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MECHANICAL CHARACTERIZATION OF DRUG-COATED MELT ELECTROWRITEN MESH IMPLANTS FOR PELVIC ORGAN PROLAPSE REPAIR

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1 INTRODUCTION

Pelvic organ prolapse (POP) occurs when one or more organs in the pelvis slip from their normal position and bulge into the vagina, often due to weakened pelvic floor ligaments and muscles, typically from pregnancy and aging. Severe cases of POP require surgery, often involving implantation of surgical meshes to support the damaged tissues. The downside of these meshes include mesh erosion through the vagina, pain, infection, bleeding, urinary incontinence and recurrent prolapse, leading the Food and Drug Administration (FDA) to ban transvaginal surgical meshes for POP in the United States [1]. One assumption about the reported complications is that they are due to insufficient biocompatibility and inappropriate biomechanical properties of these implants. Another prevalent factor in surgical pelvic mesh failure are infections, caused mainly by gram-positive, gram-negative, anaerobic bacteria, and fungal microorganisms, many of which are capable to develop antibiotic resistance, given their ability to attach to the meshes' surface and develop biofilm [2].

Polycaprolactone (PCL) meshes produced through Melt Electrowriting (MEW) have already been proven to present biomechanical properties closest to the ones of the vaginal tissues than the Restorelle® mesh [3] and being effective in producing 3D-printed implants with incorporated antimicrobial agents to prevent infections associated with medical devices [4]. This way, PCL meshes were printed through MEW and uniaxial tensile tests and microbiological assays were performed, to mechanically characterize the produced meshes and the incorporation of the antibiotic ciprofloxacin, respectively.

2 METHODS

Technical-grade PCL meshes with different fibre's diameter and pore size were printed through MEW. Next, uniaxial tensile tests were performed on 50x10 samples of the meshes. Force-displacement curves were acquired for three samples of each category, allowing to obtain average stress-strain curves. Finally, 1 cm^2 meshes samples were submerged in a solution of ciprofloxacin (Cipro) (0.9% w/w) for its incorporation. Fourier transform infrared spectroscopy (FTIR) analysis allowed to evaluate drug incorporation and the antimicrobial activity of the meshes was tested

using the agar diffusion assay towards *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 43300 and *Staphylococcus aureus* ATCC 29213. For biofilm formation assay, XTT (tetrazolium salt) and Crystal Violet (CV) assays were employed to understand the influence of the incorporated drugs in the metabolic activity of the biofilm and their impact on biofilm formation and biomass, respectively.

3 RESULTS AND DISCUSSION

The stress-strain curves for the meshes with the two different diameters and pore size, compared to Restorelle®, and the curves derived from anterior and posterior prolapsed vaginal human tissue are presented in Figure 1a. Although the PCL meshes behave similarly, the stresses obtained for the 240 µm diameter meshes are higher than those of the 160 µm diameter meshes, with the 1 mm pore size meshes reaching higher stress value.

Regarding the incorporation of Cipro, two signature peaks of this drug were identified in the FTIR analysis of the meshes, proving their incorporation. The zone of inhibition and biofilm formation assays demonstrated that this drug exhibits antimicrobial effects against all tested strains, including methicillin-resistant *S. aureus* (Figure 1b).

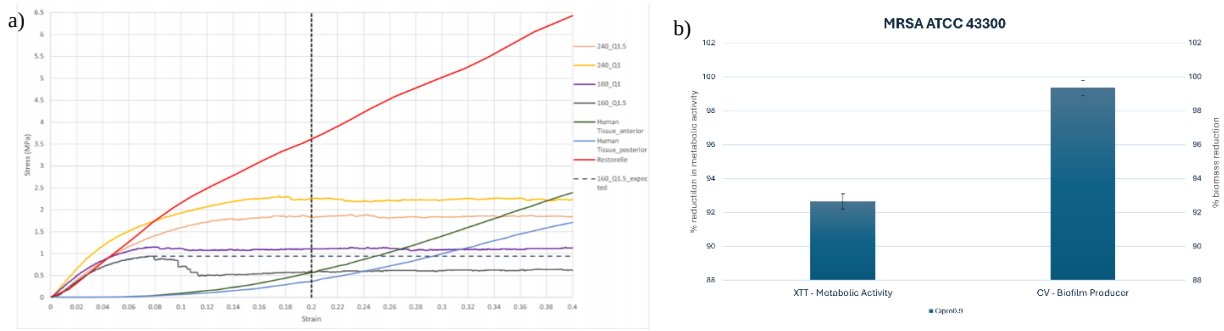

Figure 1.a) Stress-strain curves obtained through uniaxial tensile testing; b) Results from XTT and CV assays.

AGKOWLADGMENTS

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