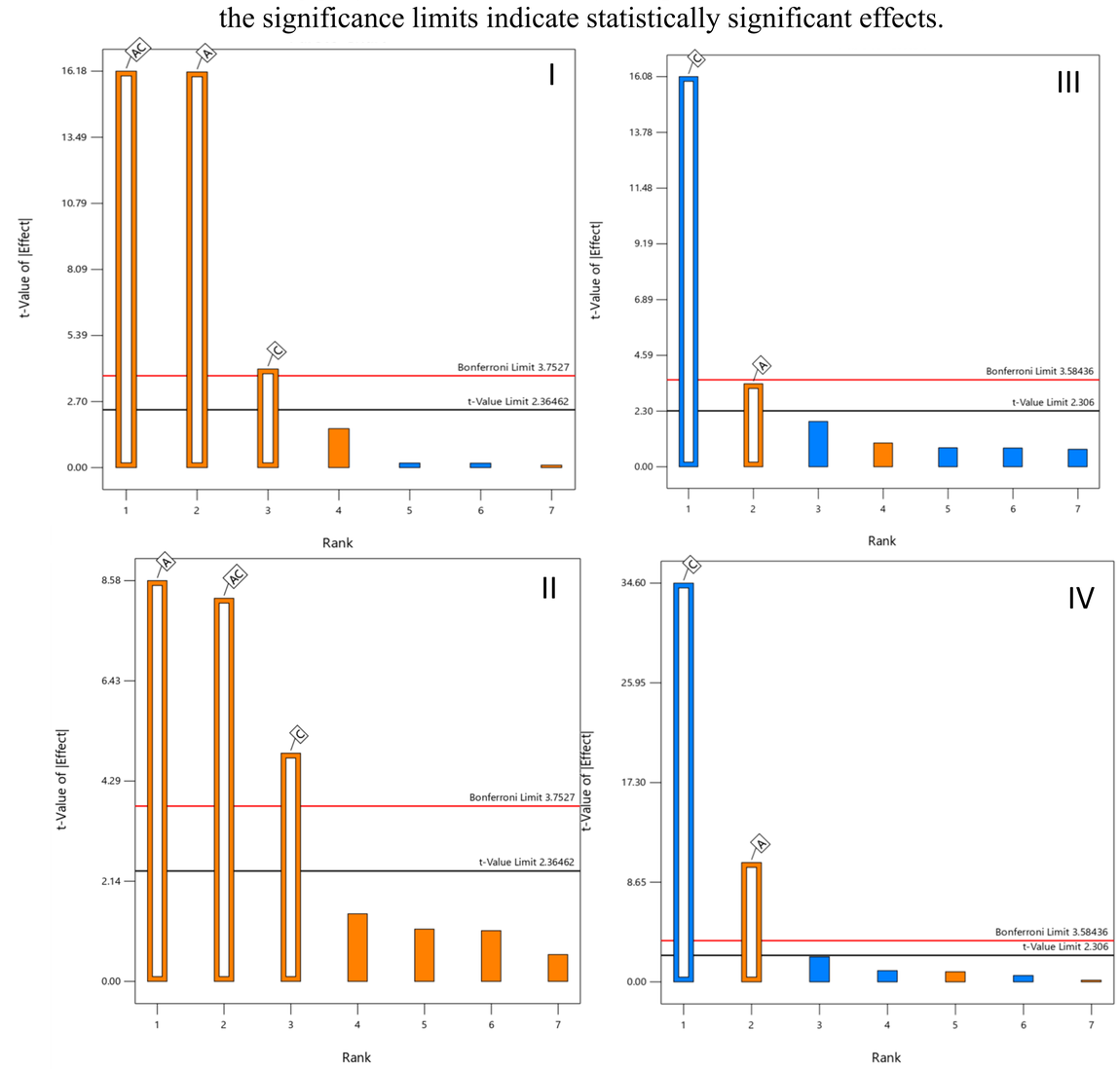
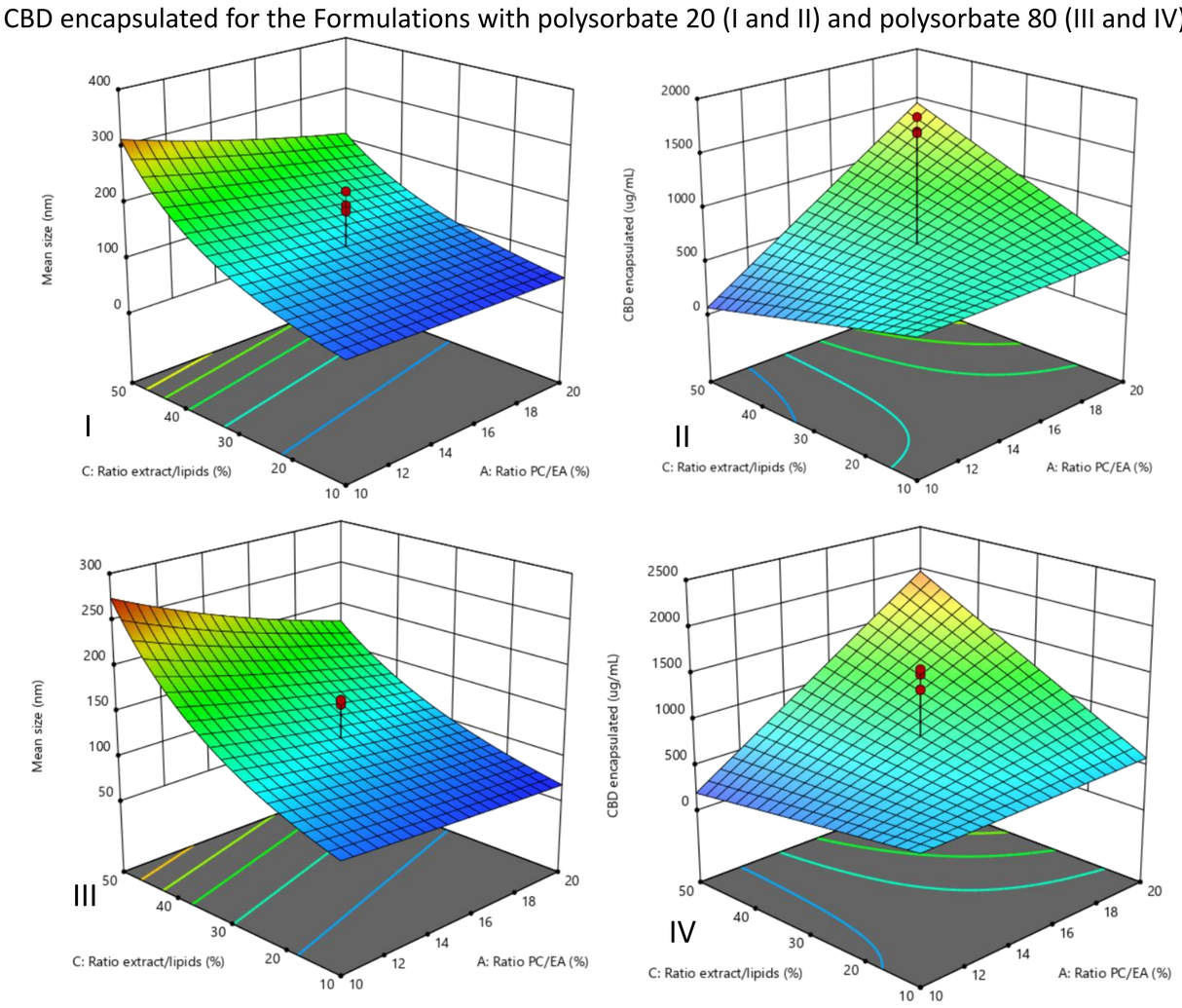


