Toxicity evaluation of Solid Lipid Nanocarriers using *in vitro* and *in vivo* approaches

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INTRODUCTION & AIM

Solid lipid nanocarriers (SLNs) are promising systems for drug delivery due to their ability to protect, control, and target active compounds. However, their biological safety must be carefully evaluated. This study investigates the toxicity of SLNs with different surface charges using both *in vitro* and *in vivo* models.

METHOD

In vitro:

Human neonatal dermal fibroblasts (HDFn) were exposed to SLNs with positive (SLN^+) or negative charged (SLN^-) surface charges, and their individual components (Precirol® ATO 5 , Benzalkonium chloride and Tween® 80) for 24 and 48 hours. Cell viability was assessed using the MTT assay.

In vivo:

***Drosophila melanogaster* flies** were treated with various concentrations of SLNs (10, 20, and 100 µg/mL) and their components. Evaluations included egg count, hatching rate, sex distribution across multiple generations (P0, F1, and F2), and daily survival monitoring.

RESULTS & DISCUSSION

1. SLN^+ showed greater cytotoxicity *in vitro*, likely due to the presence of benzalkonium chloride.
2. SLN^- preserved cell viability, suggesting better biocompatibility.
3. *In vivo*, no significant effects on reproduction, survival, or sex ratios were observed in *Drosophila*.
4. These results highlight the role of surface charge in cytotoxicity and the relevance of *in vivo* validation.

In vitro assay

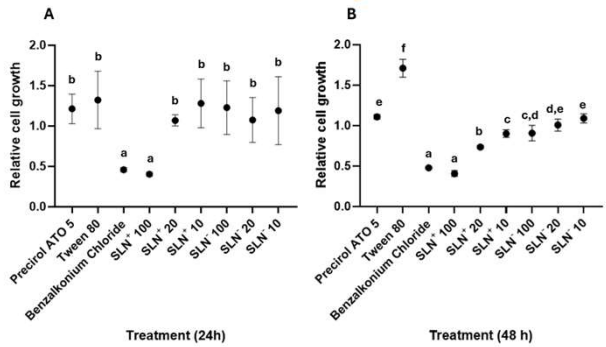

Figure 1. Relative HDFn cell growth after 24- (A) and 48-hours (B) exposure to SLN^+ and SLN^- at different concentrations (10, 20, and 100 µg/mL), and their components (Precirol® ATO 5, Tween® 80 and benzalkonium chloride). Different letters indicate statistically significant differences between the tested formulations.

In vivo assay

Assay 1: Effect in the First generation (F1)

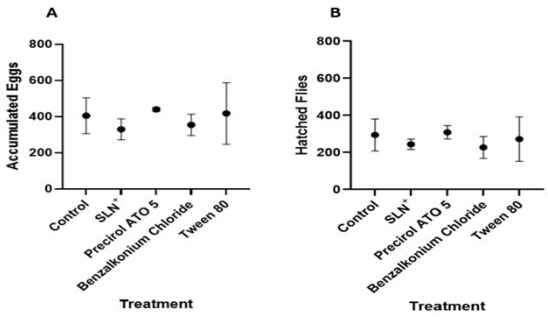

Figure 2. Average number of eggs deposited (A), and flies hatched (B) after continuous exposure to different treatments: SLN^+, Precirol ® ATO 5, Benzalkonium chloride, and Tween ® 80.

Assay 2: The sex influence on toxicity

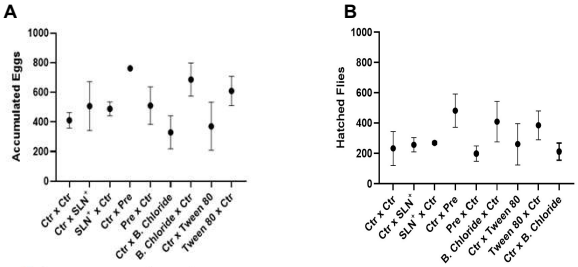

Figure 3. Average number of eggs accumulated (A) and hatched flies (B) after the cross of untreated flies and flies treated with different treatments (The crosses represented are Control x Control, Control x SLN^+, SLN^+ x Control, Control x Precirol ® ATO 5, Precirol ® ATO 5 x Control, Control x Benzalkonium chloride, Benzalkonium chloride x Control, Control x Tween ® 80, Tween ® 80 x Control. Crosses are represented in female x male form.).

Assay 3: Mortality evaluation

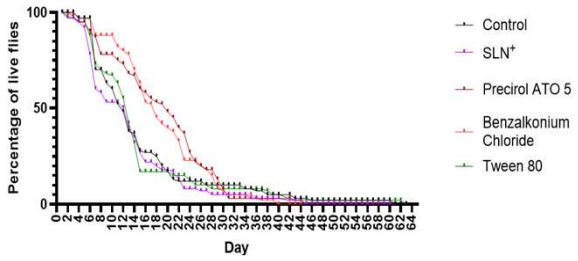

Figure 4. Percentage of live flies over time across different treatments (SLN^+, Precirol® ATO 5, Benzalkonium chloride and Tween® 80). Flies were kept at 25ºC, and the diet was renewed weekly to prevent F1 hatching.

CONCLUSION

SLNs hold potential as drug delivery platforms, but surface charge plays a crucial role in cytotoxic behavior. *In vitro* assays revealed increased toxicity for SLN^+, while *in vivo* assays showed no adverse effects on *Drosophila* reproduction or viability. Continued research is necessary to balance safety and effectiveness in future SLNs.

FUTURE WORK / REFERENCES

1) Danaei M., et al. Impact of Particle Size and Polydispersity Index on the Clinical Applications of Lipidic Nanocarrier Systems. Pharmaceutics. 2018; 10:57.
2) Müller, R., et al. (2000). Solid lipid nanoparticles (SLN) for controlled drug delivery: a review of the state of the art. European Journal of Pharmaceutics and Biopharmaceutics, 50(1), 161–177.

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