

SUPPLEMENTARY MATERIAL

Innovative wound healing utilizing bioactive fabrics functionalized with *Tormentillae rhizoma* extract: An *in vivo* study on *Wistar albino* rats

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1. Filed Emission Scanning Electron Microscopy (FE-SEM) analysis of examined fabrics

FE-SEM analysis revealed that both the untreated fabrics (CO, WO, PA, and CA) and their counterparts functionalized with *Tormentillae rhizoma* extract (CO+Extract, WO+Extract, PA+Extract, and CA+Extract) exhibit comparable surface morphology. This indicates that the functionalization process does not induce any visible morphological changes, such as increased surface roughness or film deposition. These observations confirm that the structural integrity of the fabrics remains preserved and that the functionalization likely occurs at the molecular level without significantly altering the native surface topography.

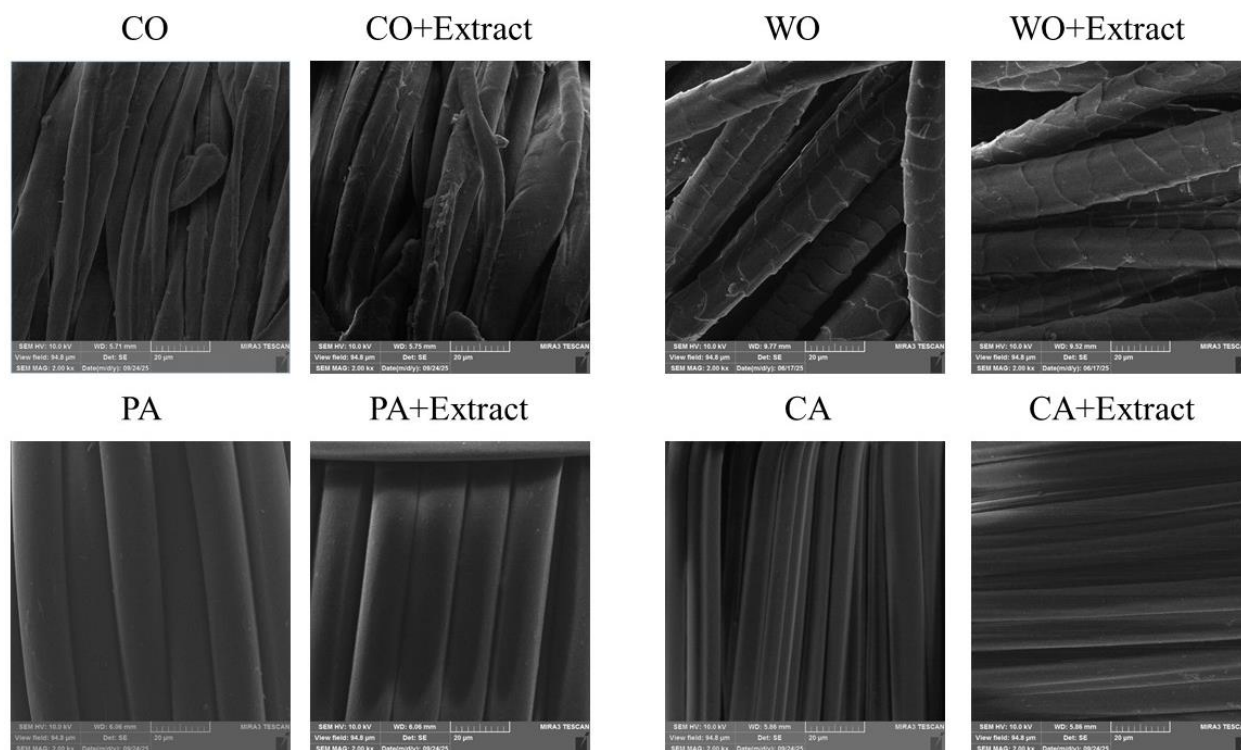


Figure S1. Microphotographs of examined fabrics.

