ARC CTET Training Centre for Cell & Tissue Engineering Technologies

A Delayed Release Implant made of Poly(glycolide-*co*-trimethylene carbonate-*co*-ε-caprolactone)

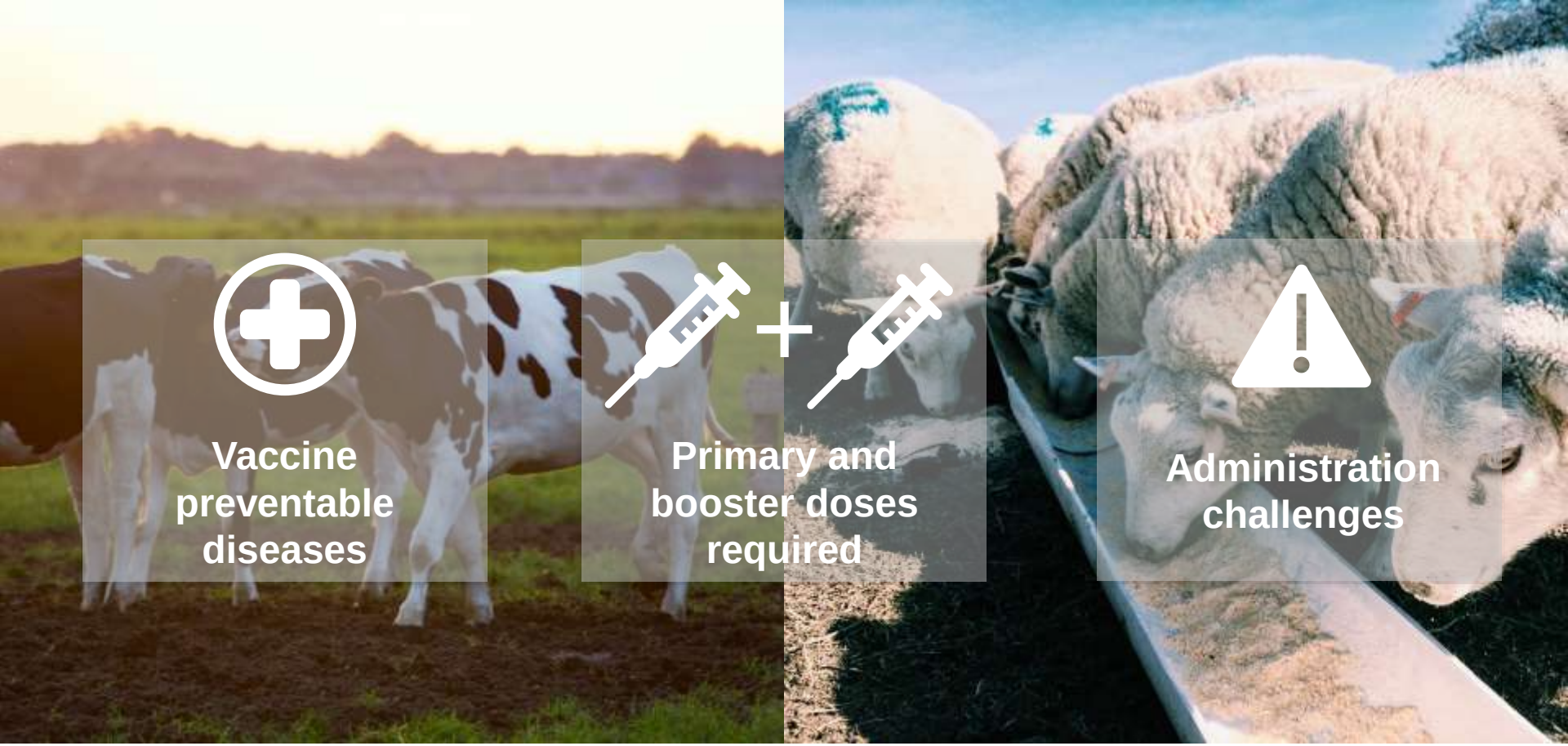
Presented by Norman Ilich

38 APS, New Zealand | February 2024

QUT

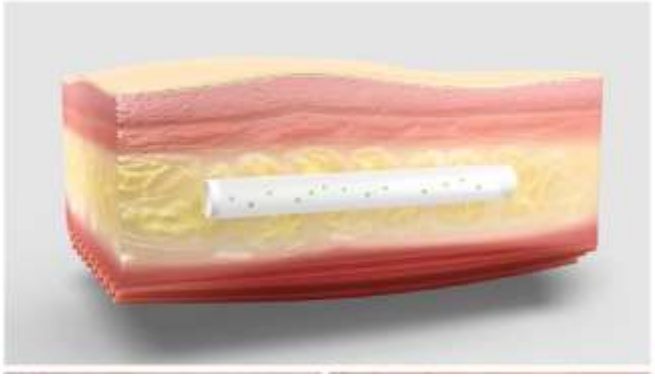
MONASH University

Australian Government
Australian Research Council


Vaccine preventable diseases
Primary and booster doses required
Administration challenges

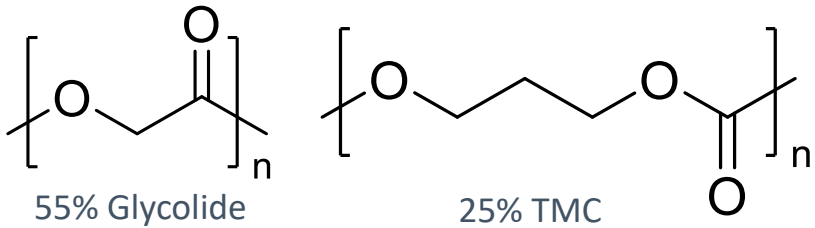
ARC CTET

Bioresorbable Polymers



Melchels FPW, Fehr I, Reitz AS, Dunker U, Beagley KW, Dargaville TR, et al. Initial design and physical characterization of a polymeric device for osmosis-driven delayed burst delivery of vaccines. Biotechnology and Bioengineering. 2015;112(9):1927-35.

Poly(glycolide-co-trimethylene carbonate-co-ε-caprolactone) P(GA-TMC-CL)



