

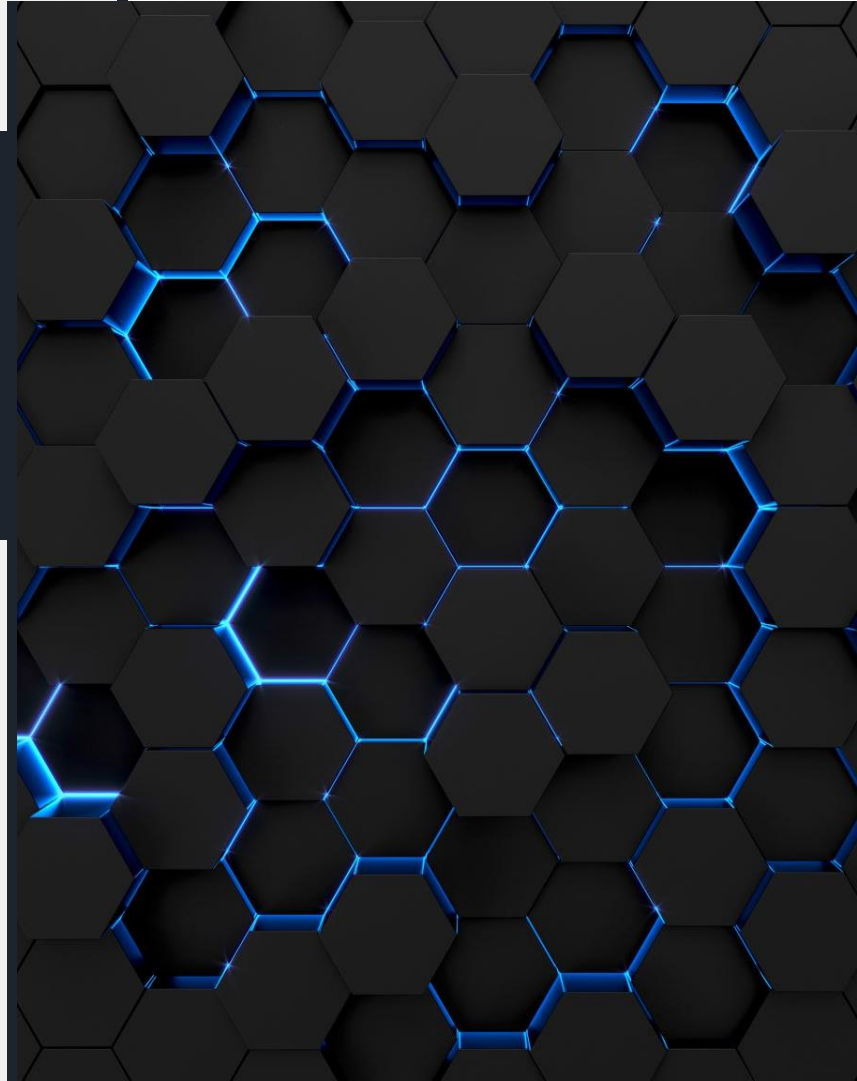


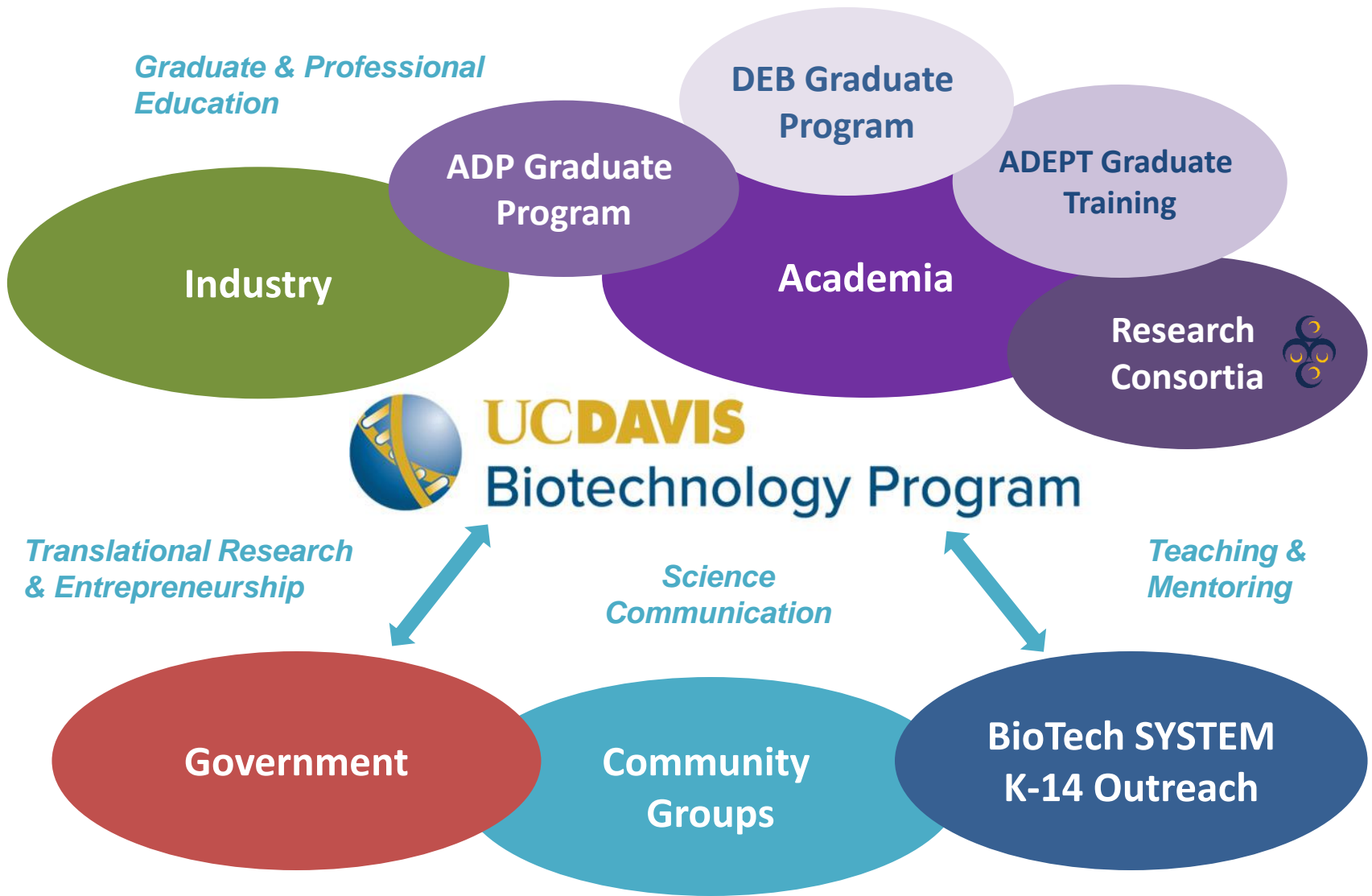
UC DAVIS CULTIVATED MEAT CONSORTIUM

December 3, 2024

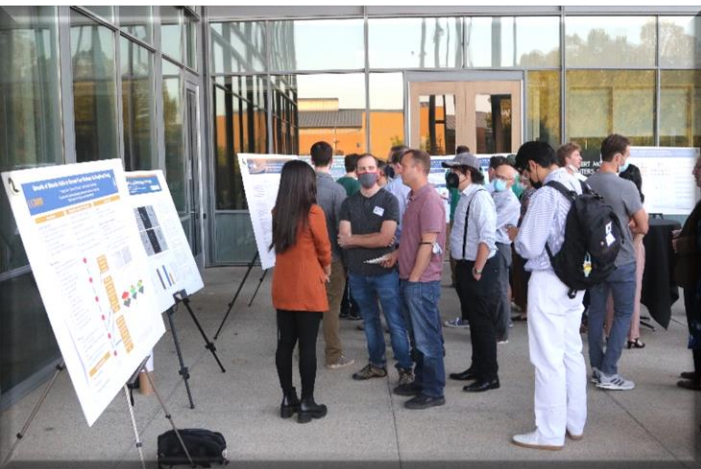
Dr. Denneal Jamison-McClung

- Director, [UC Davis Biotech Program](#)
- Co-founder, [UC Davis Cultivated Meat Consortium](#)
- Leadership Team, [Integrative Center for Alternative Meats and Proteins \(iCAMP\)](#)





Established in 1986 and reporting to the Office of Research, the UC Davis Biotech Program works to bring all members of the life science community together to promote biotechnology education and technology development.



UC Davis Cultivated Meat Consortium (CMC)

- Biotech Program has been actively engaged in hosting industry speakers and placing students in internships in the alt protein / cultivated meat industry since ~2015.
- CMC formed in late 2019 to bring together interested students, faculty researchers and educators at UC Davis – co-founded with Prof. David Block.
- In 2024, we officially added a focus on alternative proteins (fungal and plant-based) and formed the Integrative Center for Alternative Meat and Protein (iCAMP) with Executive Director, Kara Leong.
- UC Davis faculty have internal and external funding on a variety of research and education projects for alt proteins and cultivated meat.

