

# Mechanical and biological assessments of braided artificial tendons functionalized with cork extract

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## Introduction

The incidence of human tendon ruptures has increased over the years, and represents one of the main causes of musculoskeletal injuries that occur annually, due to high mechanical loads, degenerative processes, trauma, stretching, chronic overuse, inflammation, etc.

Synthetic grafts, previously associated with high rates of failure and inflammation, are now drawing renewed interest in regenerative medicine. There is also an emphasis on finding environmentally sustainable alternatives to minimize the biomedical field's ecological impact. In this regard, lyocell, polyethylene terephthalate (PET), and biodegradable polyester (PB) stand out as promising materials for developing artificial tendons.

Simultaneously, there is increasing interest in plant-derived therapeutic agents, especially cork, due to its biocompatibility and beneficial properties, such as antioxidants, antimicrobials, and anti-inflammatories. Like the aforementioned polymers, cork also offers a reduced environmental impact.

Considering these alternatives, the primary goal of the research is to create artificial tendons using braided structures, which will then be enhanced with natural cork extract. This strategy aims to replace damaged tendons and enhance the quality of life for those affected.

## Materials and Methods

### Cork extraction

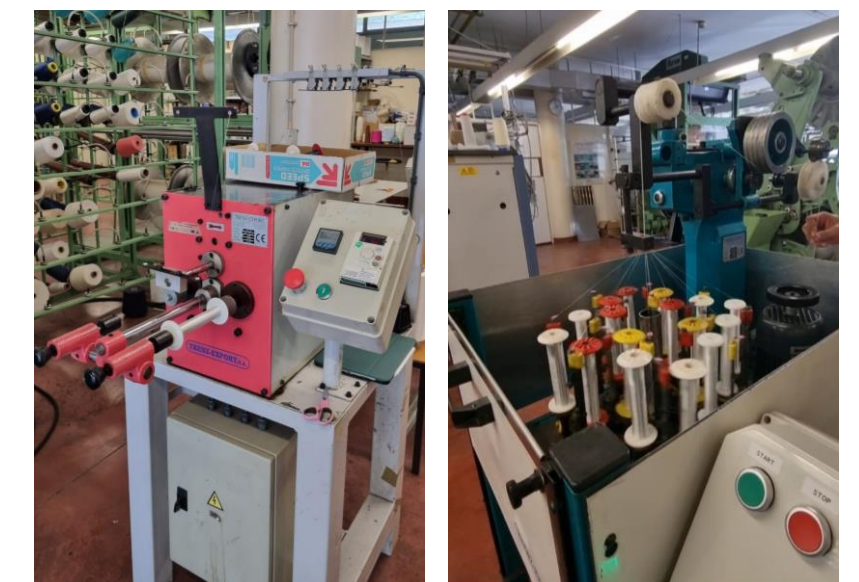
Extraction by repeating the cycle 3 times, and 4 successive extractions are made, changing the powdered extract between extractions, using hydroethanolic solution



### Production of braids

Production of braids with core:

**Lyocell and PET:** braided with 32 loose core threads  
**PB:** braided with 4 loose core strands



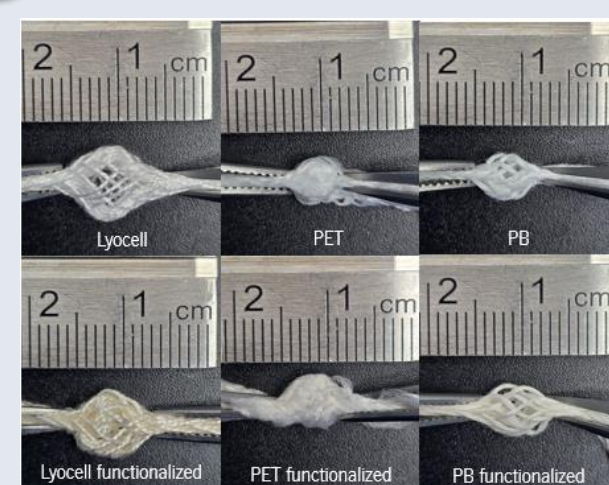
## Results and Discussion

### 1 Minimum inhibitory (MIC) and bacterial (MBC) concentration

		Cork
<i>P. aeruginosa</i>	MIC (mg/mL)	0,32
	MBC (mg/mL)	0,32
<i>S. aureus</i>	MIC (mg/mL)	0,16
	MBC (mg/mL)	0,08

A concentration of 0.32 mg/mL, MBC concentration will be incorporated to eliminate bacteria after incorporation into the fibrous system.

### 2 Morphology of braids



A color change is observed in the braids after functionalization.