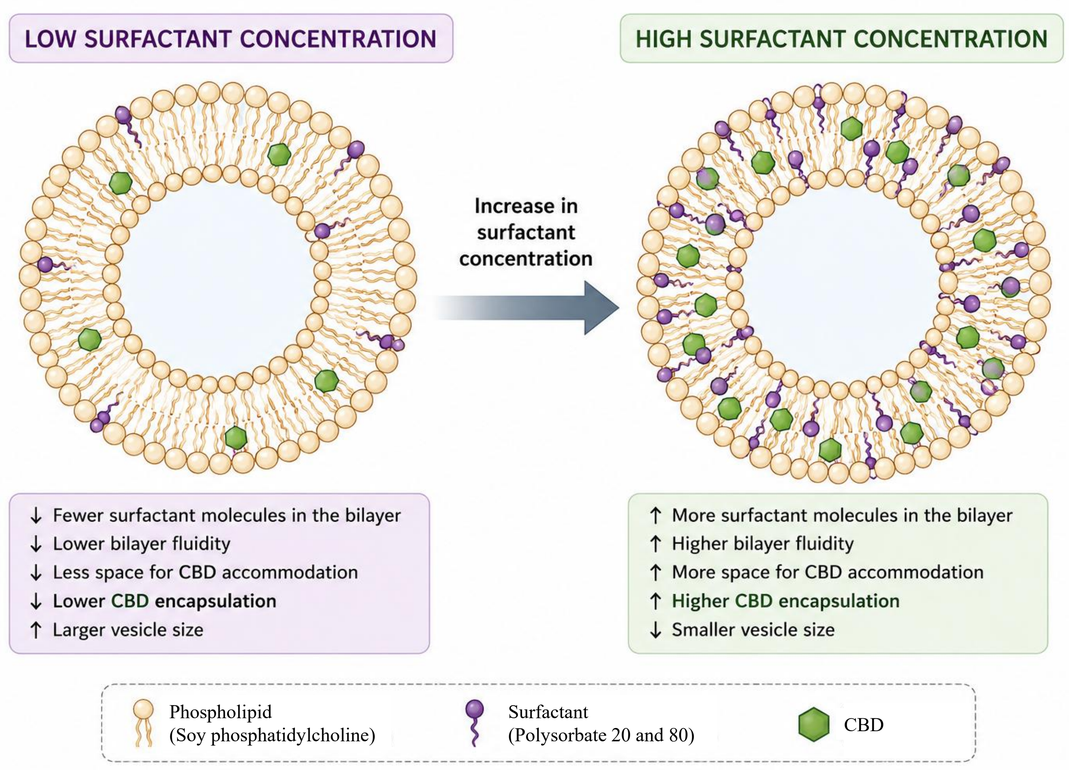
Figure 2: Three-Dimensional Illustration of the Independent Variables (A and C) on the Mean Size and CBD encapsulated for the Formulations with polysorbate 20 (I and II) and polysorbate 80 (III and IV)



4 Conclusion

- Increasing surfactant concentration reduced particle size and enhanced CBD encapsulation
- Extract concentration positively affected both vesicle size and encapsulated CBD
- Polysorbate 80 generated smaller vesicles than polysorbate 20 across the design space

5 Proposed mechanism



Acknowledgements

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CAPES

References

Contacts