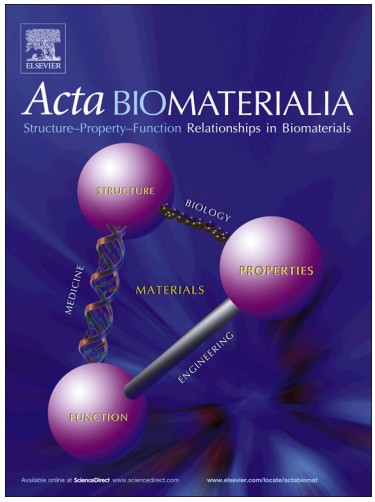


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# Structural characterization and viscoelastic constitutive modeling of skin

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## Abstract

A fascinating material, skin has a tensile response which exhibits an extended toe region of minimal stress up to nominal strains that, in some species, exceed 1, followed by significant stiffening until a roughly linear region. The large toe region has been attributed to its unique structure, consisting of a network of curved collagen fibers. Investigation of the structure of rabbit skin reveals that it consists of layers of wavy fibers, each one with a characteristic orientation. Additionally, the existence of two preferred layer orientations is suggested based on the results of small angle x-ray scattering. These observations are used to construct a viscoelastic model consisting of collagen in two orientations, which leads to an in-plane anisotropic response. The structure-based model presented incorporates the elastic straightening and stretching of fibrils, their rotation towards the tensile axis, and the viscous effects which occur in the matrix of the skin due to interfibrillar and interlamellar sliding. The model is shown to effectively capture key features which dictate the mechanical response of skin.

Keywords: dermis; collagen; constitutive equation; rabbit; viscosity.