55% Glycolide

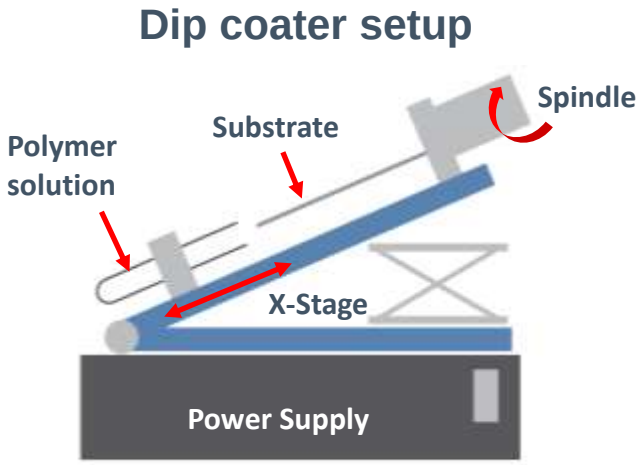
25% TMC

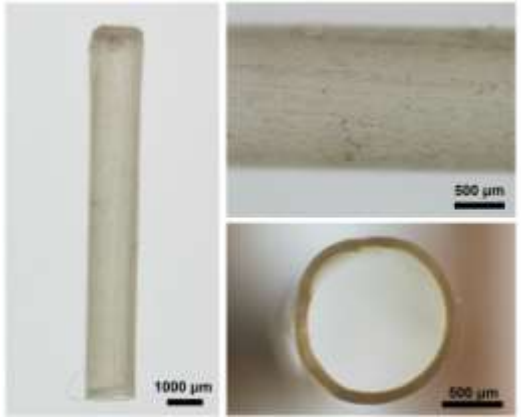
20% Caprolactone

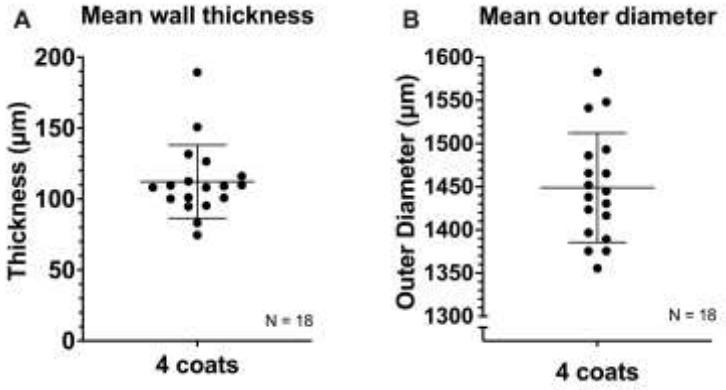
T_m = 190°C T_g = -20°C

ARC CTET

Implant Fabrication





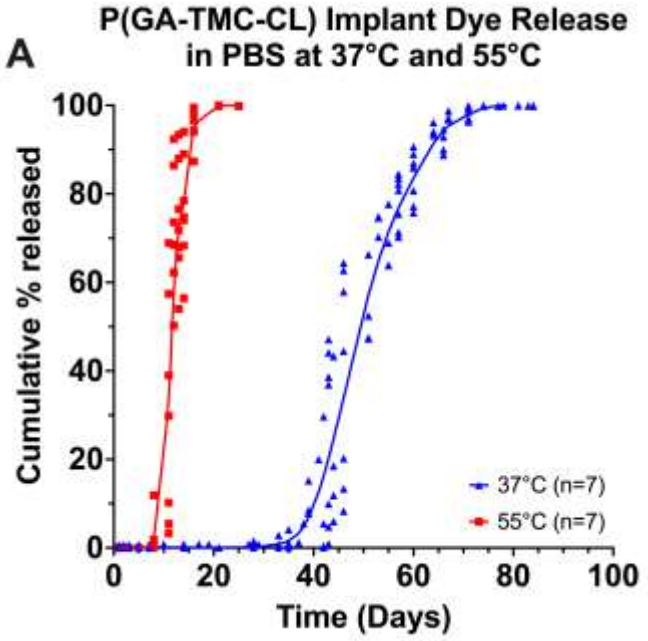


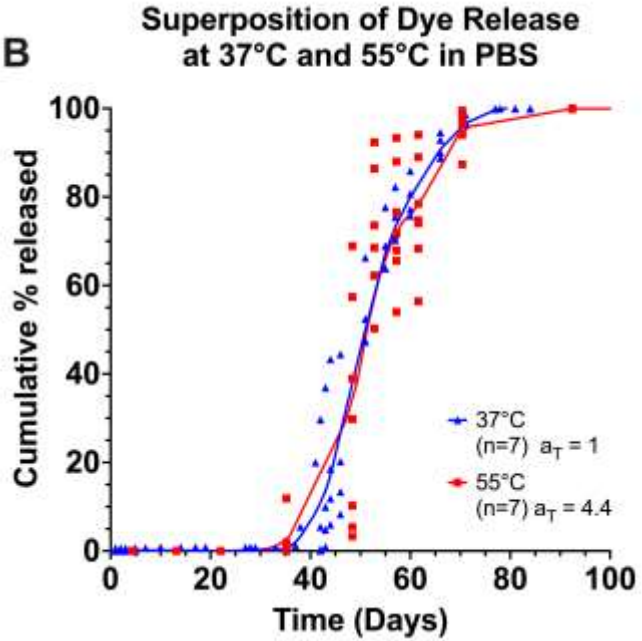
1. Prepare 0.12 g/mL P(GA-TMC-CL) in HFIP
2. 4 coats onto substrate
3. Dry and anneal at 190°C for 30 min
4. Swell in ethanol to remove from substrate