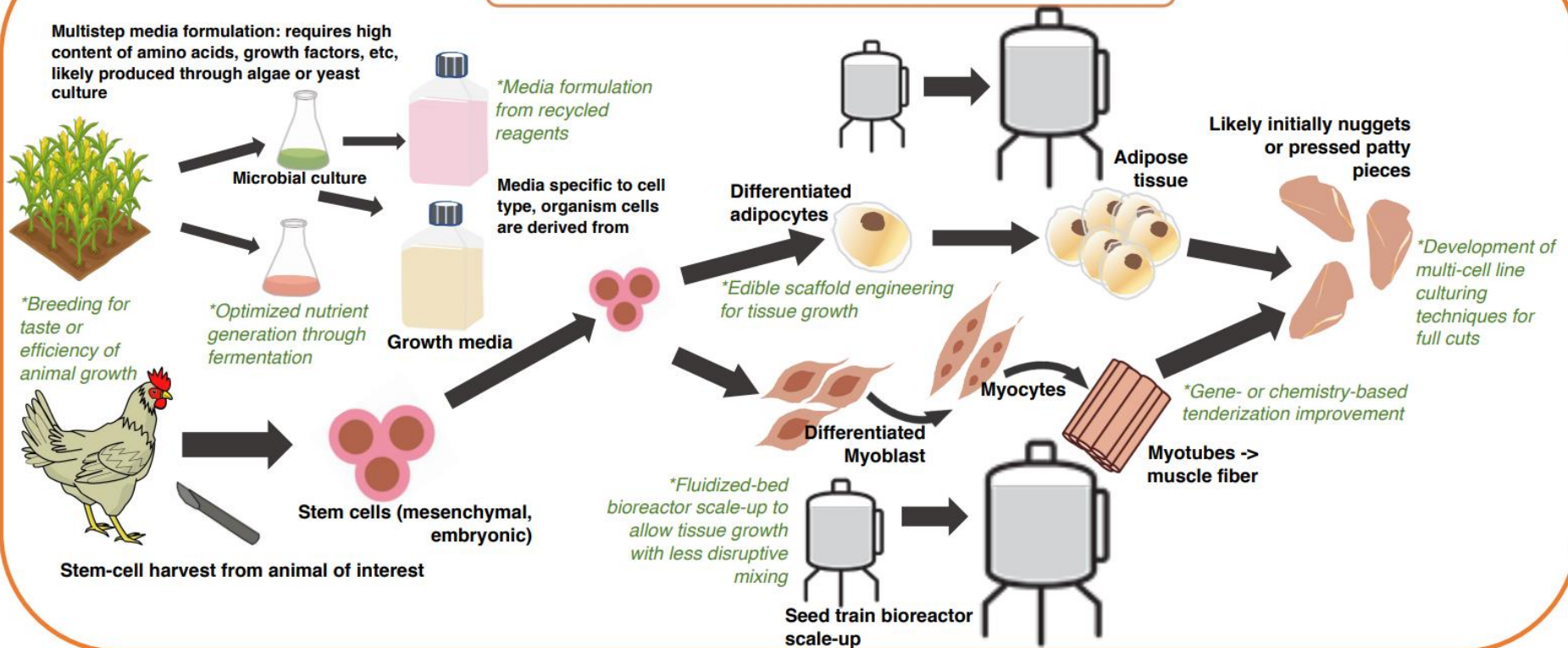
Foundational Biotech Platforms for Cell Ag Biomanufacturing

Interdisciplinary Biotech!

- Nutrition and food chemistry
- Molecular and cell biology
- Synthetic biology and metabolic pathway engineering
- Bioprocessing
- Tissue engineering and materials science



Cultured Animal Tissue Production



Infographic created by Dr. Rachel Danielson for her DEB blog, "Cellular Ag: Giving Your Plate a Biotech Reboot - Part 1" (Jan 19, 2022).

