Minifridge-sized bioreactor can quickly produce T cells needed for cancer treatment

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A minifridge-sized bioreactor developed by Washington State University researchers is able to manufacture cancer-killing white blood cells at 95% of the maximum growth rate – about 30% faster than current technologies. Credit: Shelly Hanks, Washington State University

A new tool to rapidly grow cancer-killing white blood cells could advance the availability of immunotherapy, a promising therapy which harnesses the power of the body's immune response to target cancer cells.

Washington State University researchers have developed a minifridge-sized bioreactor that is able to manufacture the cells, called T cells, at 95% of the maximum growth rate—about 30% faster than current technologies. The researchers report on their work in the journal *Biotechnology Progress.* They developed it using T cells from cattle, developed by co-author Bill Davis of WSU's Veterinary College, and anticipate it will perform similarly on human cells.

In 2022, there were over 1,400 different types of therapies using T cells in development, with seven approved by the FDA for a variety of cancer treatments. Use of the therapy, called chimeric antigen receptor T cell (CAR-T), is limited, however, because of the cost and time needed to grow T cells. Each infusion treatment for a cancer patient requires up to 250 million cells.

"The manufacturing demand for this growing number of therapies is not being met, so there is a gap that needs to be filled in terms of biomanufacturing solutions," said first author Kitana Kaiphanliam, a postdoctoral researcher in WSU's Gene and Linda Voiland School of Chemical Engineering and Bioengineering. "At the end of the day, they need to be upscaled, so they can be used by more people."

The bioreactor uses centrifugal force to act on the growing cells while they are suspended as a dense, cloud and continuously bathed by the inward flow of medium containing nutrients. The prototype comes out of four decades of research on designing a centrifugal bioreactor to rapidly densify and expand cells, led by Chemical Engineering Professor Bernie Van Wie, Kaiphanliam's advisor and a co-author on the paper.

The most recent prototype is also self-contained within a sterile cabinet.

"It acts like a biosafety cabinet. It can be used in circumstances where clean manufacturing facilities are not available or easily accessible, so it can democratize these cell-based therapies," said Kaiphanliam.

The researchers are working to improve the bioreactor. They hope to add multiple chambers and expect that they'll eventually be able to produce enough cells in three days for three doses of a therapy. They also plan to start testing with human T cells and have begun communicating with cancer researchers on beta testing at Fred Hutchinson Cancer Center. Kaiphanliam and co-author Brenden Fraser-Hevlin have also started a company, Ananta Technologies Inc., with the idea of eventually producing and marketing the technology.

"I recognized the potential that this bioreactor could have on cell-based therapies and manufacturing for these therapies, and I didn't want to see it stuck in an academic laboratory," said Kaiphanliam. "I really hope having novel technologies to help with manufacturing reduces that financial barrier for these life-saving therapies."

To protect the associated intellectual property and further enhance the commercial value of this technology, the Office of Commercialization has filed a U.S. patent application that is pending.

More information: Kitana M. Kaiphanliam et al, Development of a centrifugal bioreactor for rapid expansion of CD8 cytotoxic T cells for use in cancer immunotherapy, *Biotechnology Progress* (2023). DOI: 10.1002/btpr.3388

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