ARC CTET

HFIP: Hexafluoroisopropanol

Screening for Delayed Release

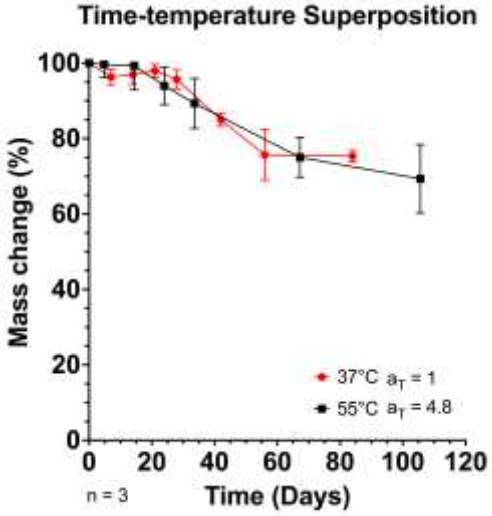




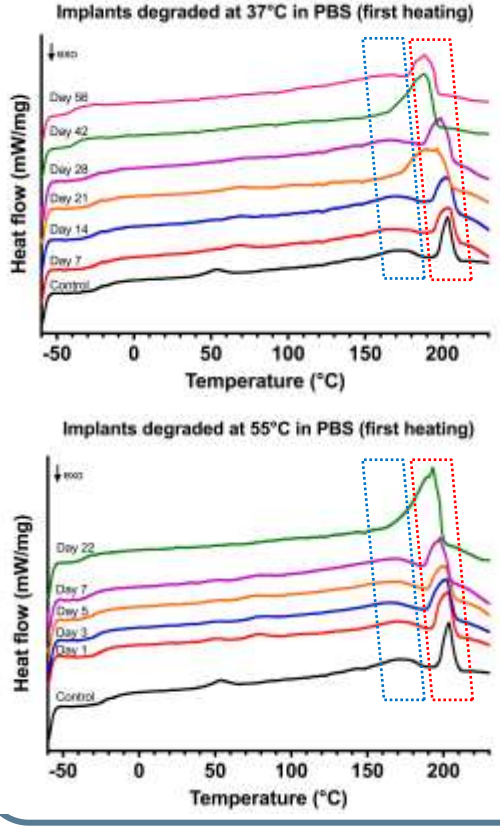
ARC CTET

Implant Characterisation

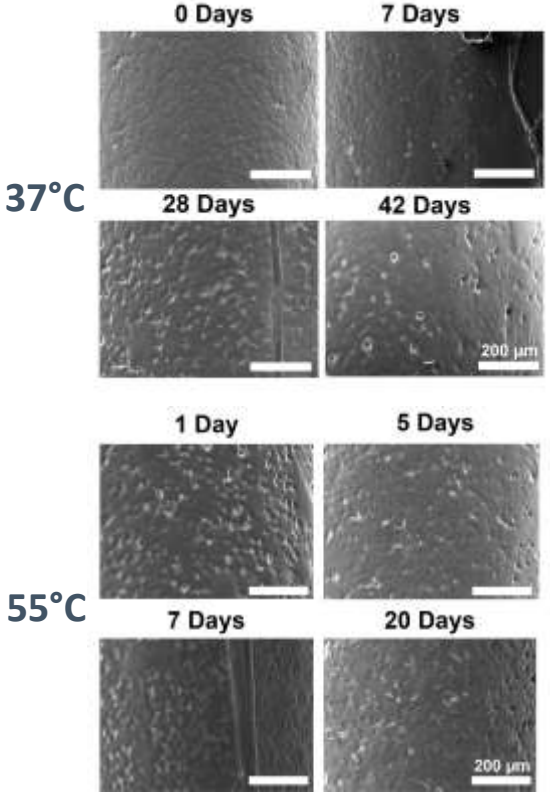