<https://biotech.ucdavis.edu/blog/cellular-ag-giving-your-plate-biotech-reboot>

**Breeding for
taste or
efficiency of
animal growth*

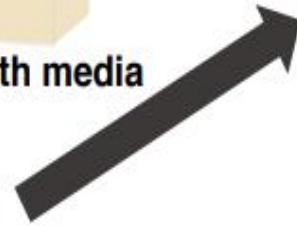


Stem-cell harvest from animal of interest



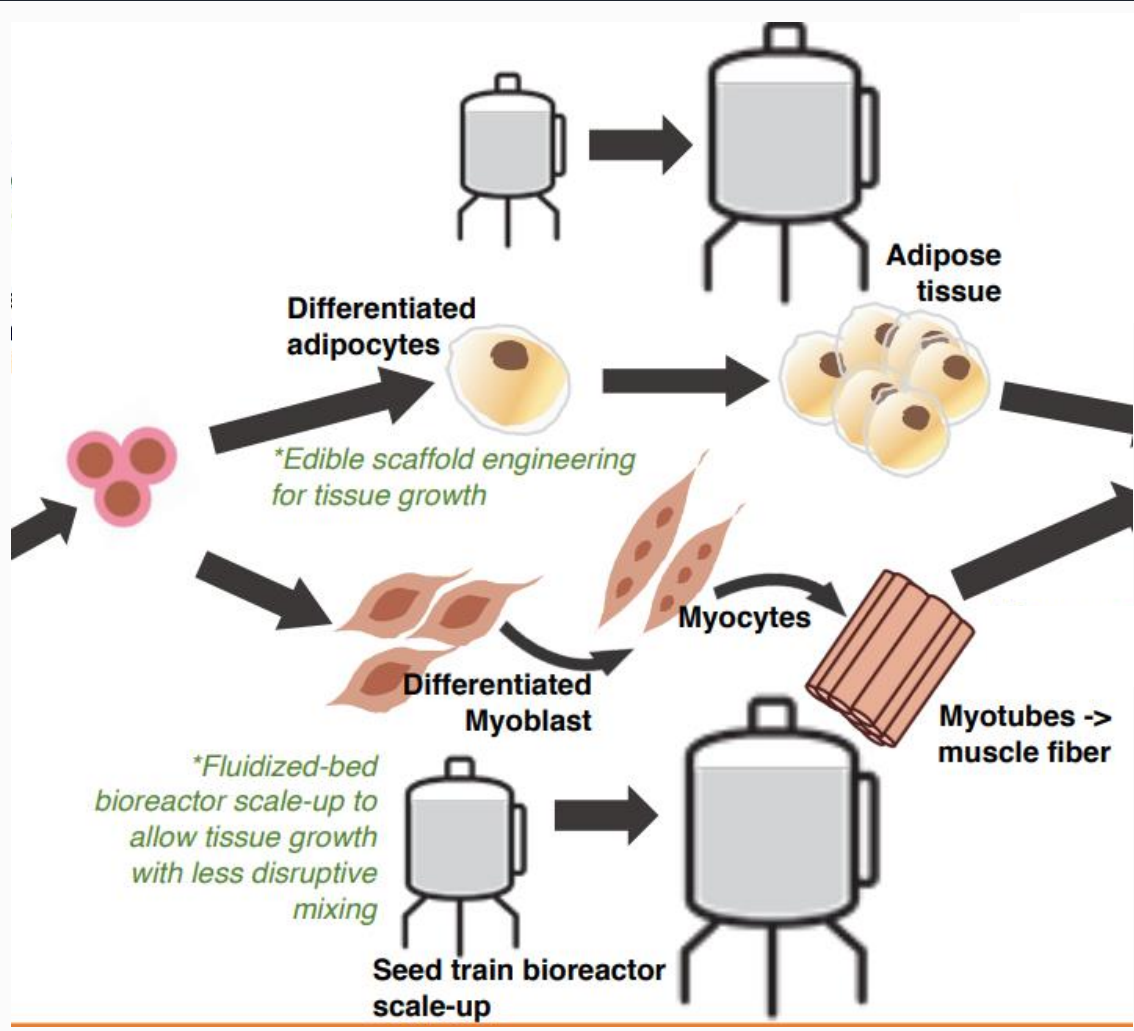
**Stem cells (mesenchymal,
embryonic)**

Growth media



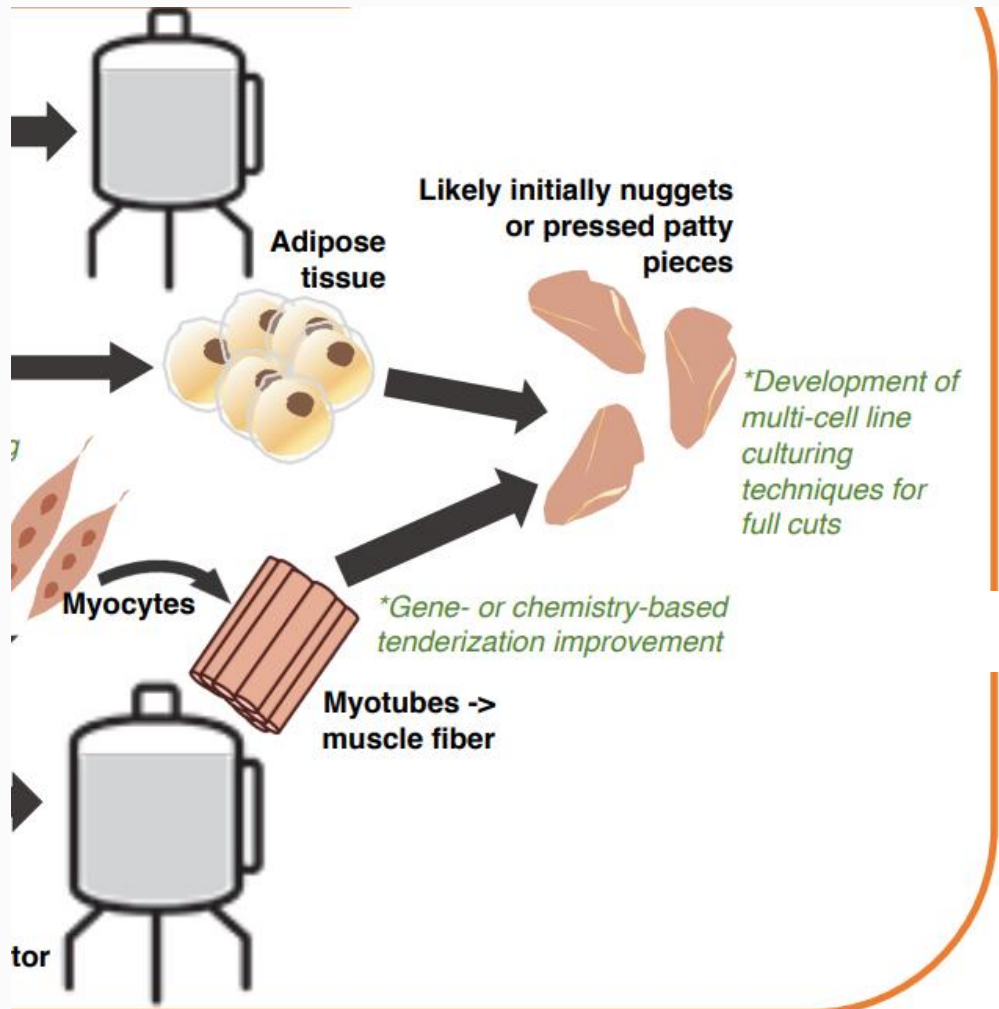
**CULTIVATING STEM
CELLS AND
ASSEMBLING
TISSUES**

*STEP 1 –
ESTABLISH A CELL
LINE*



CULTIVATING STEM CELLS AND ASSEMBLING TISSUES

STEP 2 - GROW AND DIFFERENTIATE CELLS



CULTIVATING STEM CELLS AND ASSEMBLING TISSUES

STEP 3 –
COMBINE CELLS
AND TISSUES INTO
MEAT PRODUCTS

Rationale for Cultivated Meat and Alt Protein Research

Global demand for meat / protein is high and will increase dramatically as diets/economies change

Protein sourcing for many traditional diets (e.g., ranching, fishing) have unsustainable environmental and human health impacts (e.g., antibiotic resistance, pandemic potential)

Low resource environments inhabited by people will need alternative sources of protein (e.g., low earth orbit and space, during times of drought / extreme weather events)



Future Foods for Space!



Future Foods for Space (FFS):
mobilizing terrestrial food sustainability for Earth-independent resilience

Research and Innovation Symposium

New Investigator Pilot Research Projects

Research & Innovation Training Workshop

Mentorship Network

Educational Webinar Series

Shown: cell-based meat

Funded in May 2024 by the Baylor College of Medicine's [Translational Research Institute for Space Health \(TRISH\)](#) - [Space Health Ingress Program \(SHIP\)](#) through NASA NNX16AO69A.

PI Denneal Jamison-McClung (UC Davis)

Co-PI David Kaplan (Tufts University)

Co-PI Karen McDonald (UC Davis)

Co-PI Matt McNulty (Tufts University)

