MEDICAL TECHNOLOGY TRANSFER

U.S. Army Medical Research and Materiel Command
Fort Detrick Maryland

Plasma-Alginate Composite Gel Matrix

For Tissue Engineering Applications

The Army seeks a partner interested in commercializing this technology

Status

Patent
US Provisional Application 62/844,327

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Title
A Plasma-Alginate Composite Material Having Improved Mechanical Support for Stem Cell Growth and Delivery

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Publications

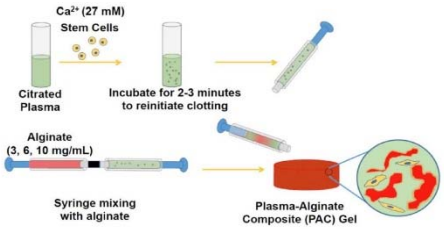
Enhancing natural clot formation for improved wound-healing applications.

The Market Need

At the heart of tissue engineering is the challenge to optimize scaffolding material with cellular constructs. Blood plasma-based biomaterials have been extensively explored, as they mimic in vivo clots that form after any injury and are therefore a natural choice for stem cell delivery or to initiate regenerative processes, notably angiogenesis. However, they cannot be used to deliver exogenous materials and are limited by their sub-optimal degradation rates, mechanical properties and insufficient durability. Alginate gels are well known for their rigidity and controlled release properties. But they lack the molecular domains to enable proper cell adhesion and growth necessary for cell delivery and tissue engineering applications.

The Technology

The inventors have developed a plasma alginate composite (PAC) matrix that, combined, address the limitations of each material alone. In the presence of calcium and without added thrombin, a plasma-alginate composite gel is formed into a combined product with separate gel domains. Optimizing the timing and order of component mixing for the PAC composite gels is the key to this invention.



Applications

The PAC hydrogel system has applications in burn and wound healing as well as soft tissue regeneration. Greater stiffness allows for greater durability and easier product application, while controlled degradation rates allow for improved timing of released materials. Because the two layers of the gel remain distinct, this allows for separate functions within a single gel. For example, the alginate domain can be loaded with an antimicrobial agent for sustained release in vivo and subsequent infection control, whereas the plasma domain can be loaded with therapeutic stem cells to enable cell proliferation and tissue remodeling.

Competition

Genetic Engineering & Biotechnology News (GEN) estimated a $9 billion "tissue engineering" marketplace and identified 49 companies, of which 21 were currently selling products. Some of those companies include Allergan, CryolifeMiMedx Group, RTI Surgical and Vericel. (February 2019, Vol. 39 No. 2). Technologies that address skin regeneration and wound healing are complex and rapidly evolving. There are 4 main approaches to delivering the cells and growth factors necessary to replicate and repair damaged tissues – topical spray, direct injection, systemic delivery and cell-seeded scaffolds.

Highlighted Benefits

- Decouples degradation rates and stiffness, allowing for constants degradation despite an order of magnitude increase in stiffness, leading to easier manipulation for clinical applications
- Adipose Stem Cells (ASC) cultured within the PAC gels remain similar in behavior to plasma-only gels. ASCs cultured in the PAC gels do not undergo significant differentiation, and stemness markers are maintained, allowing induced differentiation in in vitro or in vivo applications.
- PACs exhibit improved mechanical properties and benefit from facile fabrication

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