Mass loss



Thermal Analysis

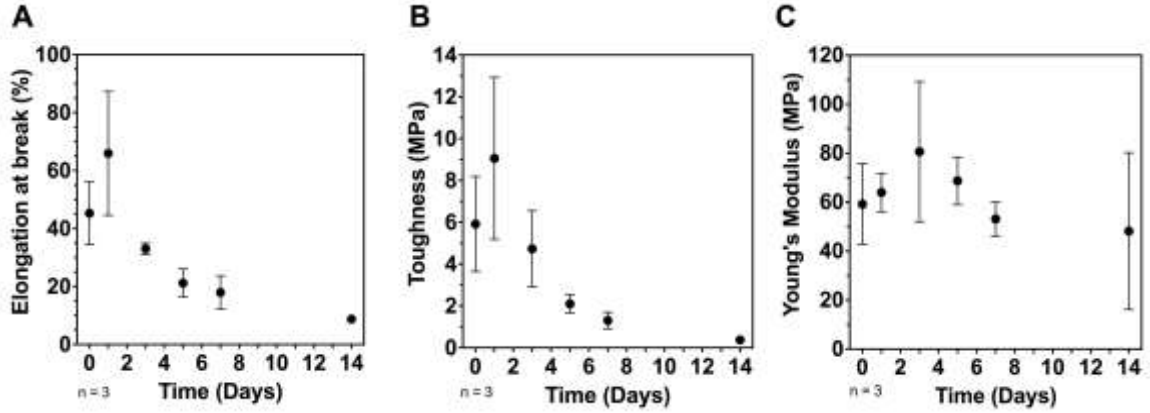


Surface morphology

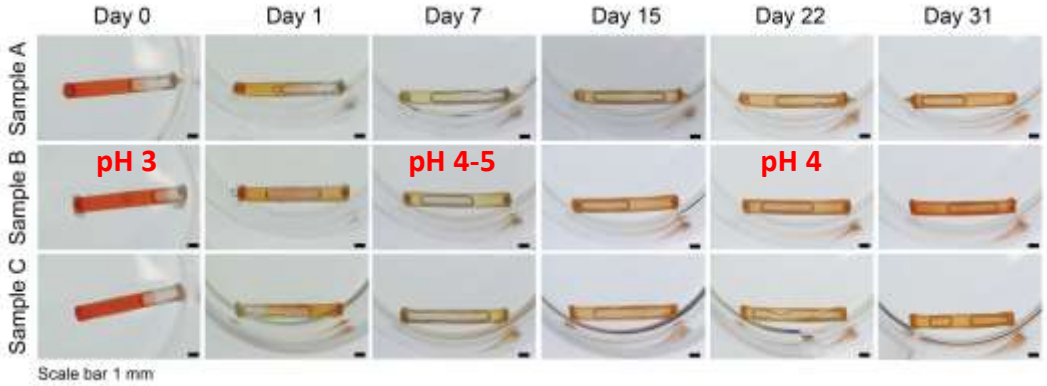


Implant Characterisation

Tensile Strength
(Accelerated at 55°C in PBS)