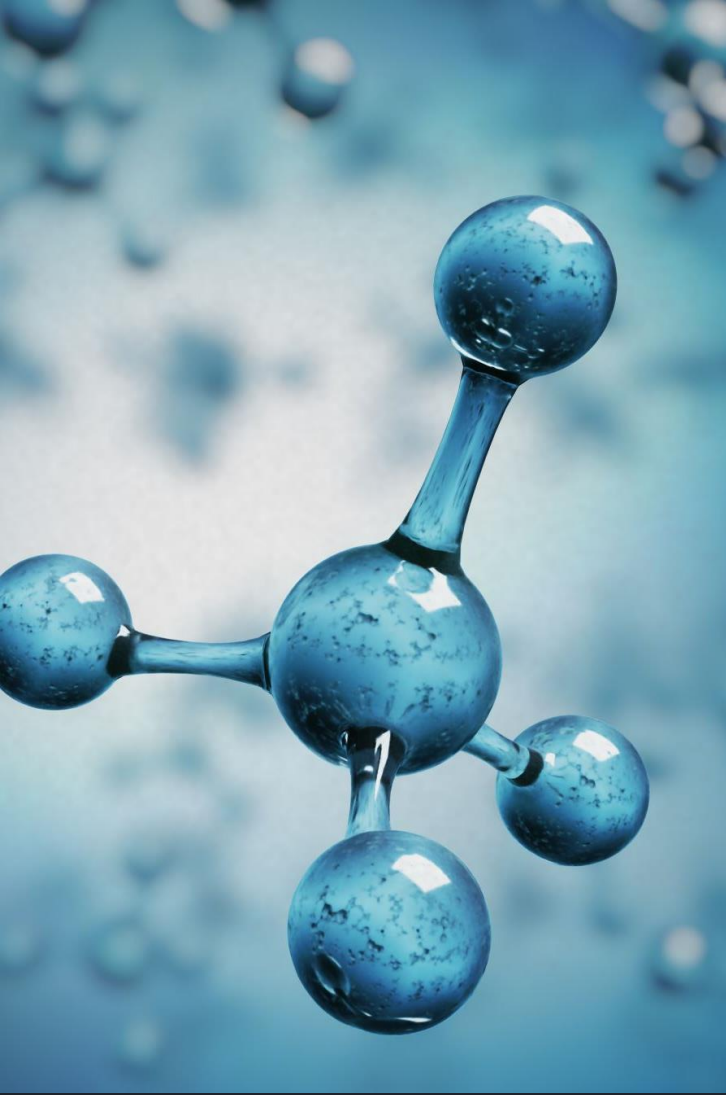
Co-PI Somen Nandi (UC Davis)



TRANSLATIONAL
RESEARCH INSTITUTE FOR
SPACE HEALTH



CULTIVATED
MEAT
RESEARCH AT
UC DAVIS



The \$3.55M NSF Growing Convergence Research (GCR) Award, “Laying the Scientific and Engineering Foundation for Sustainable Cultivated Meat Production” was first in the U.S., funded to:

Establish Cell Lines

Develop an efficient strategy for stem cell amplification and differentiation to muscle, fat, and connective tissue that maintains cell line stability and supports scalability.

Optimize Media and Processing

Develop inexpensive, serum-free media and establish large scale bioprocessing for cultivated meat production.

Create Scaffolds

Develop biomaterials and processes to create three-dimensional tissue structure.

Conduct Economic & Sustainability Analyses

Develop techno-economic analysis (TEA) and life cycle analysis (LCA) for cultivated meat production.

2020 National
Science Foundation
Award #2021132

Cell Lines for Cultivated Meat

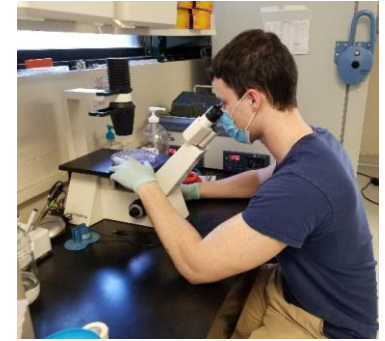
- Smith Lab (Neurobiology, Physiology and Behavior)
 - Specializes in growing skeletal muscle for repairing muscles -> applying knowledge to cell culture and structure products
 - Role for alginates or other microcarriers/matrices for promoting cell division and growth

- Denicol Lab (Animal Science)
 - Specializes in reproductive biology -> investigating age and type of cells best for starting cell cultures
 - Possible role for embryonic stem cells (can tolerate more divisions before differentiation)



Cell Culture Media Optimization

- Block and Baar Labs working on media that is:
 - Serum-free
 - Antibiotic-free
 - Less costly
 - Reduce/optimize required basic components
 - Piloting use of complex ag residues (cheaper, less refined)

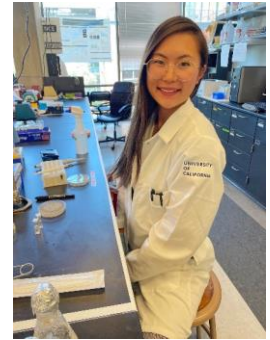


- Publications

- Cosenza, Z., Astudillo, R., Frazier, P. I., Baar, K., & Block, D. E. (2022). Multi-information source Bayesian optimization of culture media for cellular agriculture. *Biotechnology and Bioengineering*, 119(9), 2447–2458.
- Cosenza, Z., Block, D. E., & Baar, K. (2021). Optimization of muscle cell culture media using nonlinear design of experiments. *Biotechnology Journal*, 16(11), 2100228.
- O'Neill, E. N., Cosenza, Z. A., Baar, K., & Block, D. E. (2020). Considerations for the Development of Cost-Effective Cell Culture Media for Cultivated Meat Production.

