DECELLULARIZED SMALL INTESTINE FOR BURN WOUND TREATMENT: A TISSUE ENGINEERING PARADIGM SHIFT?

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1. INTRODUCTION

Burn injuries are a significant global health issue, causing approximately 11 million injuries and 180,000 fatalities each year (1). Beyond physical trauma, burn injuries lead to complications such as infections and sepsis. Burn scars can also diminish quality of life by affecting joint mobility and daily activities (2,3). Conventional dressings and autografts have limitations, necessitating novel treatment strategies (4). Decellularized xenografts, particularly from porcine small intestine (SI), offer a promising alternative due to their content of growth factors and structural proteins essential for wound healing (5,6). Preserving these bioactive molecules while ensuring cost-effectiveness requires carefully designed decellularization processes. **This study investigates a new decellularization protocol aimed at creating a safe and highly preserved extracellular matrix (ECM) from porcine SI for optimal functional wound dressing.**

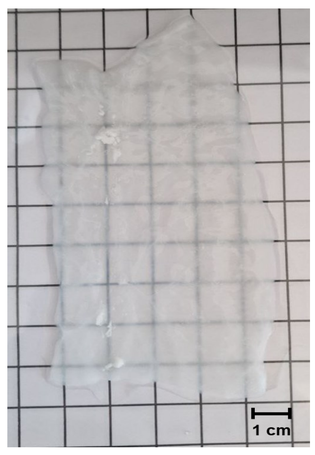
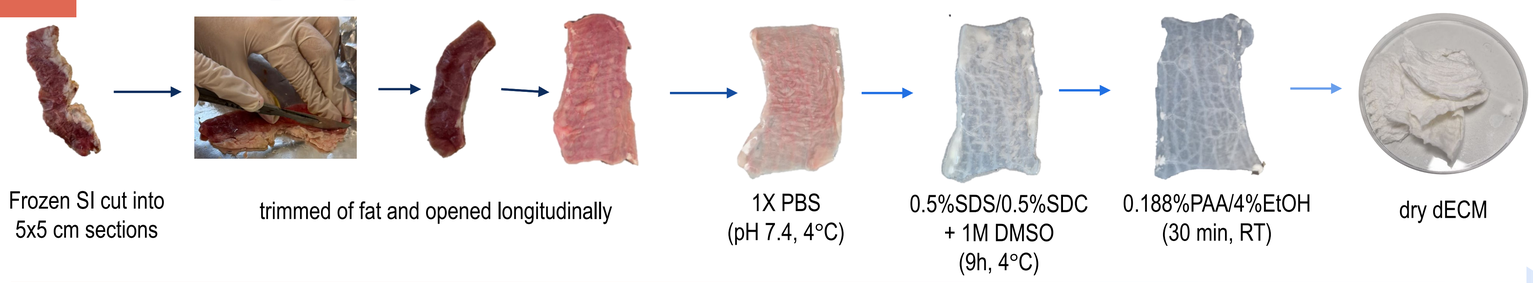


Figure 1 – Example of a decellularized porcine SI

2. METHODS



CHARACTERIZATION

- H&E staining
- DNA quantification
- Ultrastructure (SEM)
- WVTR
- Swelling ability
- Uniaxial tensile test
- FTIR
- Indirect contact cell viability
- ECM staining (verhoeff, T. Masson, Orceina, Alcian Blue)

3. PROTOCOL VALIDATION

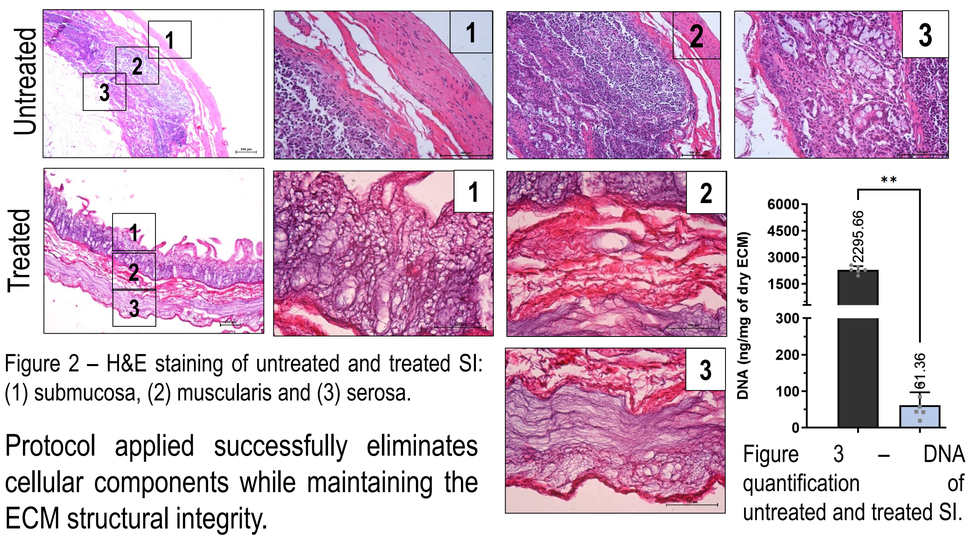


Figure 2 – H&E staining of untreated and treated SI: (1) submucosa, (2) muscularis and (3) serosa.

