Polyesters of citric acid and short-chain diols blended with PLA to produce electrospun nonwovens

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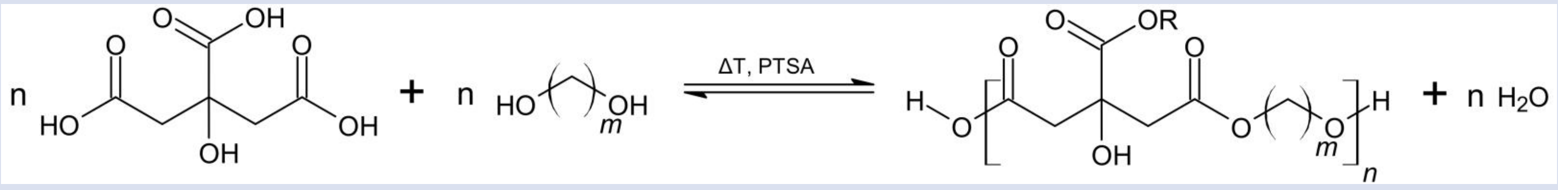
1 Introduction

Biomaterials based on citric acid have shown potential to be used as blood vessel and skin tissue substitutes. Changing the aliphatic chain length of the diol allows functional design strategies to control the implant's mechanical and surface properties and its degradation profile.

The aim of this work was to obtain electrospun nonwovens by mixing PLA with different poly(diol citrates) to study how the diol chain length influences the material properties.

2 Synthesis – poly(diol citrates)



m = 2, 4, or 6
R = H or polymer

Fig. 1. Schematic illustration of the synthesis of poly(dimethylene citrate) **(P-1,2-ECit)**, poly(tetramethylene citrate) **(P-1,4-BCit)**, and poly(hexamethylene citrate) **(P-1,6-HCit)**.

3 Results – electrospun nonwovens characterisation

morphology

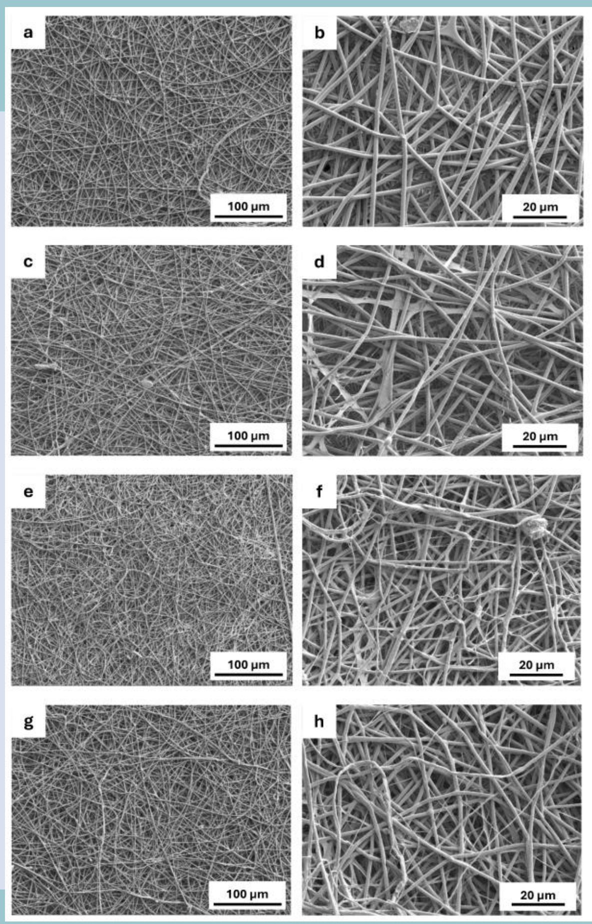


Fig. 2. SEM micrographs; from the top: PLA **(a,b)**, P-1,2-ECit/PLA **(c,d)**, P-1,4-BCit/PLA **(e,f)**, and P-1,6-HCit/PLA **(g,h)**.

surface properties

Table 1. Results of water contact angle measurements.

	material	water contact angle (°)
resin	P-1,2-ECit	23.5±2.4
	P-1,4-BCit	24.4±3.3
	P-1,6-HCit	24.5±2.9
nonwoven	PLA	118.5±4.3
	P-1,2-ECit/PLA	85.7±3.0
	P-1,4-BCit/PLA	54.9±1.0
	P-1,6-HCit/PLA	the droplet spreads and soaks into the material