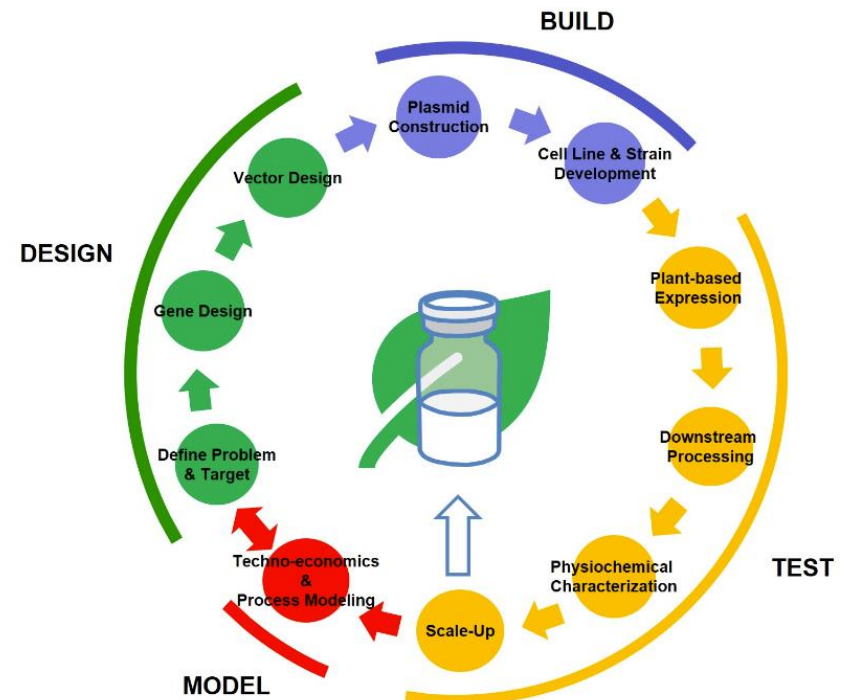
Edible Microcarriers

- Block and McDonald Labs working on microcarriers:
 - Fungal and plant cells
 - Promote / compatible with cell culture
 - Edible / add flavor
 - Inexpensive
- Provisional Patent
 - Ogawa, M., & Block, D. E. (provisional). *Compositions including filamentous fungal biomass and cultured animal cells, and methods of forming and using.* (Patent No. 0652.000004US60).
- Start-Up Company
 - Optimized Foods
 - Cell-cultured caviar
 - Edible fungal carriers
 - [March 2023 DEB Blog "Which Came First: the Egg or... the Egg? How Scientists are Reimagining Caviar as Fish-less Fish Eggs" by Dr. Natalie Sahabandu](#)



TEA for Cultivated Meat

- McDonald / Nandi Lab Group
 - Lab specializes in plant-based cell culture and is looking at TEA models and plant-based microcarriers for cultivated meat
 - TEA modeling supports use of 260,000L or larger air lift bioreactors for a “cost of goods” COGS of \$13.0/kg.
- Publication
 - Negulescu, P. G., Risner, D., Spang, E. S., Sumner, D., Block, D., Nandi, S., & McDonald, K. A. (2022). *Techno-Economic Modelling and Assessment of Cultivated Meat: Impact of Production Bioreactor Scale* (<https://doi.org/10.1002/bit.28324>).





Creating Scaffolds

Easy – Unstructured Products (e.g., meatballs, sausages, “chicken” nuggets)

Difficult – Structured Products (e.g., whole meat cuts with layered tissues – chicken breast, marbled steak, salmon filet)

Create biomaterials and processes that allow creation of three-dimensional tissue structure.
(Research Team - J. Kent Leach and Jiandi Wan)

UC Davis Faculty Research Programs for Cultivated Meat include:



