Cultured...well, what is it: A discussion of the techniques, regulation, and outlook for food produced with cultured animal cells

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National Animal Nutrition Program
NANP Summit 2019
Synonyms

- Artificial meat
- Cultured meat
- Clean meat
- Fake meat
- In vitro meat
- In vitro muscle
- Lab grown meat
- Meat without animals
- Meat without slaughter
- Synthetic meat
What's in a name? That which we call a rose by any other name would smell as sweet.

- Identification
- Regulatory/Safety oversight
- Labeling
- Marketing
- Consumer perception

Juliet Capulet, A long time ago
Definition of Meat

- Animal tissue considered especially as food
  - Merriam-Webster

- The flesh of animals used as food. In practice this definition is restricted to a few dozen of the 3000 mammalian species; but it is often widened to include, as well as the musculature, organs such as liver and kidney, brains and other edible tissues
  - Lawrie’s Meat Science 7th ed.

- Part of the muscle of any cattle, sheep, swine, or goats which is skeletal or which is found in the tongue, diaphragm, heart, or esophagus, with or without the accompanying and overlying fat, and the portions of bone (in bone-in product such as T-bone or porterhouse steak), skin, sinew, nerve, and blood vessels which normally accompany the muscle tissue and that are not separated from it in the process of dressing
  - Does not include muscle found in the lips, snouts, or ears
  - 9 CFR 301.2 (FSIS-USDA)
Meat According to the AMSA

**Meat** - Skeletal muscle and its associated tissues derived from mammalian, avian, reptilian, amphibian, and aquatic species *harvested for human consumption*. Edible offal consisting of organs and non-skeletal muscle tissues are also considered meat.

A Quick Distraction

Should edible insects and insect protein powders be classified as meat?

• Classified in the Kingdom of Animalia
• Definition of meat – tissues from ANIMALS consumed as food

• The AMSA does not classify insects or insect powder as meat, however, they are included in the list of acceptable topics in the organization’s journal

• Why...?
• 2017 – U.S. harvested **9.4 billion** animals (cattle, pigs, sheep, turkeys, chickens) under federal inspection

• 2017 – U.S. produced **52.13 billion** pounds of red meat
  – 26.3 billion lbs of beef
  – 25.6 billion lbs of pork
  – 80.2 million lbs of veal
  – 150.2 million lbs of lamb/mutton

Perspective

• 2017 – U.S. produced **48.1 billion pounds of poultry**
  – 42.2 billion lbs of chicken
  – 5.9 billion lbs of turkey

100.23 billion lbs of meat produced in the U.S. in 2017

Per capita consumption of meat and poultry was 182.2 pounds.
Daily Meat Consumption

4.8 oz

Men

3.1 oz

Women

2018 - Scope of the Meat Industry

US Meat Industry (retail)
(Sales = $200 billion USD)

Plant-based Alternatives
(Sales = $4.1 billion USD)
- Meat
- Milk
- Cheese
- Yogurt
- Etc.

Retail sales of plant-based food alternatives has increased 17% from August 2017 through August 2018

Rabobank Talking Points, February 2019
Conversion of Muscle to Meat
• Meat scientists do not have enough information about cultured tissue to determine whether it should be called meat or how it should be regulated.

• Please note that samples of cultured tissue have not been available for evaluation of the safety, composition, nutritional bioavailability, functionality and sensory properties to understand how it compares to meat from conventional animal production.
Federal Responsibility for the Regulation of Food Safety in the U.S.

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https://www.fda.gov/AboutFDA/Transparency/Basics/ucm194879.htm
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<td>- Food additives</td>
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<td>- Infant formula</td>
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<td>- <strong>Other food products</strong> (although the USDA plays a lead role in some meat, poultry, and egg products)</td>
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# Federal Responsibility for the Regulation of Food Safety in the U.S.

## USDA

- **Poultry**
  - Domestic chickens, turkeys, ducks, geese, and guineas
  - Ratites and squab (pigeon)
- **Eggs**
  - Egg products, such as dried, frozen, or liquid eggs
- **Meat**
  - Cattle, lamb, pigs, goat, horse, mules
    - Carcasses and parts
- **Products with meat**
  - >3% raw meat
  - >2% cooked meat or other portions of the carcass
  - >30% fat, tallow, meat extract
  - >2% cooked poultry
  - >10% poultry skins, giblets, fat, and poultry meat in any combination

## FDA

- **Non-specified poultry**
  - Wild turkeys, ducks, and geese
- **Eggs**
  - Shell eggs of domestic chickens, turkeys, ducks, geese, or guinea
- **Seafood (except catfish)**
- **Meat**
  - Non specified meat such as bison, rabbit, game animals, zoo animals and members of the deer family including elk and moose
- **Products with meat**
  - <3% raw meat
  - <2% cooked meat or other portions of the carcass
  - <30 fat, tallow, meat extract
  - <2% cooked poultry
  - <10% poultry skins, giblets, fat, and poultry meat in any combination
Milk

