SMART
Singapore-MIT Alliance for Research and Technology

SMART Researchers Develop New Gelatin Microcarrier for Cell Production

Gelatin-based microcarriers offer higher yield and scalability compared to existing commercial microcarriers

- New microcarrier, or particle used in bioreactor-based cell manufacturing, offers significantly higher harvest of cells grown with over 90% harvest rate compared to 50-60% rate seen in current standards
- Homogenous microcarrier dimensions facilitate uniform environmental conditions for controlling consistent cell numbers per microcarrier
- Facilitates expansion of mesenchymal stromal cells used to treat various ailments such as heart attacks, bone defects and immune system rejection of cell therapies

Singapore, 29 October 2020 - Researchers from Singapore-MIT Alliance for Research and Technology (SMART), MIT's research enterprise in Singapore, have developed a novel microcarrier for large-scale cell production and expansion that offers higher yield and cost-effectiveness compared to traditional methods, and reduces steps required in the cell retrieval process. Microcarriers are particles used in bioreactor-based cell manufacturing of anchorage-dependent cells.

SMART's newly developed dissolvable gelatin-based microcarrier has proven useful for expansion of mesenchymal stromal cells (MSCs), a cell type of great current interest as they can be isolated from adult tissues and further expanded to treat various ailments such as bone and cartilage defects and the body's rejection of foreign bone-marrow and cells (called graft vs. host disease). This dissolvability of the microcarriers also eliminates an additional separation step to retrieve the cells from the microcarriers. This reduces the complexity of cell manufacturing and increasing the ease with which the therapeutic cells can be harvested to make the product for patients.

SMART's Critical Analytics for Manufacturing Personalized-Medicine (CAMP) Interdisciplinary Research Group (IRG) discovered that gelatin microcarriers, which fully dissolves in enzymatic treatment, can be useful in the cell recovery step – one of the current bottlenecks faced in 3D microcarrier culture. The novel gelatin microcarrier showed higher yield and reduced cell loss at the cell harvesting step compared to commercial microcarriers, with comparable cell attachment efficiency and proliferation rate.

Their discovery is explained in a paper titled "Dissolvable gelatin-based microcarriers generated through droplet microfluidics for expansion and culture of mesenchymal stromal cells" published in Biotechnology Journal and co-authored by researchers from SMART CAMP, Massachusetts Institute of Technology (MIT), National University of Singapore (NUS) and City University of Hong Kong (CityU).

“Our study achieved over 90% harvest rate of cells grown on the gelatin microcarriers, which is significantly higher than the 50-60% harvest rate seen in current standards,” said Dr. Ee Xien Ng, lead author of the paper and CAMP alumnus. “Using gelatin microcarriers also achieved tight control over microcarrier dimensions (for example, microcarrier diameter and stiffness) that facilitate uniform environmental conditions for controlling consistent cell numbers per microcarrier.”

The research also showed that MSCs cultured by gelatin microcarriers retain critical quality attributes of retrieved cells, such as a higher degree of trilineage multipotency with more balanced differentiation performance compared to commercial microcarriers. Most commercial microcarriers showed similar trends in adipogenic differentiation efficiency, while losing some degrees of chondrogenic and osteogenic differentiation capability.

“Innovations in microcarriers will aid in the scalability of certain cell types such as mesenchymal stromal cells for cell-based therapy, including for regenerative medicine applications,” says Professor Krystyn J. Van Vliet, co-author of the paper as well as Lead Principal Investigator at CAMP and Professor of Materials Science and Engineering and Biological Engineering at MIT. “Developing a microcarrier platform for MSC culture has been a key part for SMART CAMP’s understanding and managing the critical quality attributes of these cell therapy products. We hope our findings help bring about better, more efficient and scalable cell therapies with predictable therapeutic outcomes for multiple patient needs, and high harvesting efficiency of those potent cells.”

While the study focused on whether gelatin microcarriers are suitable for MSC culture and expansion, the team’s research could potentially be extended for other types of anchorage-dependent cells.

The research is carried out by SMART and supported by the National Research Foundation (NRF) Singapore under its Campus for Research Excellence And Technological Enterprise (CREATE) programme.

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About Singapore-MIT Alliance for Research and Technology (SMART) [新加坡-麻省理工学院科研中心]

Singapore-MIT Alliance for Research and Technology (SMART) is MIT’s Research Enterprise in Singapore, established by the Massachusetts Institute of Technology (MIT) in partnership with the National Research Foundation of Singapore (NRF) since 2007. SMART is the first entity in the Campus for Research Excellence and Technological Enterprise (CREATE) developed by NRF. SMART serves as an intellectual and innovation hub for research interactions between

MIT and Singapore. Cutting-edge research projects in areas of interest to both Singapore and MIT are undertaken at SMART. SMART currently comprises an Innovation Centre and five Interdisciplinary Research Groups (IRGs): Antimicrobial Resistance (AMR), Critical Analytics for Manufacturing Personalized-Medicine (CAMP), Disruptive & Sustainable Technologies for Agricultural Precision (DiSTAP), Future Urban Mobility (FM) and Low Energy Electronic Systems (LEES).

SMART research is funded by the National Research Foundation Singapore under the CREATE programme.

For more information, please visit http://smart.mit.edu

About Critical Analytics for Manufacturing Personalized-Medicine (CAMP IRG)

CAMP is a SMART interdisciplinary research group launched in June 2019. It focuses on better ways to produce living cells as medicine, or cellular therapies, to provide more patients access to promising and approved therapies. The investigators at CAMP address two key bottlenecks facing the production of a range of potential cell therapies: critical quality attributes (CQA) and process analytic technologies (PAT). Leveraging deep collaborations within Singapore and MIT in the United States, CAMP invents and demonstrates CQA/PAT capabilities from stem to immune cells. Its work addresses ailments ranging from cancer to tissue degeneration, targeting adherent and suspended cells, with and without genetic engineering.

CAMP is the R&D core of a comprehensive national effort on cell therapy manufacturing in Singapore.

For more information, please visit: https://camp.smart.mit.edu/

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