Master Thesis Defense
3D PRINTING OF BIOCOMPATIBLE CRYOGELS FOR BONE TISSUE ENGINEERING

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Bone tissue engineering

In 3D printing, there are challenges for produce scaffolds:

- Bioink materials
- Low cytotoxicity
- Mechanical strength
- Controlled biodegradability
- Porosity

Aim:

Our work aims to produce **hydrogel scaffolds** with **high porosity** and **exceptionally large pores** for bone tissue engineering by addressing the limitations of extrusion-based 3D printing through **optimal ink formulation** and **cryogenic synthesis.**

Objectives:

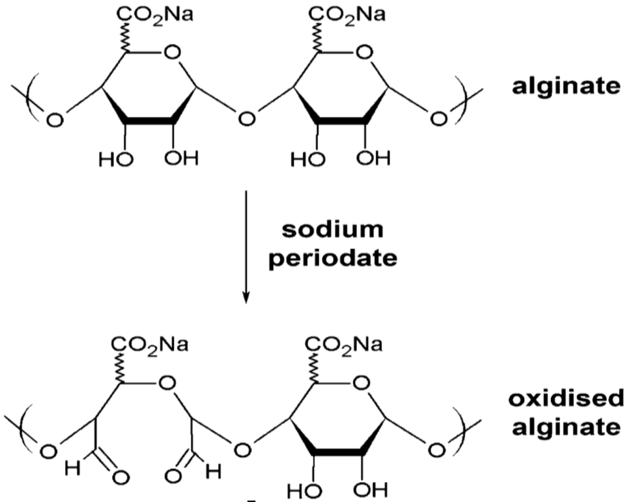
Achievement of the aim has been conducted via the following objectives:

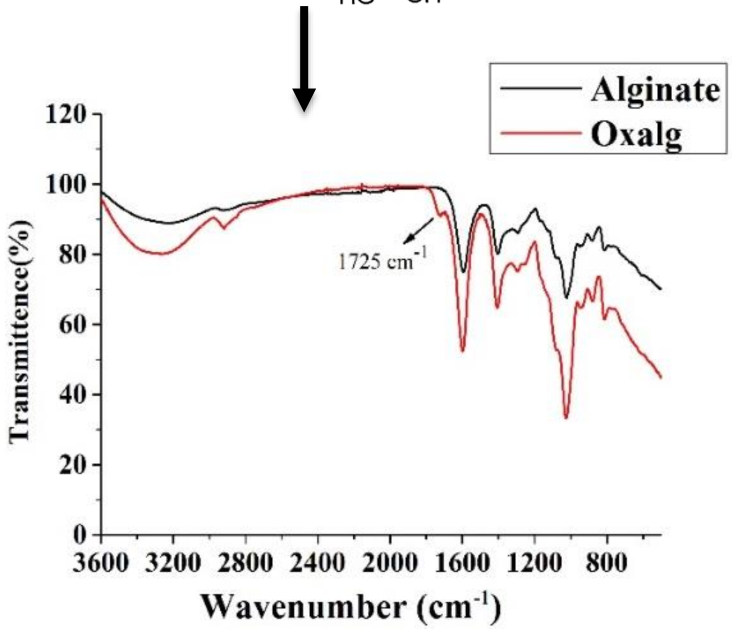
- **Gel/OxAlg-based ink** for 3D printing
- **Macroporous Gel/OxAlg-based scaffolds** via **cryogelation**
- **Mechanical properties** and **morphology** of 3D printed scaffolds
- **Biocompatibility** and **stability** of the scaffolds **in vitro**

Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

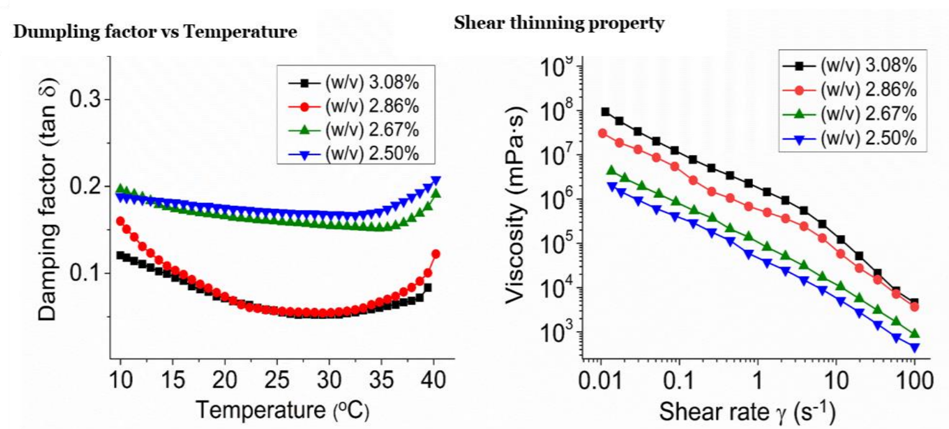
Methodology and Materials

- **Oxidized Alginate synthesis**:

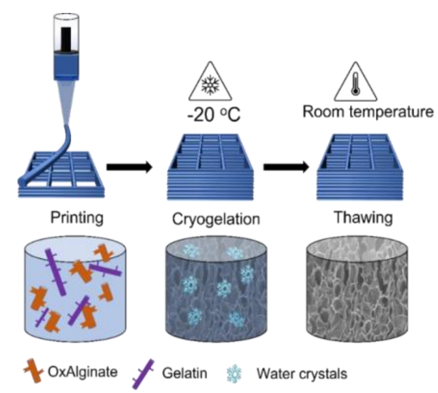




- **Gel:Oxalg (1:1) w/v (8%) bioinks rheology:**



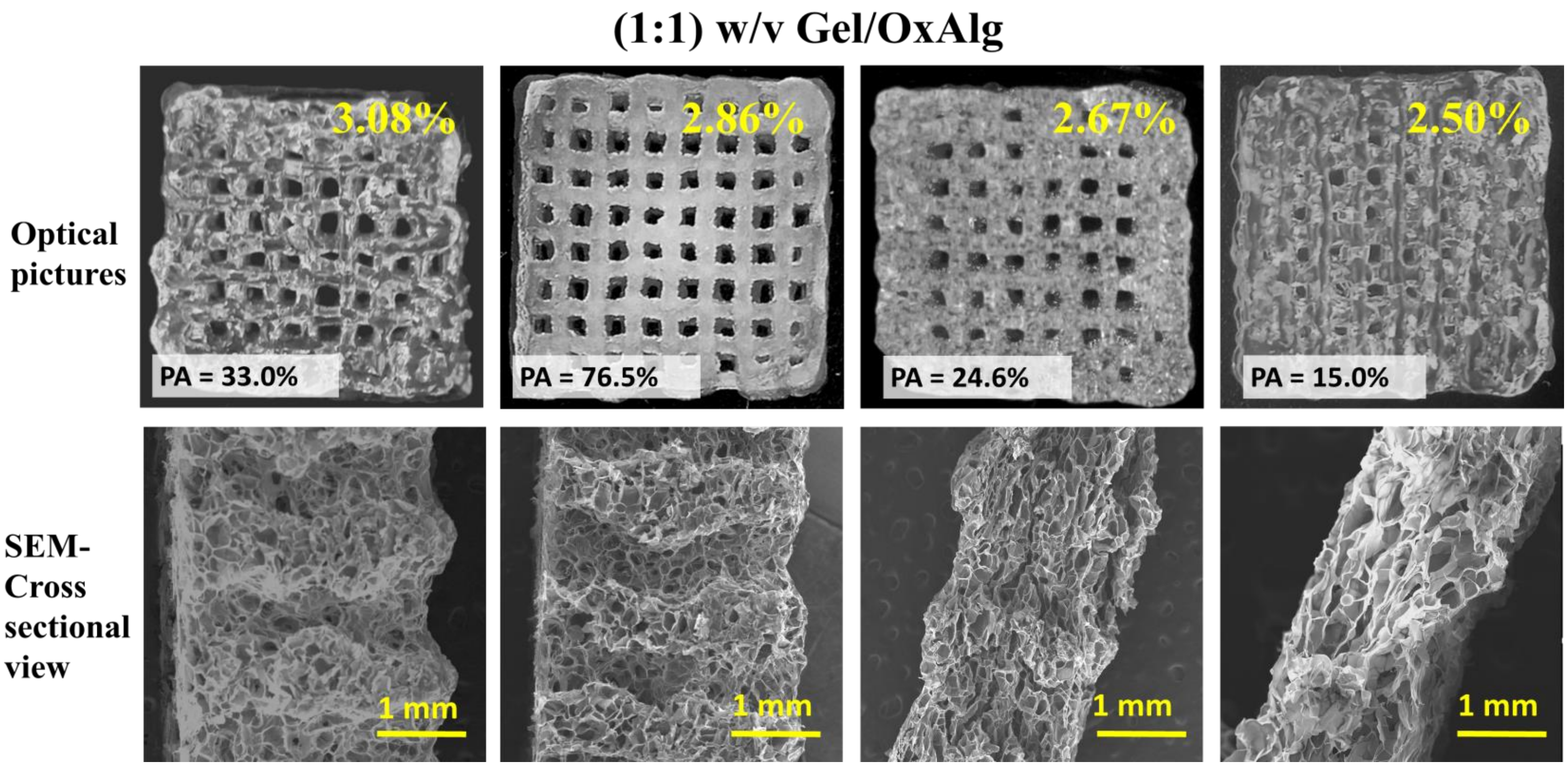
- **3D printing of scaffold via cryogelation:**



