



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?



*What's in a name? That which we call a rose
by any other name would smell as sweet.*

Juliet Capulet, A long time ago

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



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 and Muscle Biology™



Meat Science Lexicon*

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- **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...?

Perspective



- 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

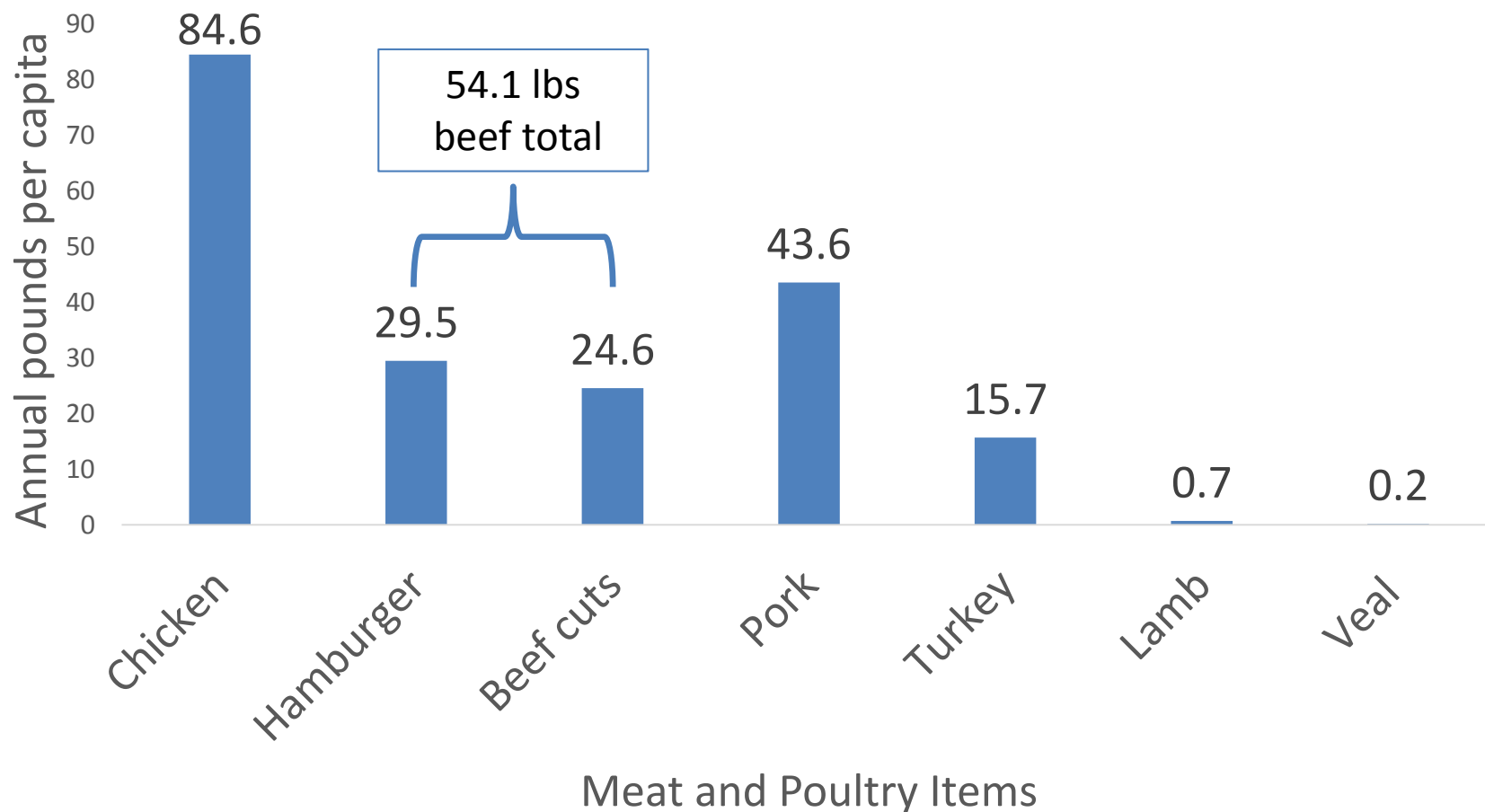


100.23 billion lbs of meat
produced in the U.S. in
2017

Annual U.S. Consumption, 2014



Per capita consumption of meat and poultry was 182.2 pounds



Daily Meat Consumption



4.8 oz



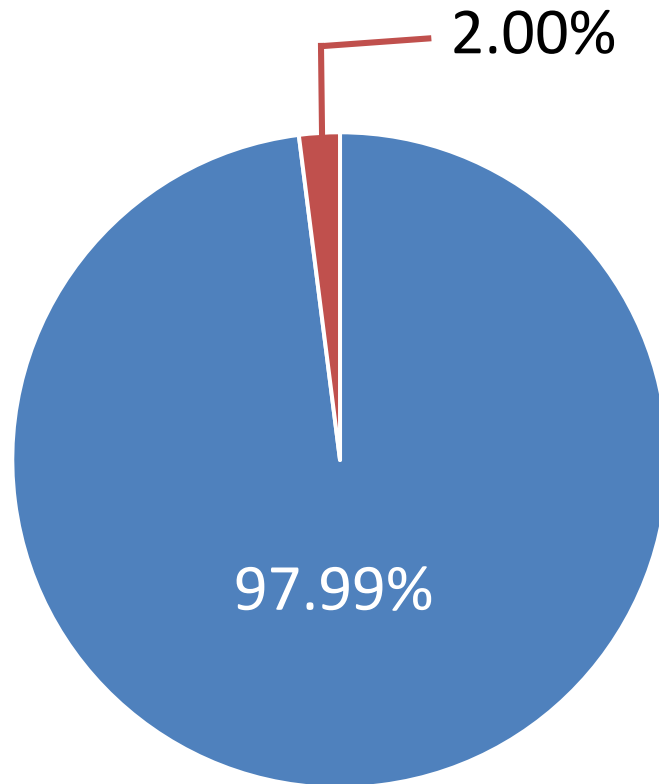
Men

3.1 oz



Women