### 3 Functionalization

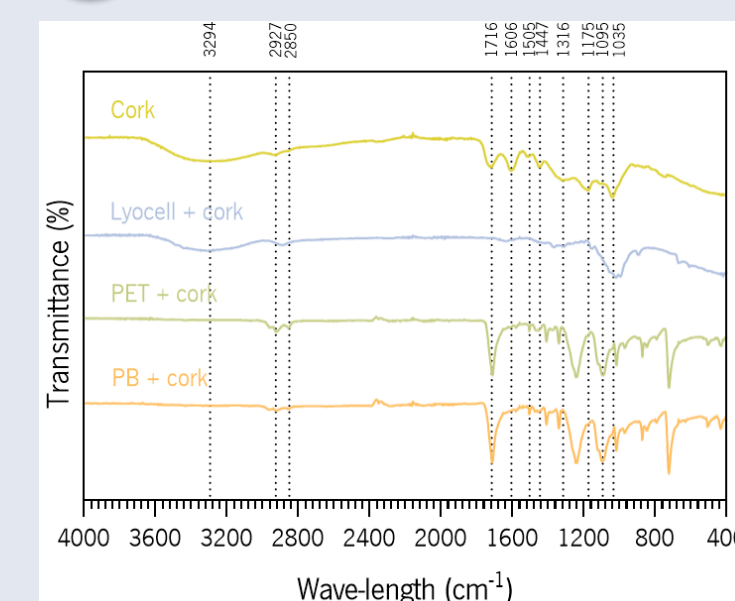
	Dip coating	Binding through dopamine coating	Surface activation with UV light followed by dip coating
Lyocell	0,23 ± 0,04	0,14 ± 0,01	-0,03 ± 0,14
PET	0,19 ± 0,02	0,14 ± 0,01	0,05 ± 0,01
PB	0,12 ± 0,01	0,12 ± 0,00	0,01 ± 0,03

	Lyocell	PET	PB
0,32 mg/mL	0,23 ± 0,04	0,19 ± 0,02	0,12 ± 0,01
0,64 mg/mL	0,25 ± 0,05	0,18 ± 0,05	0,17 ± 0,02
1,6 mg/mL	0,55 ± 0,14	0,45 ± 0,20	0,33 ± 0,16
3,2 mg/mL	1,2 ± 0,34	0,76 ± 0,25	0,73 ± 0,36




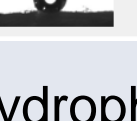
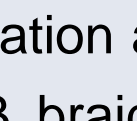
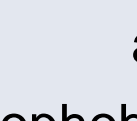
The concentration of 1.6 mg/mL was selected to functionalize the braids.

### 4 FTIR functionalized braids



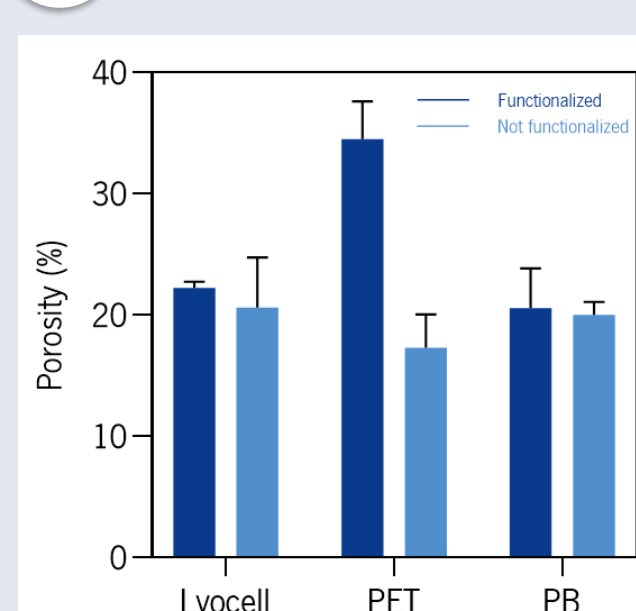
In the locations of the cork peaks, after functionalization, the braided peaks are more pronounced.

### 5 Contact angles

	Contact angle (°)	Images
Lyocell	<5	
Functionalized lyocell	<5	
PET	137,91 ± 8,54	
Functionalized PET	114,60 ± 13,69	
PB	152,28 ± 12,67	
Functionalized PB	147,07 ± 10,06	