Protocol applied successfully eliminates cellular components while maintaining the ECM structural integrity.

Figure 3 – DNA quantification of untreated and treated SI.

4. MATERIAL PROPERTIES

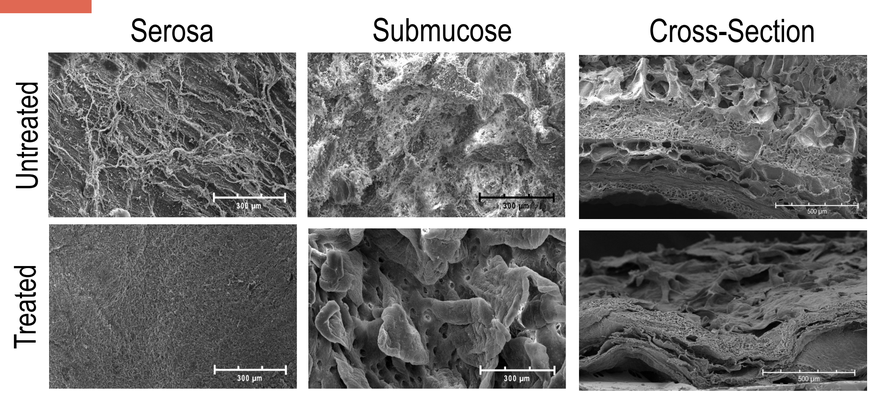


Figure 4 – Scanning electron microscopy of untreated and treated SI.

Treated sample present structural integrity when compared to untreated, with organized fibers (serosa) and exposed porosity (submucosa)

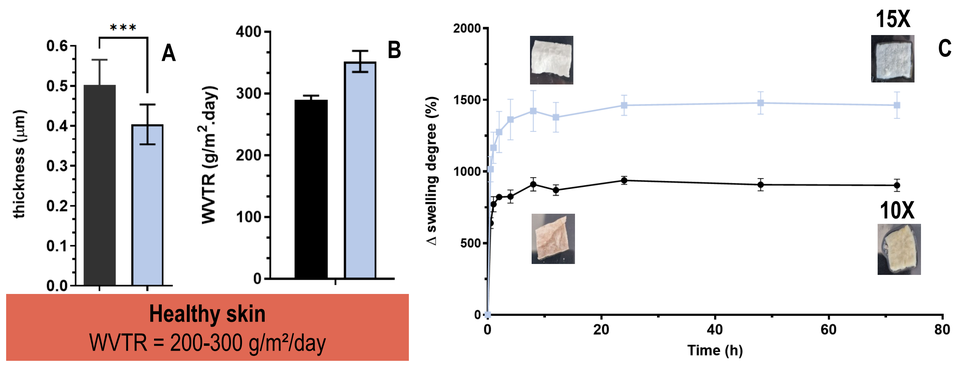


Figure 5 – Untreated and treated SI materials properties: (A) Thickness, (B) Water vapor transmission rate and (C) swelling ability.

Water vapor transmission rate (WVTR) is essential for maintaining a moist environment and preventing excess fluid accumulation. WVTR of SI closely resembles that of skin. Additionally, the dECM can absorb up to 15 times its weight in exudate without losing structural integrity.

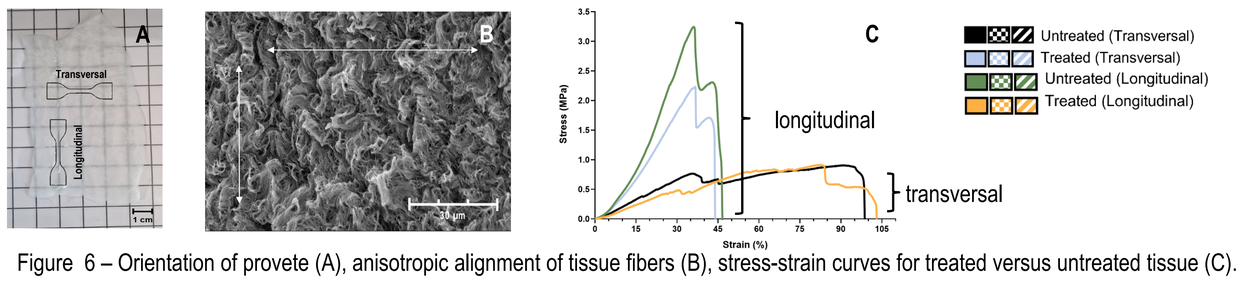


Figure 6 – Orientation of provete (A), anisotropic alignment of tissue fibers (B), stress-strain curves for treated versus untreated tissue (C).

