CITREGRAFT™: Bioactive Bone Graft Substitute Enhances Bone Marrow Aspirate Applications

ACUITIVE TECHNOLOGIES

Repair | Regenerate | Resorb

ABSTRACT

Bioactive bone graft substitutes restore the structural integrity and functionality of damaged tissue by promoting osteogenesis. Acuitive Technologies Inc. (ATI) has developed CITREGRAFT, a synthetic, bioactive scaffold designed for easy handling, body fluid uptake, and growth factor retention. The purpose of this study is to characterize the bioactivity, liquid wicking, and protein interactions of CITREGRAFT.

EXECUTIVE SUMMARY/BACKGROUND

Bone graft substitutes are used to repair defects from trauma, infection, tumor removal, spinal fusion, and reconstructive surgery. However, their effectiveness is often limited by poor handling, low biological activity, variable resorption rate, and poor integration. Leveraging the benefits of citrate in bone anatomy and physiology, ATI has developed CITREGEN®, a citrate polymer technology that mimics natural bone chemistry and supplies the energy needed for regeneration. Exclusively made with CITREGEN and bioactive glass, CITREGRAFT is a highly porous and bioactive synthetic bone graft substitute designed to fill bony voids within the skeletal system *(extremities and pelvis)*. CITREGRAFT benefits include:

- ✓ Bioactive formulation
- ✓ Easily morselized
- ✓ Holds its position within the defect
- ✓ Absorbs 5 times its weight in fluids
- ✓ Synergizes with bone marrow aspirate (BMA) to improve bone regeneration and graft integration
- ✓ Increases cell energy for regeneration

RESULTS AND DISCUSSION

Bioactivity

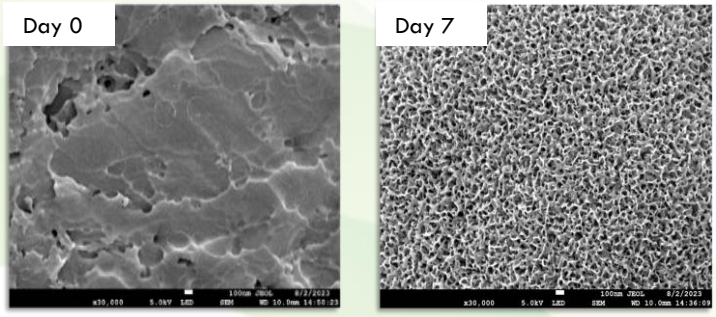

Figure 1. SEM images of CITREGRAFT surface before and after submersion in simulated body fluid (SBF) at 30,000x magnification.

Apatite, a calcium- and phosphate-rich mineral, promotes bonding between the biomaterial and native bone. A material is considered bioactive if apatite forms on its surface within a defined period during incubation in SBF. The SEM images of the CITREGRAFT scaffolds after incubation in SBF show the formation of apatite on the scaffold surface within 7 days (Figure 1), providing an osteoconductive surface to support direct bone apposition.

Liquid Uptake

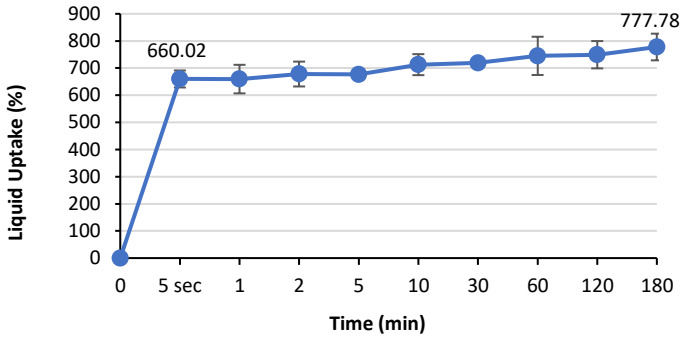

Figure 2. CITREGRAFT liquid uptake ratio (%) over time (min) in simulated bone marrow aspirate solution.

Liquid uptake was assessed by measuring the mass changes over time at 37 °C in a simulated bone marrow aspirate solution. As shown in Figure 2, the highly porous and hydrophilic microstructure of CITREGRAFT absorbs more than five times its weight in fluids. The higher sustained liquid uptake suggests efficient retention in a marrow-like environment.

Protein Binding

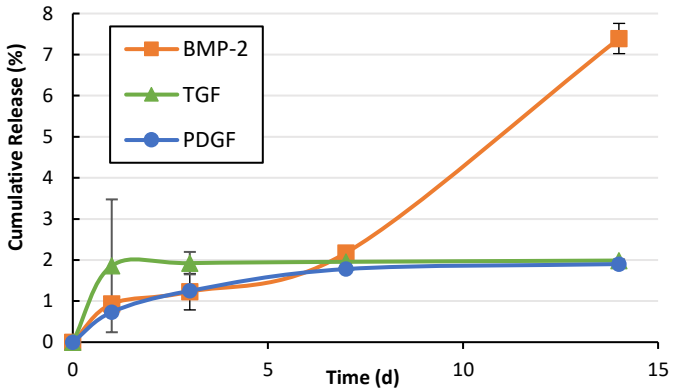

Figure 3. Cumulative release (%) of BMP-2, TGF, and PDGF from CITREGRAFT at 0, 1, 3, 7, and 14 days *in vitro*.

BMP, PDGF, and TGF were selected as model proteins due to their high abundance in BMA. As shown in Figure 3, all model growth factors exhibited strong binding to the scaffold, highlighting the strong protein interactions with CITREGRAFT and its potential to enhance bone regeneration when combined with BMA.

CONCLUSION

CITREGRAFT leverages CITREGEN technology to overcome limitations of conventional bone graft substitutes by improving handling, liquid uptake, and protein binding. Its demonstrated bioactivity and synergy with orthobiologics establish CITREGRAFT as a viable option for surgeons seeking innovative solutions for bone repair and regeneration.

References:

Acuitive Technologies. (2025). *Data on file TM251008*. Acuitive Technologies, Allendale, NJ, USA.