FIBRILLAR COLLAGEN STRUCTURE IN OVINE LEATHER AND RELATED MATERIALS AND ITS RELATIONSHIP TO STRENGTH

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ABSTRACT

Leather is used for a number of products including those of the garment, automotive and footwear industries. The footwear industry provides a consistent demand for leather. However, due to strength properties of leather produced from ovine skins, ovine leather is not currently used in significant quantities in this industry. A greater understanding of the structure of ovine leather could assist in designing processing steps to increase ovine leather strength. Fibrillar collagen is a major structural component of a number of tissues including skin and is the main component of leather. Small angle X-ray scattering (SAXS) is an X-ray diffraction technique that can be used to investigate fibrillar collagen structure and distribution.

A relationship is found between the orientation of collagen fibrils in ovine leather and tear strength. Stronger leather has a greater alignment of collagen fibrils parallel to the leather surface while weaker leather has more fibrils out of this plane. The fibrillar collagen structure is fairly consistent across the entire ovine leather skin, with the relationship between orientation index and tear strength maintained at all positions investigated. The fibrillar collagen structure of ovine skins changes during leather processing with the alignment of collagen fibrils, in the direction parallel to the skin surface, consistently increasing after the pickling stage.

Significant changes occur to the fibrillar collagen structure of ovine leather during uni-axial stretching. Initial strain results in reorientation of collagen fibrils followed by stretching of individual fibrils. The response to strain varies, with stretching of fibrils occurring more evenly across cross-sections in stronger samples than in weaker samples. The response of a different collagen rich material, a decellularized extracellular matrix biomaterial, to uni-axial strain is similar to that of leather.

The findings of this work greatly increase the knowledge of the fibrillar collagen structure of ovine leather. Through this work a fundamental relationship between fibrillar collagen orientation and tear strength has been identified. The results of this work can be used to develop appropriate processing techniques to create leather with desired characteristics.

The knowledge gained in this work is applicable to leathers produced from different species and may extend to other processed collagen rich tissues and tissue products.

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