TheScientist
EXPLORING LIFE, INSPIRING INNOVATION

READ THIS ARTICLE ONLINE

Removing the Animals from Lab-Grown Meat

Growing meat in a laboratory may seem like science fiction, but researchers around the world are perfecting the culture of animal muscle intended for human consumption.

Niki Spahich, PhD
May 9, 2022

The number of people desiring sustainable food options is on the rise, and meat grown in the laboratory rather than on the farm is gaining attention. Cultured meat is made from stem cells called satellite cells that differentiate into mature skeletal muscle. While the promise of cultured meat may be changing how people think about eating animals, the recipe for growing skeletal muscle needs updating.

In a recent study published in *Nature Food*, Joshua Flack, cell biology team lead at the Mosa Meat cultured meat company, described a new cell culture medium for differentiating cow satellite cells into skeletal muscle.[1] Their goal was to cut fetal bovine serum (FBS) out of the recipe. FBS is an additive in most culture media that provides optimal conditions for cell growth through a mixture of

nourishing molecules. But FBS derives from bovine fetal blood. Because of its animal origins, many researchers have sought serum-free options.

“The whole aim of cultured or cultivated meat is to try to replace the meat industry, or part of the meat industry, with a much more sustainable alternative,” said Flack. “It's somewhat counter-intuitive if you're still using animal-derived products to do that.”

To develop the medium, Flack explored the cellular responses of bovine satellite cells during differentiation to figure out what drives their maturation into skeletal muscle cells. Researchers typically differentiate these cells through a process called serum starvation, where cells are first grown in an FBS-rich environment followed by a shift to a medium with low levels of FBS. Flack determined the gene expression changes enabling this cellular reprogramming by performing RNA sequencing (RNA-seq) and proteomic analyses on bovine satellite cells throughout serum starvation and found that a plethora of genes were up- or down-regulated.

“Trying to work out exactly where to start from was perhaps one of the biggest challenges,” Flack said. “We had over 2,000 differentially-expressed genes in total in the dataset across these different time points of differentiation that we measured.”

Flack found genes in his dataset that related to muscle development, protein folding, and cell-cycle inhibition. Several of the upregulated genes encoded cell surface receptors. The scientists reasoned

that activating these receptors may trigger differentiation in the absence of serum starvation.

Through some trial-and-error, they formulated a medium that triggered the same cellular mechanisms as serum starvation. As skeletal muscle cells mature, they fuse together to form multinucleate fibers that contract. When Flack grew satellite cells in the serum-free medium, he observed that the maturing cells fused together, had similar gene and protein expression profiles, had the ability to contract, and formed 3-D muscle structures, all to a similar degree as cells grown in serum starvation conditions.

“It was always the case, in my opinion, that cultivated meat could be done without serum…and this is, I think, the first really concrete demonstration of that,” said Elliot Swartz, lead scientist of cultivated meat at The Good Food Institute, who was not involved in this study. “A lot of companies don't put that information out in the open. And so being able to do that increases transparency from a consumer standpoint; it adds legitimacy from a scientific standpoint.”

Flack next plans to remove the animal-derived components from the rest of the cultured meat process, including other growth media and hydrogels and scaffolds that support the growing muscle. “We're currently in the process of scaling up that fully animal-free version,” said Flack.

Reference

1. T. Messmer et al., “A serum-free media formulation for cultured meat production supports bovine satellite cell differentiation in the absence of serum starvation,” *Nat Food*, 3:74-85, 2022.