2018- Scope of the Meat Industry



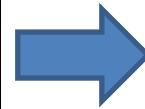
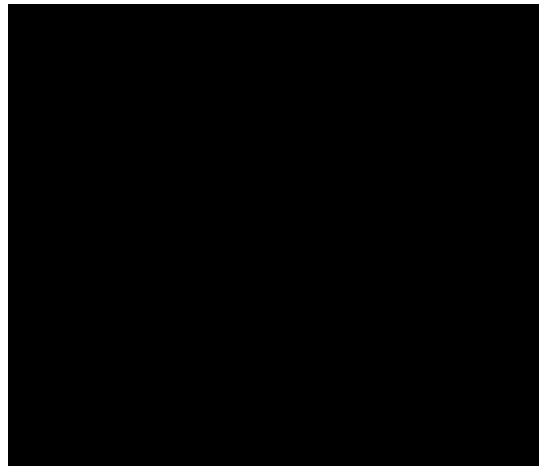
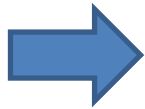
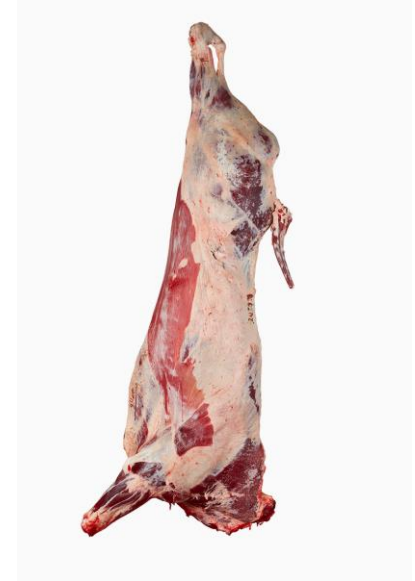
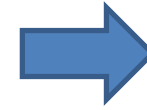
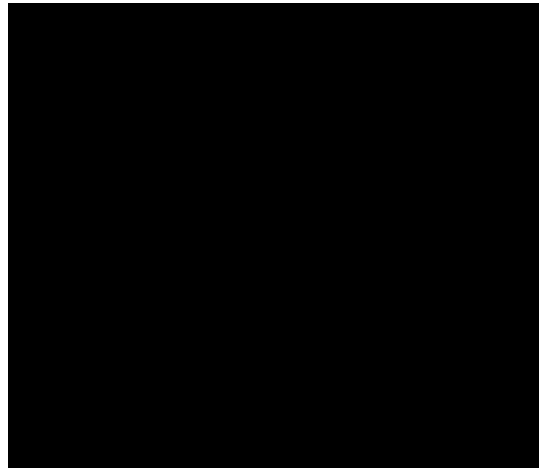
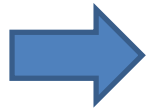
US Meat Industry (retail)
(Sales = \$200 billion USD)

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

Conversion of Muscle to Meat



Dr. Rhonda Miller

Past president of the AMSA



- 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.



USDA

- Poultry
- Eggs
- **Meat**

FDA

- **Biologics**
- **Food products**
- Drugs
- Medical devices
- Electronic products that give off radiation
- Cosmetics
- Veterinary products
- Tobacco products

Federal Responsibility for the Regulation of Food Safety in the U.S.



