

COMPOSITE BIOINKS FOR BIOMIMETIC BONE TISSUE ENGINEERING

Generating Fibercoll-Flex-N® collagen-hydroxyapatite bioinks with tunable mechanical properties

FIBERCOLL
FLEX-N®
TECHNICAL NOTE

THE NEED

Regenerating functional bone tissue

Replicating the complex bone structure in composition and mechanics in bioprinting remains challenging due to limitations in scaffold bioactivity, mechanical robustness, and printability—critical factors for experimental reproducibility and clinical translation.

THE SOLUTION

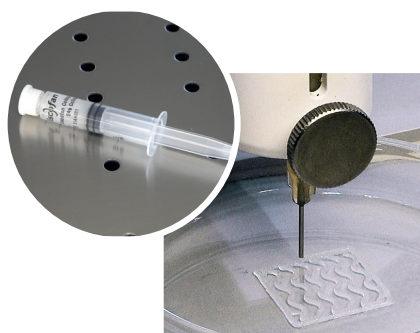
Tunable composite bioinks for viable models

By combining Fibercoll-Flex-N®, a fibrillar type I collagen bioink, with different concentrations of microparticulate hydroxyapatite (HAp) we have created a tunable bioprinted system. A step closer to natural bone composition, the 3D composite scaffolds offer robust cell viability and high print resolution.

THE IMPACT

Customized bone scaffolds for regenerative R&D

Fibercoll-Flex-N® + HAp composites represent a robust and flexible bioprinted platform for regenerative therapies for complex bone defects. The system supports high-throughput fabrication of customized scaffolds for preclinical studies in osteoconduction, mineralization, or co-cultures with stem cells.



TALK TO OUR SCIENTISTS

to discuss your bioprinting needs!
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FIBERCOLL-FLEX-N® ADVANTAGES FOR BONE TISSUE ENGINEERING

- ✓ Tunable mechanics & shape fidelity superior to traditional collagen bioinks
- ✓ Improved osteogenic differentiation potential due to HAp content
- ✓ 3D scaffolds for personalized, anatomically accurate bone grafts
- ✓ High *in vitro* cell viability and proliferation, indicating strong regenerative potential



COMPOSITE BIOINKS FOR BIOMIMETIC BONE TISSUE ENGINEERING

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FIBROCOLL
FLEX-N[®]
TECHNICAL NOTE

1. Setting up a ready-to-use protocol for Fibrocoll-Flex-N[®] + HAp composite bioinks and establishing optimal bioprinting conditions

Fibrocoll-Flex-N[®] bioink consists of complex collagen type I fibers that need to be neutralized before cell loading. We have added 5×10^6 /ml L929 cells (immortalized murine fibroblasts) to the collagen-HAp suspension to generate ready-to-use composite bioinks for 3D bioprinting.

To test printability and shape fidelity of different Fibrocoll-Flex-N[®] + HAp composite inks we have printed several 3D scaffolds with 4% Fibrocoll-Flex-N[®] bioink alone as well as mixed with three different HAp concentrations (2%, 4%, and 8% w/w) as cylinders (10x10 mm) and cubes (20x20x3 mm).

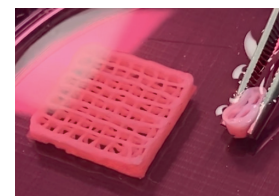


Fig. 1: Elastic scaffolds printed with Fibrocoll-Flex-N[®] 4% + HAp 4% bioink. Grid (left) and cube (right) with high shape fidelity.

2. Analysing the tunable rheology properties of the composite bioinks

We have compared the rheology properties—elastic modulus, viscous modulus and viscosity—of three different 4% Fibrocoll-Flex-N[®] + HAp composite bioinks (formulation see above) and the 4% Fibrocoll-Flex-N[®] control. The data revealed significant differences in mechanical properties of the composites and the collagen control. We also observed a positive correlation between an increasing HAp concentration with a higher elastic modulus and higher viscosity.