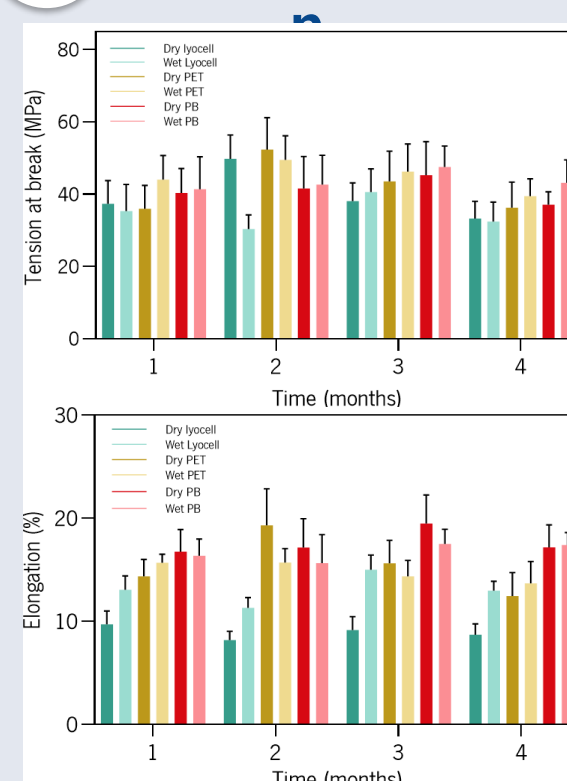
Lyocell braid is superhydrophilic pre and post functionalization and PET is hydrophobic. PB braid is superhydrophobic and functionalized PB is hydrophobic.

### 6 Porosity



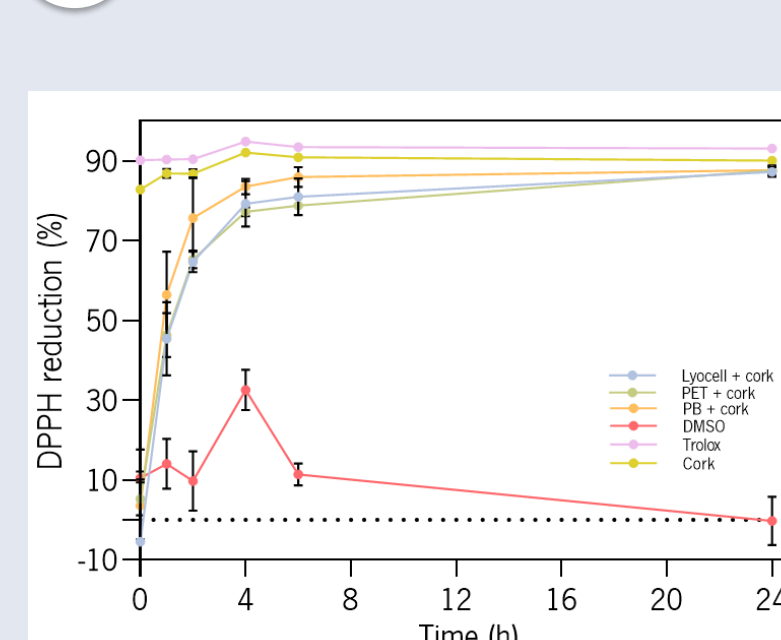
After functionalization, for all samples the porosity increases slightly.

### 7 Degradation



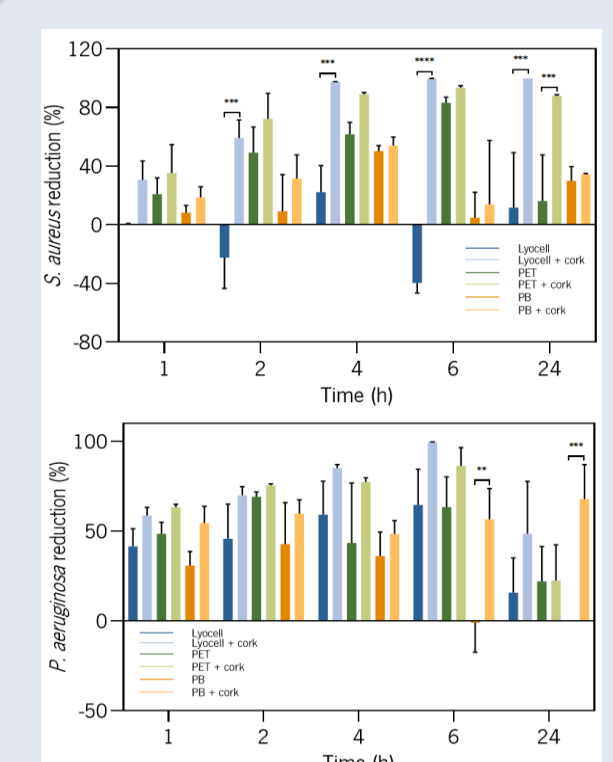
No major variations are observed after 3 months of degradation.

### 8 Antioxidant Activity



The incorporation of cork extract into the braids gives them excellent antioxidant properties.

### 9 Antibacterial Activity



On both bacteria, cork braids demonstrated a bactericidal effect, particularly at 4h and 6h.

## Conclusions and future perspectives

- The braids developed showed interesting characteristics, becoming a possible solution to solve the problem in question.
- As future perspectives, it would be interesting to investigate combinations of different materials in the braids and other possible extracts to functionalize them.

### References

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