- **Cryogenic scaffolds Characterizations:**
  - Swelling test
  - Degradation test
  - Mechanical testing
  - In-vitro testing

Results and Discussion

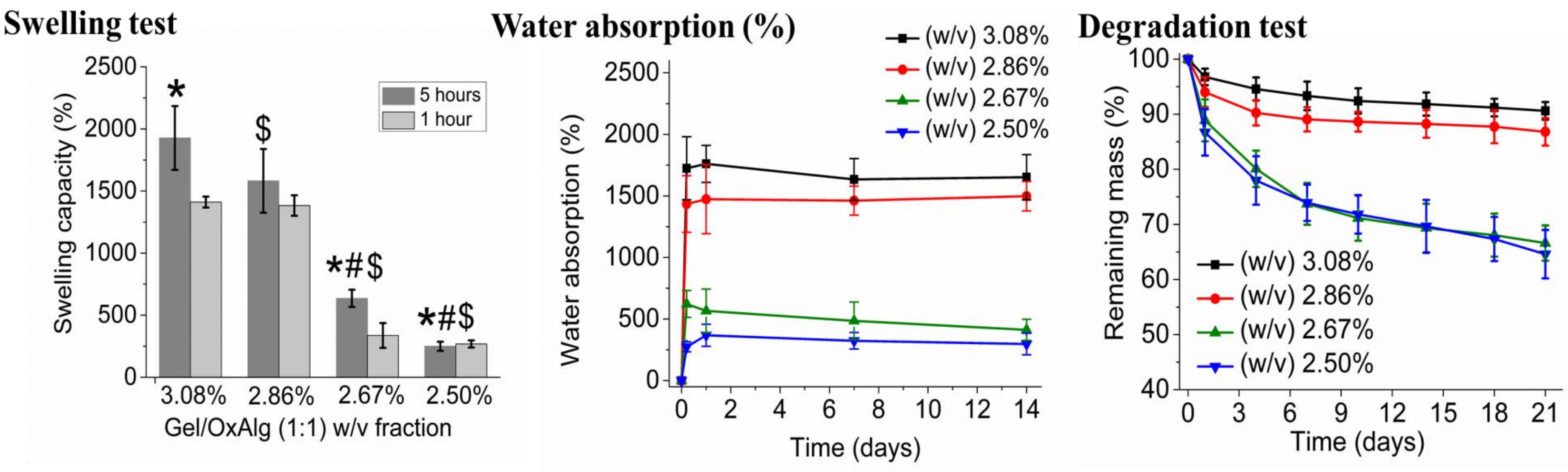
- **Gel:Oxalg (1:1) w/v (8%) cryogenic scaffolds printing with crosslinker glutaraldehyde(0.1%):**



Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

Results and Discussion

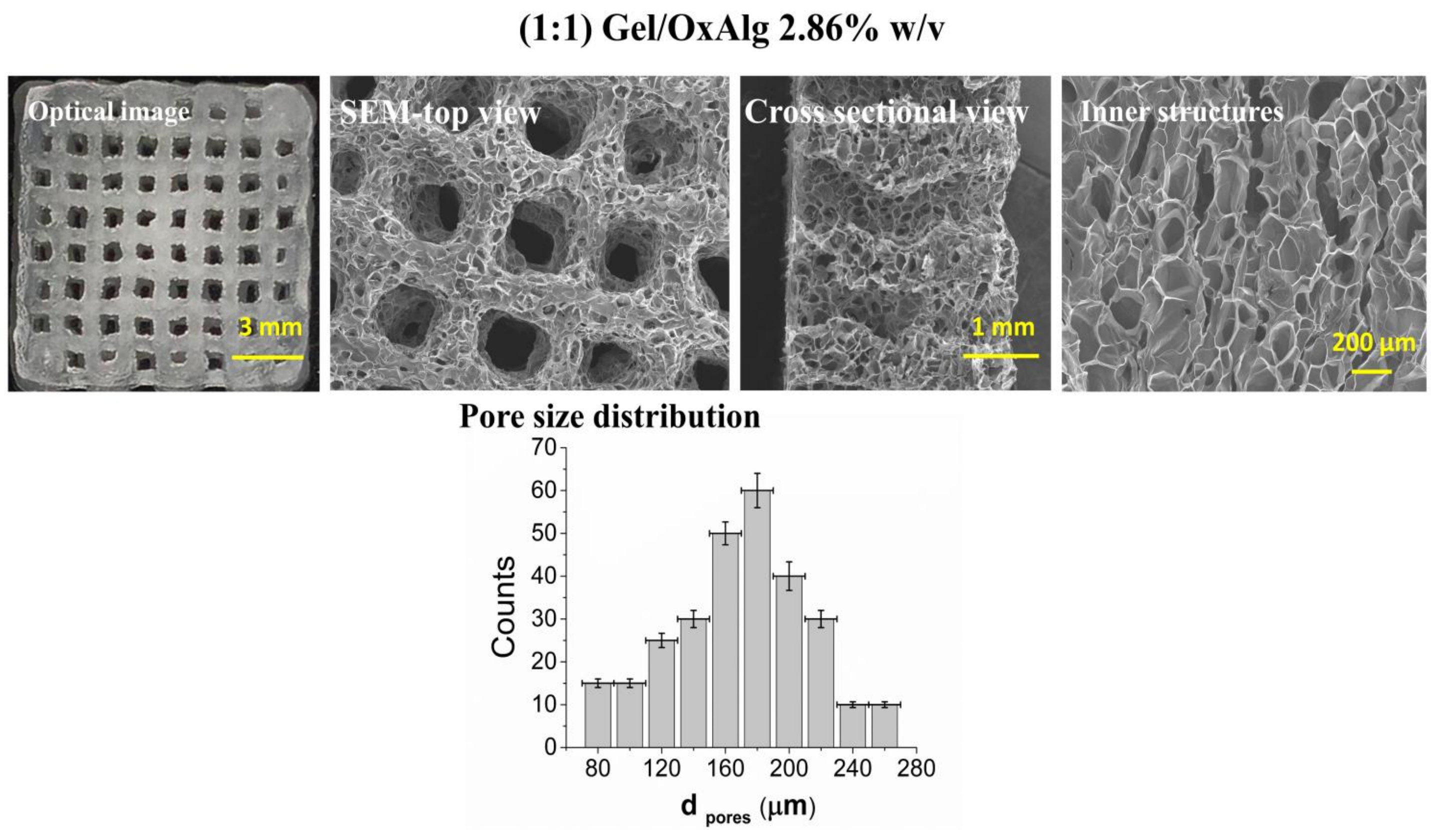
➢ **Swelling and degradation tests of Gel:Oxalg (1:1) w/v (8%) scaffolds:**



Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

Results and Discussion

- **Morphological of the selected Gelatin/Oxidized Alginate scaffold (2.86% w/v):**

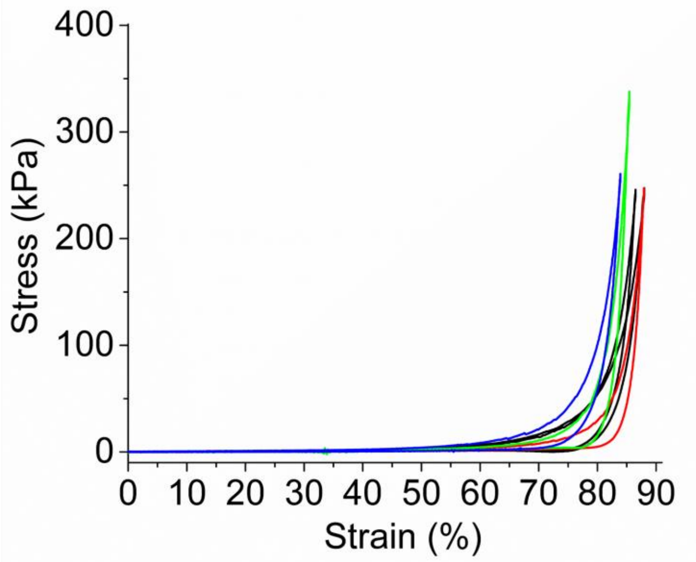


Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

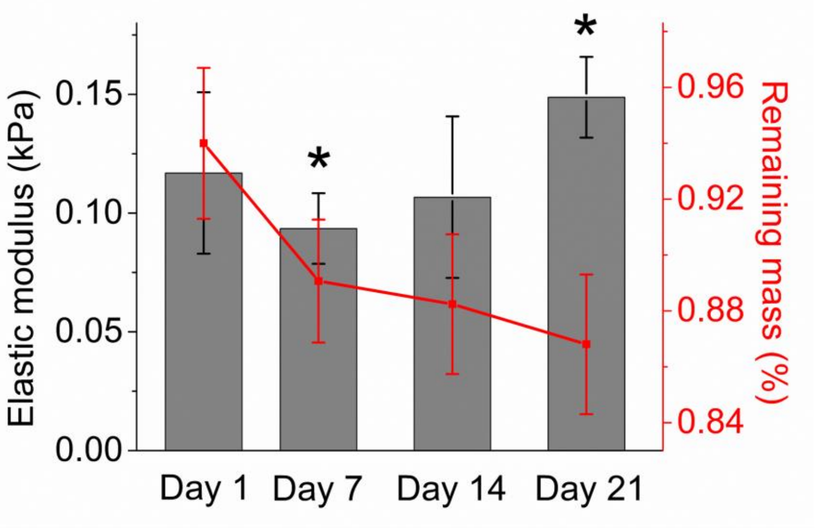
Results and Discussion

- **Mechanical testing of the selected Gelatin/Oxidized Alginate scaffold (2.86% w/v):**

