

The Effects of Chromium (III) on the Hierarchical Structure of Collagen Fibre

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Abstract: The effect of chromium(III) tanning on the hierarchical structure of skin collagen fibres was investigated by using a combination of field emission scanning electron microanalyser (FE-SEM), wide angle X-ray scattering (WAXS), X-ray photoelectron spectroscopy (XPS), confocal laser microRaman spectroscopy and circular dichroism (CD). The SEM observations show that collagen fibers gather in flexuous bundles where the thin fibrils exhibit a unique ~65 nm axial D periodicity by repeating dark (~0.4 D overlap) and light bands (~0.6 D gap) indicating the polypeptide chains of the collagen maintain their native triple helix conformation irrespective of chromium(III) salt at different concentrations. Moreover, nanoparticles of 20-40 nm between the fibrils were observed, and XPS reveals that they are Cr(III) ions. Further WAXS measurements reveal that the increasing concentration of chromium(III) results in the decrease of the order of intermolecular lateral packing and crystallite structure within helical chains, and the distortion of N and C telopeptide regions, due to intermolecular and intramolecular interactions via chromium(III) species. While Raman spectrum, XPS and CD measurements indicate that the triple helical structure of collagen is not destroyed by the bound chromium(III) species after tanning. The present studies show that the chromium(III) is only bound on the surface of collagen molecules in collagen fibres but does not destroy the integrated structure of the triple helices.

Key words: collagen fibre; hierarchical structure; chromium(III); triple helix