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Bioprintable GMP-ready GelMA for cartilage tissue engineering

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Introduction

GelMA has been considered a gold standard resin for bioprinting. However, as a natural hydrogel, it is often criticized for its lack of reproducibility resulting in huge batch-to-batch variations. Rousselot therefore introduced X-pure GelMA, in which variations in the physicochemical properties of different batches are significantly reduced. X-pure GelMA has been used to prepare X-pure-based sterile GMP-like resins for bioink production. This study evaluates the suitability of X-pure-based GelMA-INX as a bioink for cartilage tissue engineering using extrusion-based as well as volumetric bioprinting.

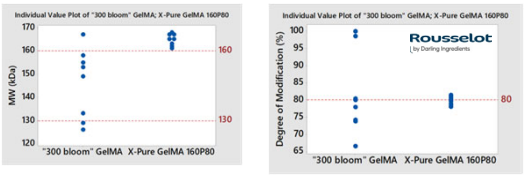
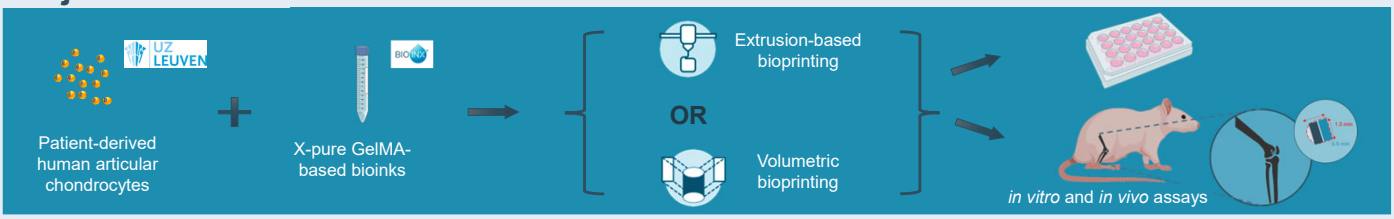


Figure 1: Individual plot of molecular weigh (left) and degree of modification (right) of '300 bloom' GelMA versus X-pure GelMA

Project overview



Extrusion-based bioprinting

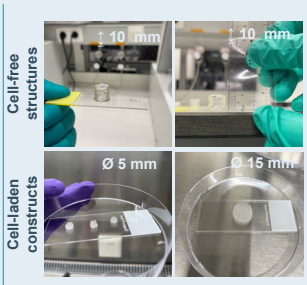
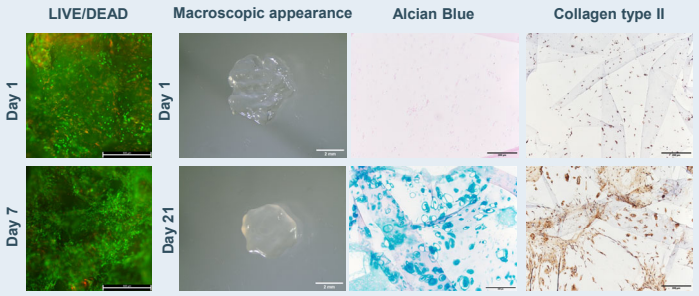


Figure 2: Extrusion-based bioprinting of X-pure GelMA-based bioink, printable at 30 ° C. (a) Macroscopic view of (bio)printed structures. (b) in vitro biological evaluation of encapsulated human articular chondrocytes, showing high viability after 7 days in vitro and high shape fidelity and cartilage-specific matrix formation after 21 days in vitro.



Volumetric bioprinting

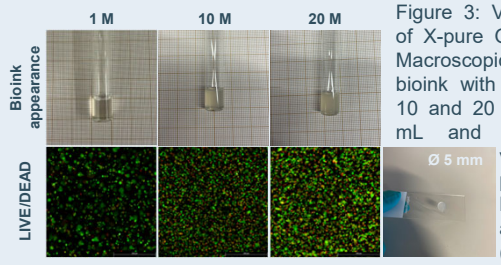


Figure 3: Volumetric bioprinting of X-pure GelMA based bioink. Macroscopic appearance of bioink with encapsulation of 1, 10 and 20 million MC3T3s per mL and corresponding cell viability in bio-printed constructs. Bioprinted construct at 20 million cells/mL (right bottom)

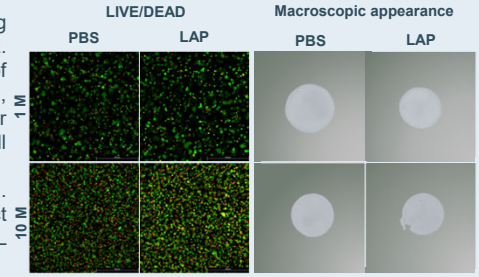


Figure 4: Evaluation of post-curing in PBS vs. 1mg/mL Lithium phenyl-2,4,6-trimethyl-lbenzoylphosphinate (LAP). Cell viability (left) in bioprinted constructs of 1 and 10 MC3T3s per mL and macroscopic appearance (right).

Conclusions

Bioinks based on X-pure GelMA provide a reproducible, low endotoxin biomaterial for biofabrication of cell-laden constructs using extrusion-based as well as volumetric bioprinting. Future work includes optimization of the volumetric bioprinting for chondrocyte-laden constructs and their *in vitro* and *in vivo* evaluation.

Acknowledgements

SBE Skeletal Biology and Engineering Research Center

Prometheus KU Leuven Division for Skeletal Tissue Engineering

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