- Milk - is lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows

21 CFR 131.110
So, Where Are We Now?

- July 2018 – FDA hosts a public meeting discussing food produced using animal cell culture technology
  
  Docket No. FDA-2018-N-2155

- October 2018 – FDA, USDA hosts a joint public meeting discussing food produced using animal cell culture technology
  
  Docket No. FSIS-2018-0036

- November 2018 – FDA, USDA agree to share regulatory oversight of cell cultured meat and poultry

- March 2019 – FDA, USDA announce they have established the framework for regulating cell-based meat and poultry
1. **Purpose**

The purpose of this agreement is to describe the intended roles of the U.S. Department of Health and Human Services Food and Drug Administration ("HHS-FDA") and the U.S. Department of Agriculture Food Safety and Inspection Service ("USDA-FSIS") (hereinafter individually a "Party", and together the "Parties") with respect to the oversight of human food produced using animal cell culture technology, derived from cell lines of USDA-amenable species and required to bear a USDA mark of inspection.
Federal Oversight

FDA and USDA have agreed to joint oversight of cell-cultured products derived from livestock and poultry.

- **FDA** – to oversee cell collection, cell banks, and cell growth and differentiation.

- **USDA** – to oversee the production and labeling of food products.

- The transition in oversight will occur during the cell harvest stage.
With greater knowledge of what are called hormones, i.e., the chemical messengers in our blood, it will be possible to control growth. We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium.
Why do we need cultured meat?

In 2012, Dr. Mark Post offered 3 motivations to explore alternatives to livestock meat production

• The substantial increase in meat demand will limit production capacity

• Societal concerns about animal welfare and public health

• Growing concern about environmental impact of livestock breeding and management

Mimicry & Efficiency

• “For a new substitute to be widely adopted, it needs to exactly mimic or even better, recreate conventional meat in all of its physical sensations such as visual appearance, smell, texture, and of course taste.”

First Cultured Meat Burger

- Dr. Mark Post
- August 2013
- First burger was cooked and sampled on live television
- Cost approximately $330,000 USD
- Developed at the University of Maastricht
- Produced with fetal bovine serum
- Beef, red beet juice (color enhancement), saffron, bread crumbs, and a binder
- Described as “quite some intense taste, its close to meat, its not that juicy, but the consistency is perfect (Hanni Retzler –Austrian Food Researcher).

https://www.theguardian.com/science/2013/aug/05/world-first-synthetic-hamburger-mouth-feel
Environment Impact

**Beef Industry**
- Direct greenhouse gas (GHG) emissions of 
  - Methane (CH\(_4\))
  - Nitrous oxide (N\(_2\)O)
- Indirect contribution of GHG 
  - Carbon dioxide (CO\(_2\)) from the conversion of land for pasture or feed use
  - CO\(_2\) from the use of fossil fuels used in associated production

**Cell Cultured Meat Industry**
- Indirect contribution of CO\(_2\) from the use of fossil fuels
- Still uncertain about the impact the growth media may have

All currently available Life Cycle Assessments (LCA) report that cell cultured technology is more environmentally friendly than the beef industry.

Environmental Impact

HOWEVER, to date, all LCA evaluating relative GHG emissions are based on carbon dioxide equivalents (CO$_2$e) which MAY overemphasize the impact of methane

- CO$_2$e – relates all GHG emissions to CO$_2$
- Gasses differ in impact on environmental energy balance and thereby temperature impact

Energy balance i.e. radiative forcing (per molecule basis)
- Carbon dioxide < Methane < Nitrous oxide

Environmental life span (per molecule basis)
- Methane (~12 yrs) < Nitrous oxide (+100 yrs) < Carbon dioxide (+200 yrs)
True cell culture environmental impact is difficult to assess because the industry is evolving so quickly!

“...the scale of cattle production required for the very high levels of beef consumption modeled here would result in significant global warming, but it is not yet clear whether cultured meat production would provide a more climatically sustainable alternative.”

How Americans Think Packages Should Be Labeled

If you were to see a package for purchase at a grocery store, or another location, containing food that is produced from animal cells to look and taste like meat, how do you think the package should be labeled?

- 52%: Meat, but accompanied by an explanation about how it is produced
- 43%: Something other than meat
- 5%: Meat, without any further explanation

Base: n = 957; excludes 6% of respondents who answered “don’t know”

Sourced from: Consumer Reports: Foods Produced Using Animal Cell Culture Technology. 2018 Nationally Representative Phone Survey
Which, if any, of the following do you believe would be an accurate way to identify this food product in its packaging?

- Lab-grown meat: 35%
- Artificial or Synthetic meat: 34%
- Something without the words meat, beef, pork, etc.: 18%
- Animal free meat: 16%
- Cultured meat: 11%
- Clean meat: 9%
- In vitro meat: 8%
- Other: 2%
- Don't know: 6%

Base: All respondents n = 1,018

Respondents were able to select up to 3 responses. If “Don’t know” was chosen, respondents were not able to select additional options.
Sorry Juliet

In this case a rose may not smell as sweet by any other name

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