Protein Analytics

Nutritional Content

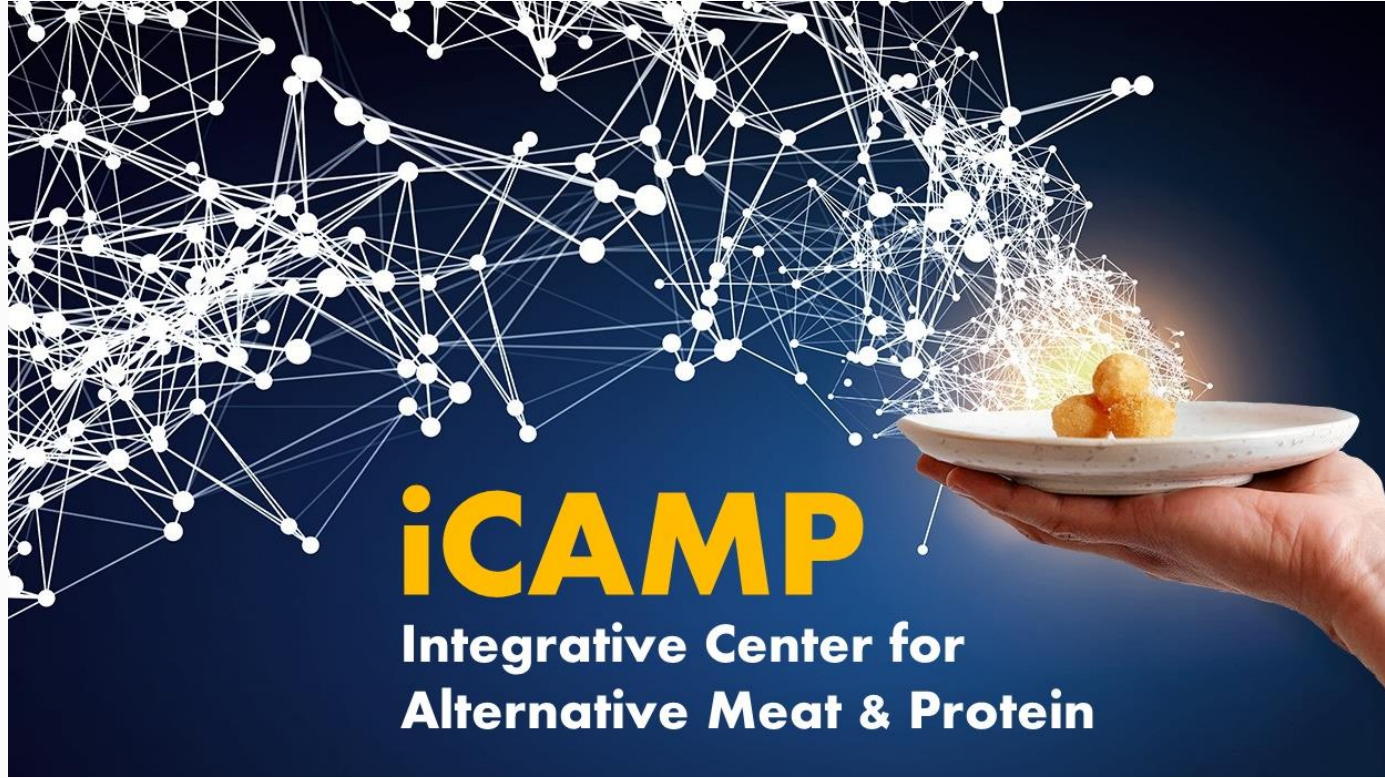
Food Safety

Sensory Science

Consumer Preferences

CMC faculty working in these areas include:

A, Oberholster, D. Sumner, A. Taha, P. Vahmani,
L. Wang, R. Zhang, and others...



iCAMP

**Integrative Center for
Alternative Meat & Protein**



iCAMP Mission



Meeting the growing global demand for delicious, nutritious, and affordable protein-rich foods.

Developing products and processes to make commercialization faster and more sustainable.

Identifying food properties driving consumer preference.



iCAMP Comprehensive Center

The first comprehensive center of excellence accelerating the commercialization of plant, fungal/fermentation, cell-based alternative meat and proteins.



PLANT BASED



FUNGAL BASED



CELL BASED

UC Davis has deep expertise in plant science and crop breeding, and is home to the unique Phaff Yeast Culture Collection – iCAMP expands CMC research and we are excited about hybrid products.

iCAMP Partnership



iCAMP EXECUTIVE LEADERSHIP



iCAMP Center Director
Professor David Block

deblock@ucdavis.edu
[David Block | LinkedIn](#)



iCAMP Executive
Director
Kara E. Leong

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iCAMP Co-Director
Professor Amy Rowat

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iCAMP Education &
Workforce Training Lead
**Dr. Denneal Jamison-
McClung**

dsjamison@ucdavis.edu
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Overarching Goals...

Develop hybrid products that smell and taste great, are affordable, and support human nutrition similarly or better than traditional meats (e.g., more fiber, phytonutrients)

Open new markets for traditional agricultural producers and fishing industry

Optimize the bioeconomy - use of plant/crop waste streams for fermentation of the alt proteins and cells to be blended

QUESTIONS?