Directional properties of native tissue, mimicking skin

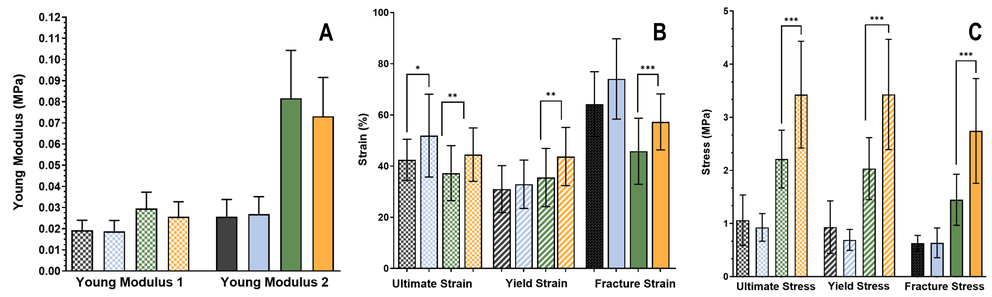


Figure 7 - Tensile properties of treated sample compared to native SI: (A) Young's Modulus; (B) Ultimate, yield and fracture Strain; (C) Ultimate, yield and fracture tensile stress.

No significant **differences** in **Young's modulus**, but treated samples show greater elongation and increased stress, likely due to enhanced swelling and chemical crosslinking during processing.

5. BIOLOGICAL PROPERTIES

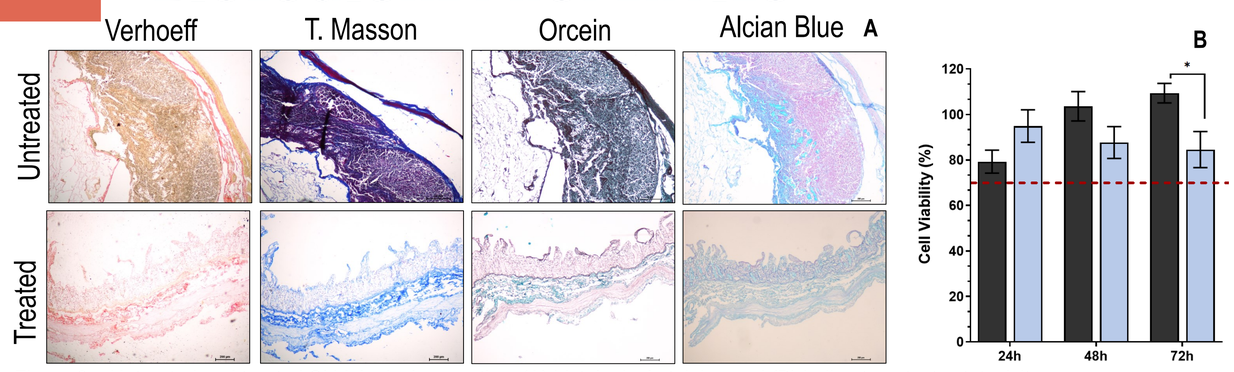


Figure 8 – Untreated and treated SI biological properties: (A) histological staining and (B) indirect contact cytotoxicity.

Verhoeff and Orcein staining showed elastic fibers presence, while T. Masson and Alcian Blue staining indicated collagen and GAGs preservation. dECM spectra (blue)revealed reduced lipid and nucleic acid bands, collagen retention as evidenced by the amide bands and peak at ~840 cm^{-1} characteristic of fibrillar collagen. Increase in ~1050 cm^{-1} band implied GAGs preservation. dECM did not release components that impacted cell metabolic activity.

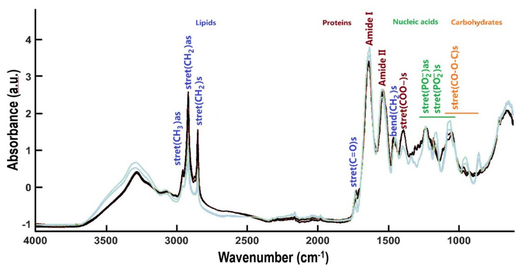


Figure 9 - IR spectra of SI.

6. CONCLUSION

Our results indicate that the protocol implemented **effectively preserves essential ECM components** and structure while **removing cellular contaminants**. The material demonstrates anisotropic preserved mechanical properties, adequate swelling capacity, and WTVR similar to skin. The treated samples present biocompatibility, as they do not hinder human fibroblast metabolic activity. This innovative strategy presents a promising approach to produce preserved ECM that could be further process to become a solution for wound healing and tissue regeneration, particularly in challenging cases like burns. Future research will focus on enhancing its antibacterial and anti-inflammatory properties to further improve its efficacy as a dressing for challenging wounds.

References

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Acknowledgements

The authors thank Isabel Pinto at Seara, S.A., Vila Nova de Famalicão, Portugal, for supplying the biological tissue. National Funds from Fundação para a Ciência e a Tecnologia (FCT), project UID/Multi/50016/2020, and Doctoral Research Grant 2021.05919.BD. BE@T–Bioeconomy for Textiles and Apparel, investment TC-C12-i01–Sustainable Bioeconomy", funded by Recovery and Resilience Program (PRR).