2. ATR-FTIR spectroscopy of the studied fabrics

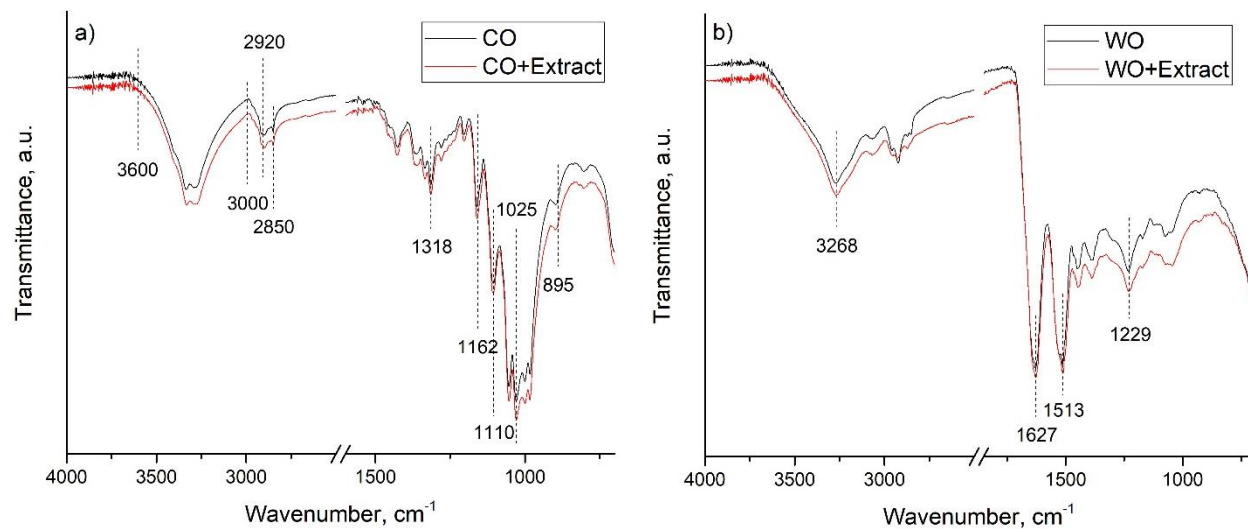
The ATR-FTIR spectrum of the CO+Extract shows no significant differences from that of CO (Fig. S2a) in terms of the position and intensity of the characteristic cellulose bands at 895, 1318, 1162, and 1110 cm^{-1} . Additionally, bands in the 3600 to 3000 cm^{-1} region (associated with hydroxyl groups), the band at 1025 cm^{-1} (characteristic for the C-O stretching of alcohol functional groups), and C-H stretchings at 2920 and 2850 cm^{-1} (indicative of methyl, methylene, and other aliphatic saturated groups) remain unchanged after functionalization. These findings suggest that the functionalization does not significantly alter the surface chemistry of the cotton fabric.

The FTIR spectrum of WO displays characteristic amide bands, as shown in Fig. S2b and 2c. The band at 3268 cm^{-1} corresponds to N-H stretching vibrations of amide A, while the strong band at 1627 cm^{-1} is attributed to C=O stretching vibrations of amide I. The band at 1513 cm^{-1} arises from a combination of N-H in-plane bending and C-N stretching vibrations (amide II), reflecting the proteinaceous nature of wool. Additionally, the band at 1229 cm^{-1} , assigned to amide III, is associated with C-N and C-O stretching vibrations. The above-mentioned confirms the presence of the typical protein backbone structure. In the spectrum of WO+Extract, all major amide bands remain present with increased intensity, suggesting that the primary structure of the wool proteins is preserved after functionalization with *Tormentillae rhizoma* extract. The most notable spectral differences between WO and WO+Extract fabrics appear in the 3000-2800 cm^{-1} region (aliphatic and aromatic C-H stretching vibrations), as shown in Fig. S2c. Specifically, the bands at 2960, 2918, 2873, and 2850 cm^{-1} become less pronounced upon functionalization. These

changes indicate the involvement of $-CH$ groups, likely from amino acid side chains, in interactions with *Tormentillae rhizoma* extract compounds during the functionalization.

Despite the presence of numerous absorption bands in the FTIR spectrum of the PA fabric, none of them exhibited any significant shift in position or change in intensity upon functionalization with the extract, PA+Extract. The bands at 3286 and 3080 cm^{-1} correspond to N–H stretching vibrations, while the bands at 2925 and 2856 cm^{-1} are attributed to CH_2 asymmetric and symmetric stretching vibrations, respectively. Bands at 1625 cm^{-1} and 1537 cm^{-1} , observed in the spectrum of the PA and PA+Extract, are assigned to N–C=O and C–N–H vibrations of the amide group, and are typically identified as amide I and amide II modes in secondary amides. Additionally, the band at 1450 cm^{-1} can be attributed to stretching, deformation, and wagging vibrations of N–H bonds. The band at 1365 cm^{-1} corresponds to the wagging vibrations of NH groups in the amide moiety. The bend centered at 1170 cm^{-1} is associated with C–CH symmetric bending combined with CH_2 twisting. Finally, the bands at 1117 cm^{-1} , 1070 cm^{-1} , and 830 cm^{-1} are related to vibrations of primary ($-NH_2$) and secondary ($-NH-$) amines.