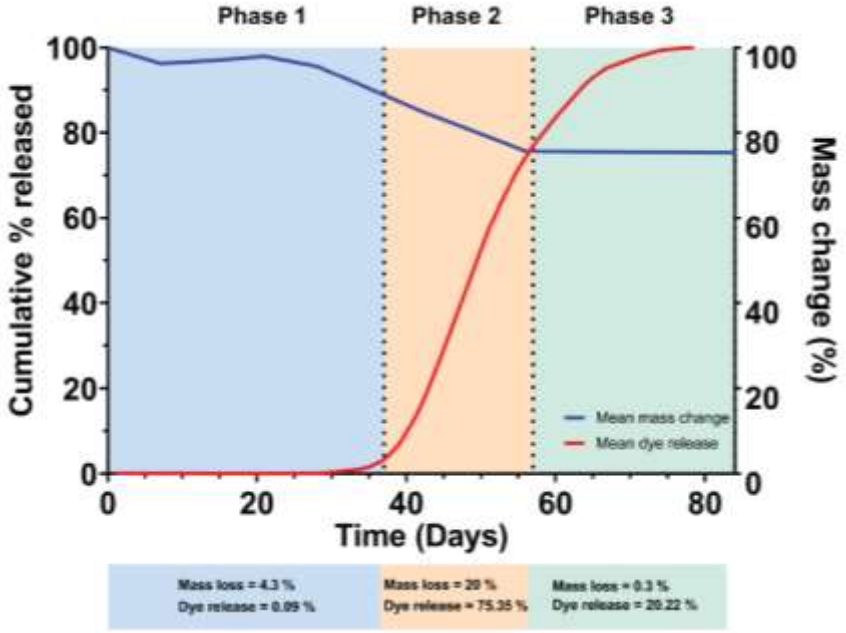


Internal pH
(Accelerated at 55°C in PBS)