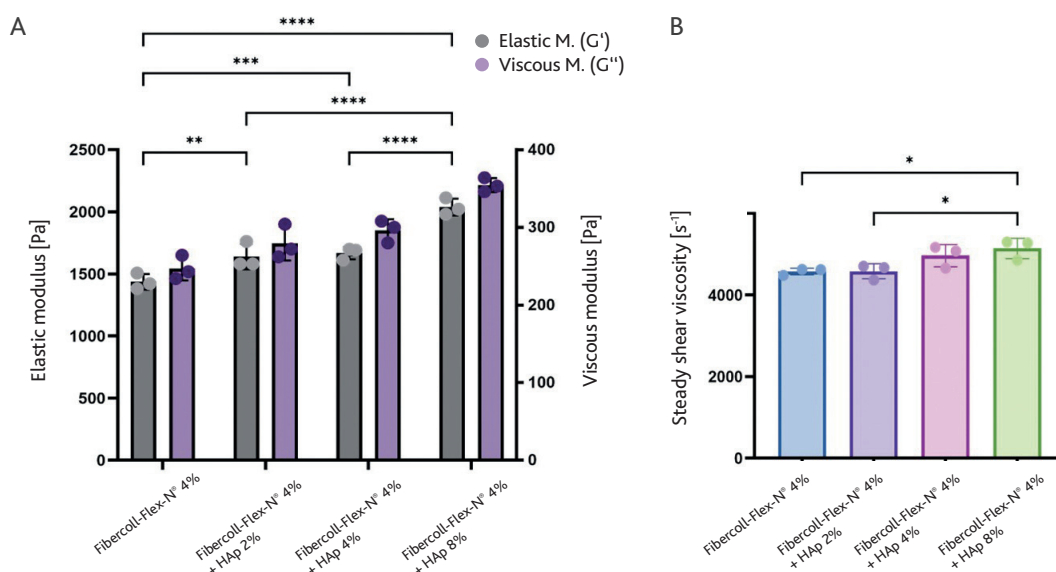


Fig. 2: Rheology data of the four formulations.

3. Evaluating cell viability of the composite bioprints

Cell viability of the composite bioprints was evaluated in cell culture experiments with Fibrocoll-Flex-N[®] 4% + HAp 8% in comparison to the control (Fibrocoll-Flex-N[®] 4%).

The scaffolds were printed at the same size as the ones used for rheological tests. The bioprints, containing 5×10^6 /ml L929 cells were checked via Live/Dead Assay[®] at day one and five. Both scaffolds showed a high amount of live cells with optimal morphology and no observable cytotoxic effects from HAp.

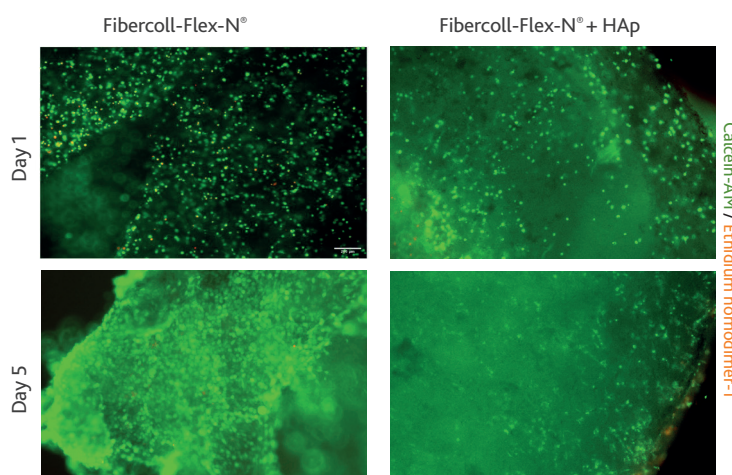


Fig. 3: Live/Dead Assay[®] (Sigma Aldrich) composite images of the Fibrocoll-Flex-N[®] scaffolds with and without HAp 8%, taken with a fluorescence microscope at day 1 and 5 of culture. Both scaffolds had a high live versus dead cell ratio.