

EVALUATION OF OCULAR IRRITANTS USING BOVINE CORNEAL HYDROGEL IN 3D AND ACELLULAR MODELS

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INTRODUCTION: The need to replace animal models in toxicological testing has encouraged the development of in vitro alternatives that are ethically responsible and biologically relevant. Due to its layered structure and transparency, the cornea presents specific challenges in modeling toxicity. Hydrogels derived from extracellular matrix (ECM) components provide a promising strategy for replicating the native microenvironment of human tissues. **OBJECTIVE:** This study aimed to evaluate the application of a hydrogel derived from bovine corneal ECM in two alternative ocular toxicity models: a 3D reconstructed epithelial model and an acellular system that simulates ECM-substance interactions. **MATERIALS AND METHODS:** Bovine corneas were decellularized and processed into a hydrogel used for both cell scaffolds and a biomolecular test solution. The 3D model was seeded with HaCaT keratinocytes and exposed to chemicals categorized under the Globally Harmonized System (GHS). Cell viability was assessed using the MTT assay, and structural changes were examined by histological staining. In the acellular approach, the biomolecular solution was exposed to the same substances, and turbidity was measured via spectrophotometry at 405 nm. **RESULTS AND CONCLUSION:** The 3D corneal model successfully supported epithelial stratification and reproduced key features of the native human cornea. It effectively distinguished irritants from non-irritants based on significant differences in cell viability and histological alterations. The acellular model demonstrated high specificity (100%) for non-irritants, showing no false positives, but low sensitivity (30%) for irritants, indicating a high false negative rate. Despite this limitation, the acellular model presents an accessible and cost-effective pre-screening tool. When combined, both models offer a robust, complementary strategy for ocular toxicity evaluation. These findings support the hydrogel's utility in simulating both tissue-level and molecular interactions, paving the way for more ethical, sustainable, and human-relevant toxicity testing in pharmaceutical, agrochemical, and cosmetic research.

Keywords: Ocular irritant; Corneal extracellular matrix; Three-dimensional model; Acellular test; Alternative methods.