Similar to the PA and PA+Extract fabrics, the FTIR spectrum of CA closely resembles that of CA+Extract (Fig. S2e). The characteristic bands were observed at 3464 cm^{-1} (O–H stretching), 1733 cm^{-1} (C=O stretching), 1366 cm^{-1} (C–H bending in acetyl groups), 1213 cm^{-1} (C–O stretching in acetyl groups), 1027 cm^{-1} (C–O–C stretching of the pyranose ring) and 900 cm^{-1} (O–H out of plane bending). These bands appear in both spectra with comparable intensity, position, and shape, indicating that the functionalization does not significantly alter the presence and accessibility of cellulose acetate surface functional groups.



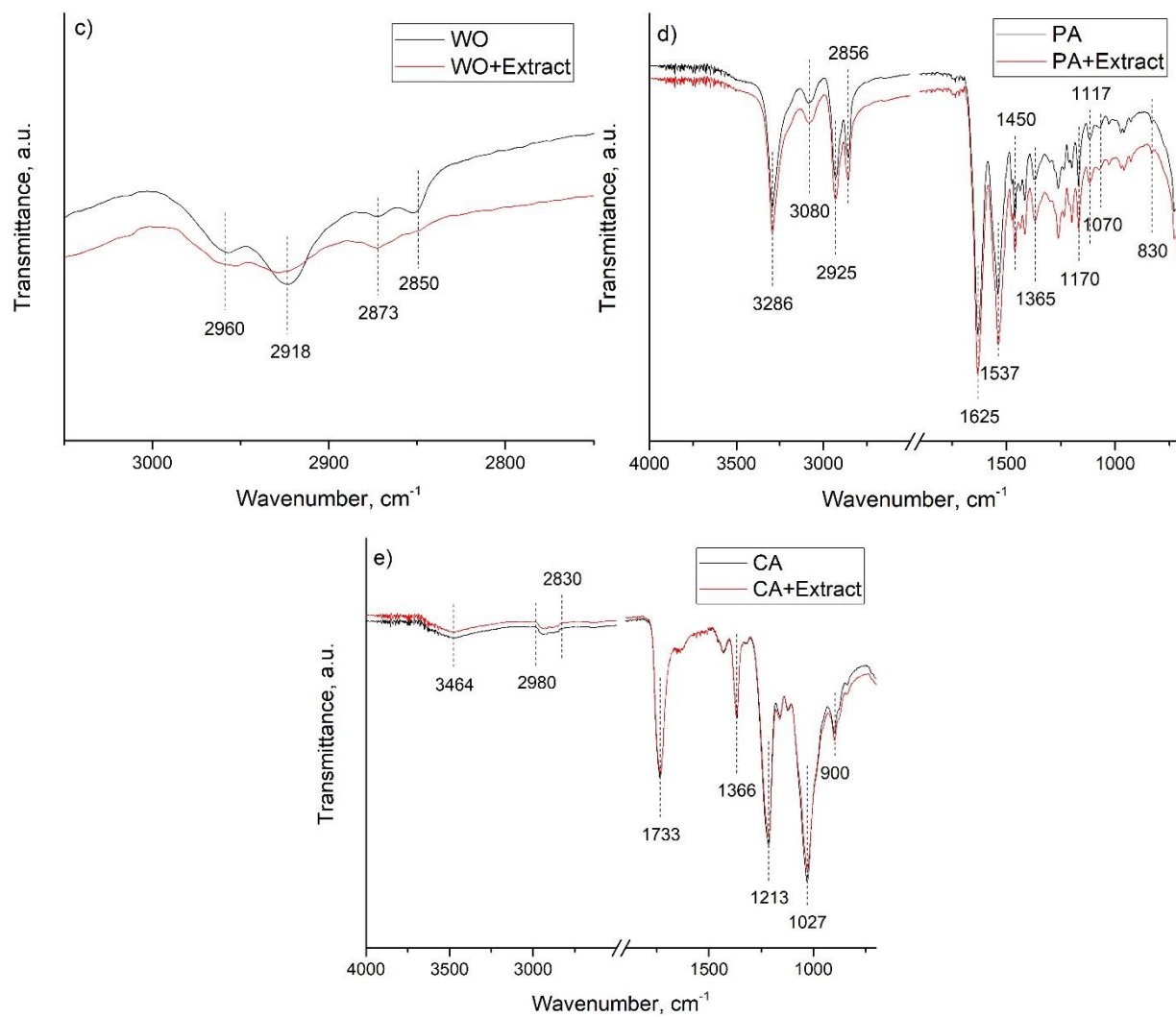


Figure S2. ATR-FTIR spectra of the studied fabrics