Case Studies of New Technologies and Their Challenges

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Disclosures

Liz Specht is employed by The Good Food Institute, a 501(c)3 nonprofit organization.

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Global demand for meat is on the rise, *despite* increasing consumer awareness of its environmental burden

2005 vs. 2050 (in tons)

Source: Food and Agriculture organization of the United Nations, ESA Working Paper No. 12-03, p. 131
We cannot continue with business as usual
Sustainable food systems require radically rethinking meat – not incremental efficiency gains

Feed (calories) → Movement; thermal energy; growing bone, brain, feathers, etc… → Food (calories)
Animal agriculture is “one of the most significant contributors to the most serious environmental problems, at every scale from local to global.”

– Livestock’s Long Shadow, 2006, UN FAO
In their latest test, Consumer Reports found bacterial contamination on 97% of chicken.

Drug resistant infections kill half a million people a year

Superbugs could cost the world $100 trillion by 2050

Despite increasing awareness that eating animal meat is harmful, consumption continues to rise.
Two solutions: plant-based meat and cell-based meat

PLANT-BASED MEAT

CELL-BASED MEAT
What is Plant-Based Meat?

Plant-based meat products are structured plant- or fungus-derived foods designed to replace animal-based meat either as stand-alone products or within recipes.
New technologies unlock opportunities to achieve functionality throughout production.
Crop Analysis and Optimization

Develop plant crops with the end application in mind (functionality, taste, nutrition, ease of isolation).
Raw Material Sourcing and Optimization

Methods to **isolate** and **functionalize** raw materials for plant-based meats
Composition and Process Optimization

Establishing the correct mix of ingredients and processes to create the desired taste, texture, smell, and structure.
Data will accelerate the next phase of plant-based meat

DATA COLLECTION AND ANALYSIS
- GENOTYPE
- PHENOTYPE
- MACRONUTRIENTS
- MICRONUTRIENTS

- FUNCTIONALITY
- PROTEIN STRUCTURING
- CONSUMER PREFERENCE
- SOIL CONDITIONS
Two solutions: plant-based meat and cell-based meat

PLANT-BASED MEAT

CELL-BASED MEAT
What is Cell-Based Meat?

Cell-based meat is genuine animal meat that can replicate the sensory and nutritional profile of conventionally produced meat because it’s comprised of the same cell types arranged in the same three-dimensional structure as animal muscle tissue.
Cell-Based Meat Production at Scale

**CELL LINE DERIVATION**
A small sample of cells is obtained from an animal.

**Phase 1: Cell proliferation**
The cells are added to a bioreactor along with cell culture media, which causes the cells to proliferate.

**Medium Recycling**

**CELL STARTER CULTURE**

**Phase 2: Tissue Perfusion**
A change in culture conditions pushes the cells to differentiate into muscle, fat, and connective tissue.

**CELLS AT MATURATION**
Primarily muscle, fat, and connective tissue.

- **Fat Cell**
- **Muscle Cell**
- **Fibroblast Cell**

*Scaffolding*
World Firsts

^ 2013 Prof Mark Post
World’s First Cell-Based Burger Patty

< 2016 Memphis Meats
World’s First Cell-Based Meatball

< 2017 Memphis Meats
World’s First Cell-Based Chicken & Duck

^ 2017 Finless Foods
World’s First Cell-Based Fish
The competitive landscape at the end of 2016
The competitive landscape today

And many more…

gfi.org
How saturated is the meat alternatives field?

What is the opportunity for exploratory research to translate into a revolutionary commercial reality?
$1.275 Billion Invested
in Plant-based and Cell-based Meat, Egg, and Dairy Companies

Source: Crunchbase; YTD as of 8/18
Strategic Investors and Partners
Meat alternative development is *highly* tractable.

Spheres represent global R&D investment into renewable energy in a single year (2011).

Total combined R&D into meat alternatives, across all years: *about $1-2 billion*

Data: Global Trends in Renewable Energy 2012
Key takeaways

• **New technologies are unlocking opportunities** to develop **the next generation of meat** using more sustainable production methods.

• Two of the most promising solutions to meet growing global protein demand are **plant-based meat** and **cell-based meat**: using plant-based ingredients and animal cells as more sustainable inputs and units of production.

• While the alternative protein field has garnered buy-in from notable industry incumbents and investors, **there is still substantial room for innovation** to advance plant-based and cell-based meat products.