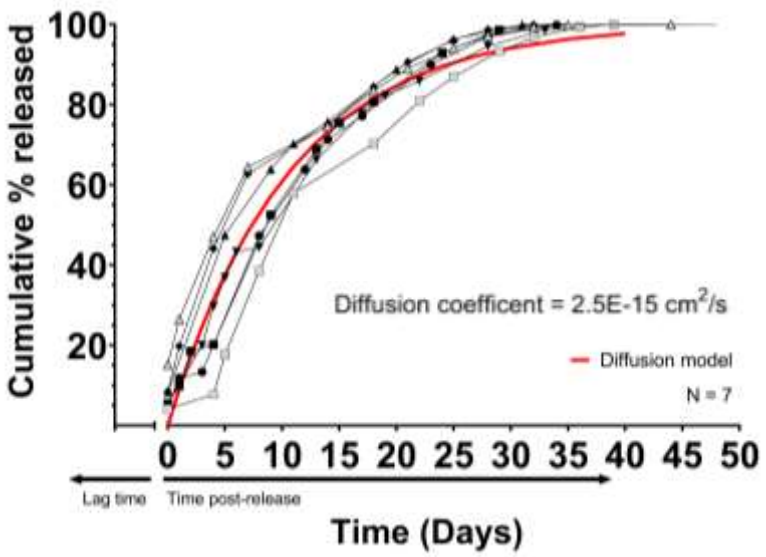


Release Mechanism

P(GA-TMC-CL) Triphasic Model



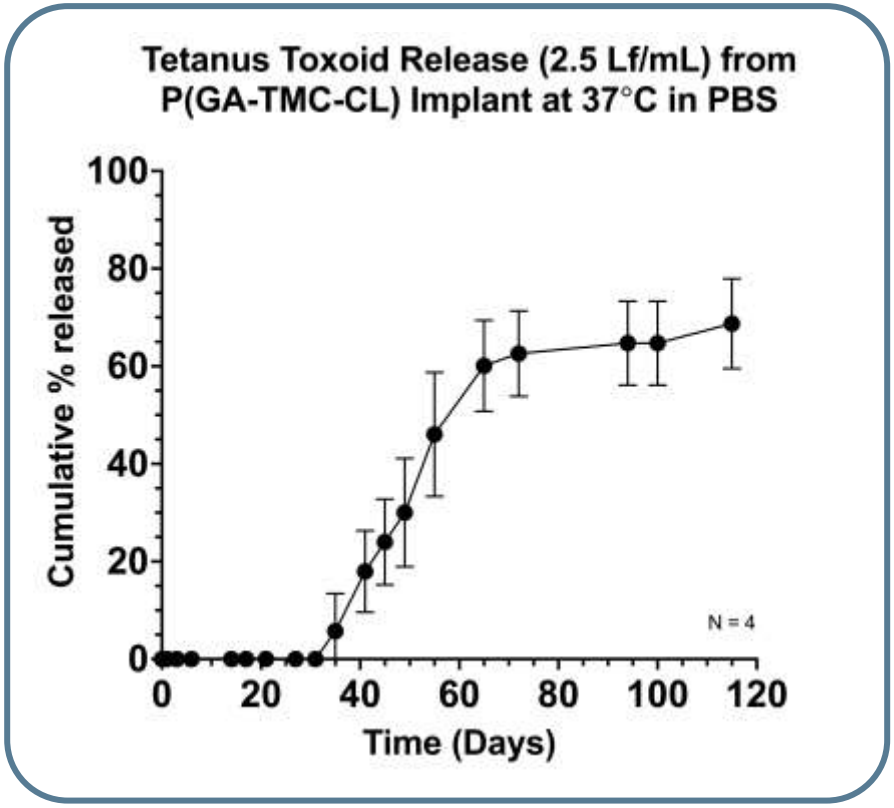
Diffusion Analysis of Dye Release at 37°C



Model from: Siepmann J, Siepmann F. Modeling of diffusion controlled drug delivery. Journal of Controlled Release. 2012;161(2):351-62.

ARC CTET

Relevant Payload Analysis



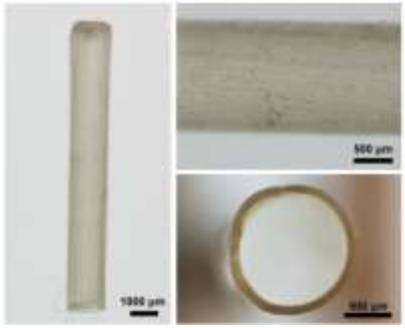
Challenges to address

- 68% release
- Sustained release after lag time
- Payload stability

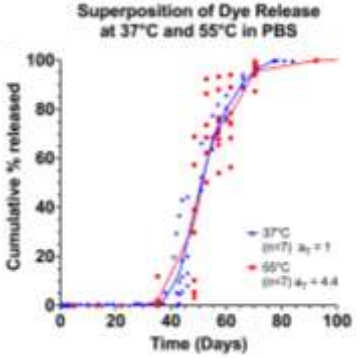
ARC CTET

Conclusions

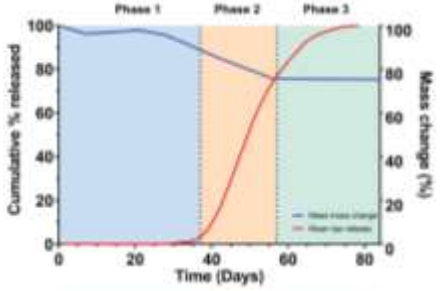
Facile fabrication of thin-walled implants via dip-coating



Promising delayed release kinetics

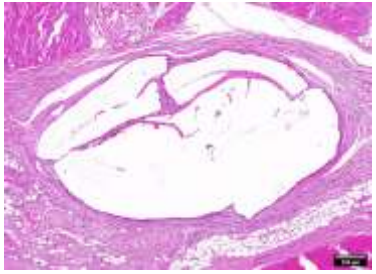


Multimodal triphasic release profile



In vivo translatability

- Payload stability
- Tissue response



ARC CTET

Acknowledgements

Supervisory team
Prof Tim Dargaville
Dr Enoch Chan

Collaborators
D/Prof Dietmar Hutmacher
Dr Scott Taylor (Poly-Med)
Brian Gaerke (Poly-Med)

Polymer Networks & Biomaterials Group

QUT Central Analytical Research Facility

ARC CTET TRAINING CENTRE FOR Cell & Tissue Engineering Technologies