Stress vs strain



Elastic modulus



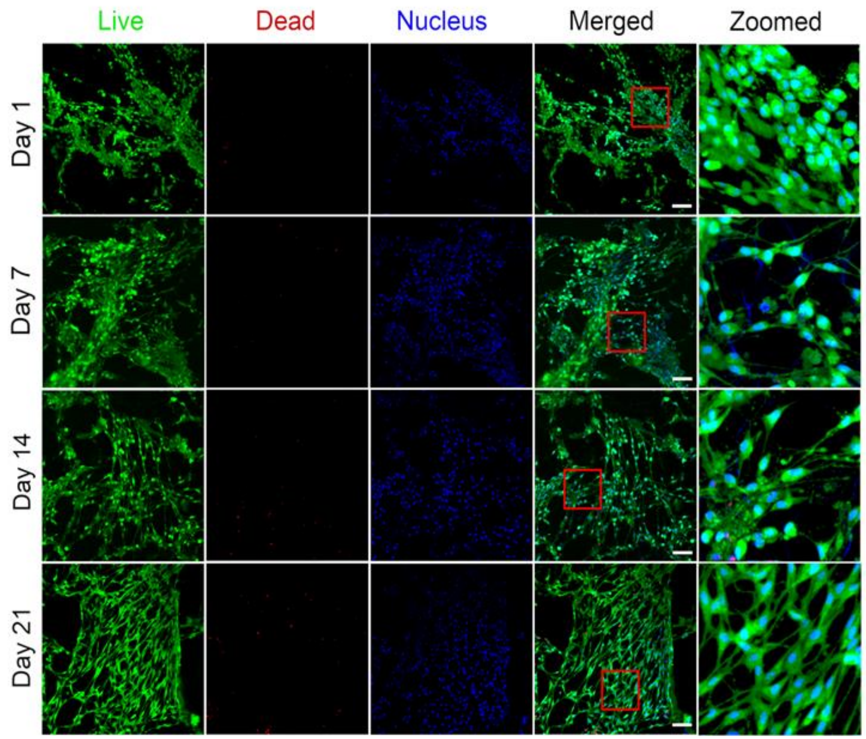
Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

Results and Discussion

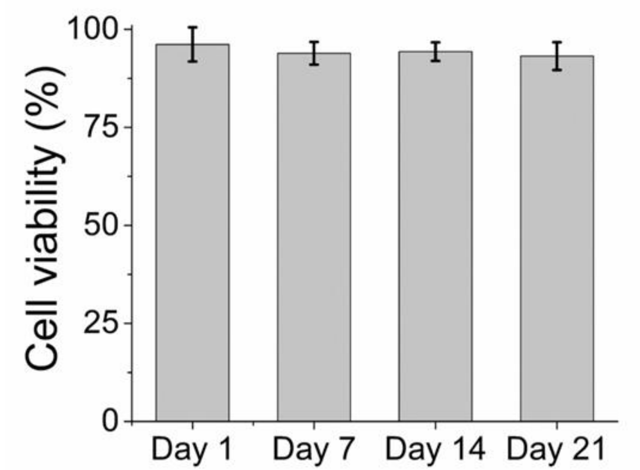
➢ **Cell seeding efficiency on Gelatin/Oxidized Alginate scaffold (2.86% w/v):**

Live/dead staining

(1:1) Gel/OxAlg 2.86% w/v



Cell viability(%)



Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

Conclusion

- Cryogenic synthesis in 3D scaffold with Gel/OxAlg mixes proposed
- Optimal composition for 3D printing with PA > 75% is 2.86% w/v (1:1) Gel/OxAlg:
  - Distinctive extra-large porous morphology
  - High swelling capacity and appropriate mechanical stability
  - After 3 weeks in aqueous condition, scaffolds preserve more than 85% of their initial mass
  - Exceptional elasticity =0.15 kPa
  - Sustained mechanical stability
  - Good biocompatibility

Moazzam et al (2022),Macroporous 3D printed structures for regenerative medicine applications.

Thank you!