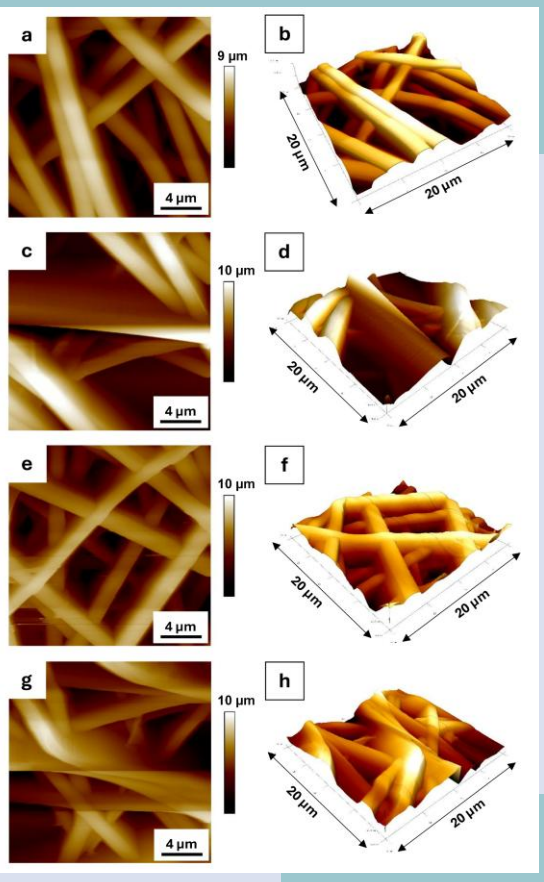


Fig. 3. 2D (left column) and 3D (right column) topographic images of nonwovens obtained by AFM; from the top: PLA **(a)**, P-1,2-ECit/PLA **(b)**, P-1,4-BCit/PLA **(c)**, and P-1,6-HCit/PLA **(d)**.

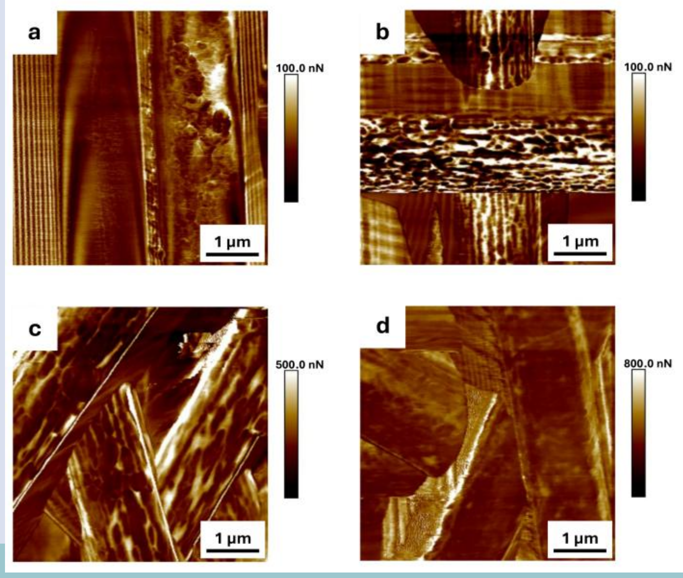


Fig. 4. Adhesion force maps of nonwovens obtained by AFM; from the top left: PLA **(a)**, P-1,2-ECit/PLA **(b)**, P-1,4-BCit/PLA **(c)**, and P-1,6-HCit/PLA **(d)**.

Table 2. Results of adhesion force measurements (AFM).

nonwoven	adhesion force (nN)
PLA	17.0±3
P-1,2-ECit/PLA	230.7±68
P-1,4-BCit/PLA	191.6±84
P-1,6-HCit/PLA	93.6±20

in vitro degradation

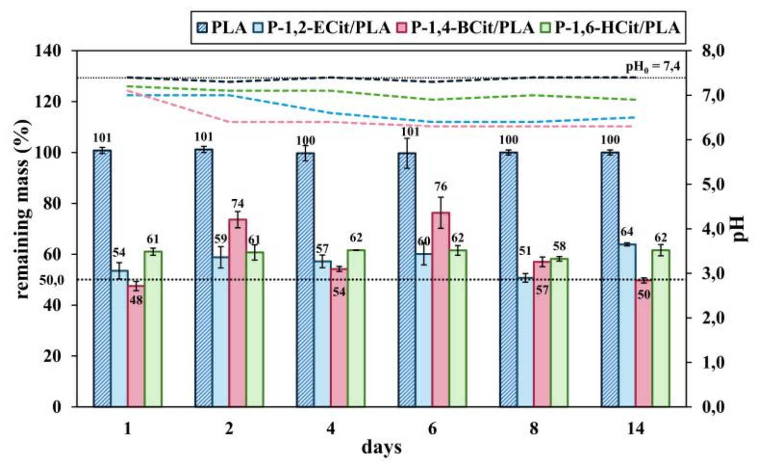


Fig. 5. Degradation pattern of the PCit/PLA and PLA nonwovens in PBS buffer (bar graph); the dashed lines represent changes in the pH value of the buffer over time.

!! thermal crosslinking

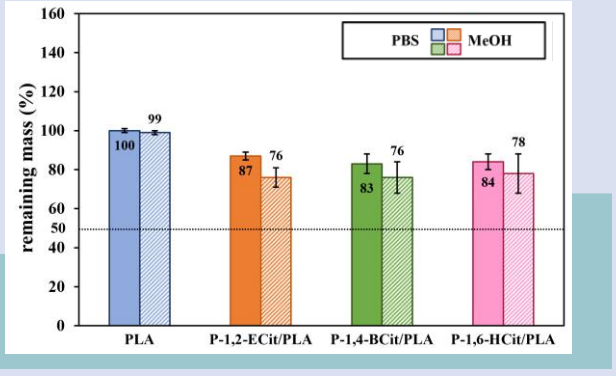


Fig. 6. Degradation pattern of the crosslinked nonwovens.

Conclusions

- well-developed, evenly distributed fibres, no structural defects
- the surface character depends on the level (macro/micro) of determination and the diol used
- the incompatibility of PCit with PLA results in material's instability in the aqueous medium
- **the solution to the problem may be to crosslink the material**