Kinetic Gel Stiffness (Rheology) of Varying Concentrations of Type I Collagen - FibriCol®

The rigidity (stiffness) of the substrate to which cells adhere can have a profound effect on cell morphology and gene expression. Regulation of cell functions by the physical properties of the extracellular matrix (ECM) has emerged as a crucial contributor to development and disease. FibriCol®, Type I Collagen (10 mg/ml) Catalog No. 5133-20ML, is widely used in making 3D gels for cell culture, tissue engineering scaffolds, and biophysical and biochemical studies.

Collagen gelation is strongly affected by pH, concentration, ionic strength, ingredient quality, temperature and working conditions (time, mixing). FibriCol® collagen was tested to determine the stiffness (Young’s modulus) of 3D gels at various concentrations (8, 4, 2, 1 mg/ml). The collagen solutions for this study were prepared by adding 10X PBS, then neutralizing the mixture per the Directions for Use and then diluting with 1X PBS to the various test concentrations while maintaining at 2-8°C. Testing the stiffness was done using ElastoSens™ Bio², an innovative mechanical testing instrument that employs a non-destructive and contactless method of gelation kinetics and a rapid analysis of gel stiffness. ElastoSens™ Bio² gently vibrates a sample and laser detects the vibrational response.

The various collagen concentrations were tested for gelation kinetics and gel elasticity. The kinetic elasticity curves were mostly sigmoidal when incubated at 37 °C. At 8 mg/ml, rapid gelation onset occurred at 10 minutes, and the stiffness plateaued at ~950 Pa. At 4 mg/ml, rapid gelation onset occurred after 12 minutes, and the stiffness plateaued at ~600 Pa. At 2 mg/ml, gelation onset occurred around 22 minutes, with a stiffness plateau of ~410 Pa. At 1 mg/ml, FibriCol® never reached a rapid gelation onset, and plateaued at ~150 Pa (for each condition, n=3).

The results (see Graph 1) show that a higher collagen concentration directly leads to a faster gel onset time and an increase in gel stiffness.

Graph 1:

![Graph showing kinetic stiffness of Type I Collagen FibriCol® at various concentrations](image)