USDA

- Poultry
- Eggs
- **Meat**

FDA

- **Biologics**
 - Vaccines
 - Blood and blood products
 - **Cellular and gene therapy products**
 - Tissue and tissue products
 - Allergenics
- **Food products**
 - Dietary supplements
 - Bottled water
 - Food additives
 - Infant formula
 - **Other food products (although the USDA plays a lead role in some meat, poultry, and egg products)**

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

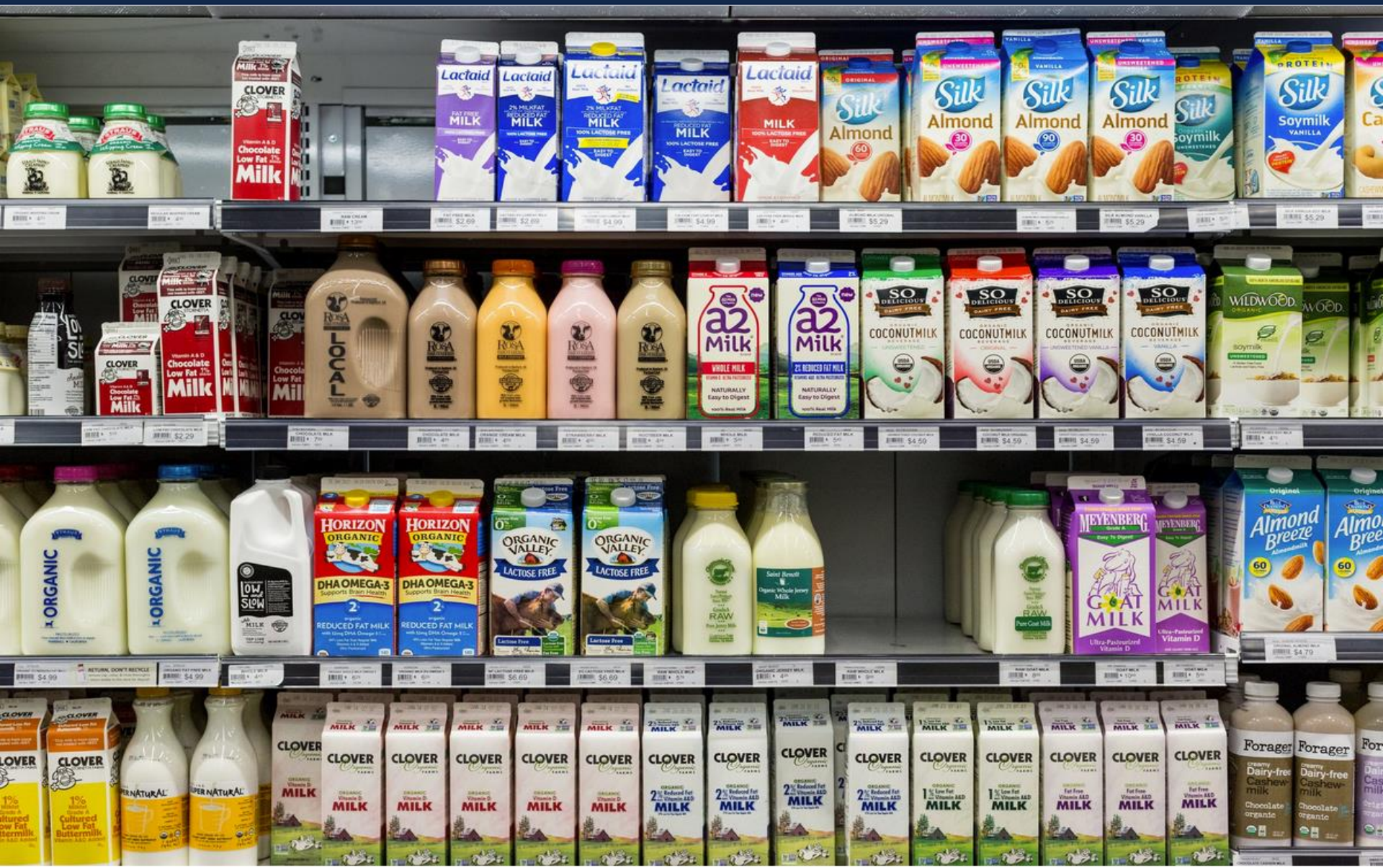


- ***Milk*** - is lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows

21 CFR 131.110



Milk



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

Federal Oversight



FORMAL AGREEMENT BETWEEN THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES FOOD AND DRUG ADMINISTRATION AND U.S. DEPARTMENT OF AGRICULTURE OFFICE OF FOOD SAFETY

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

Winston Churchill



- ❖ December 1931
- ❖ The Strand Magazine
- ❖ Fifty Years Hence
- ❖ Presented several speculations for the future



- 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).

Environmental Impact



Beef Industry

- Direct greenhouse gas (GHG) emissions of
 - Methane (CH_4)
 - Nitrous oxide (N_2O)
- 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_2e) which MAY overemphasize the impact of methane

- CO_2e – 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)

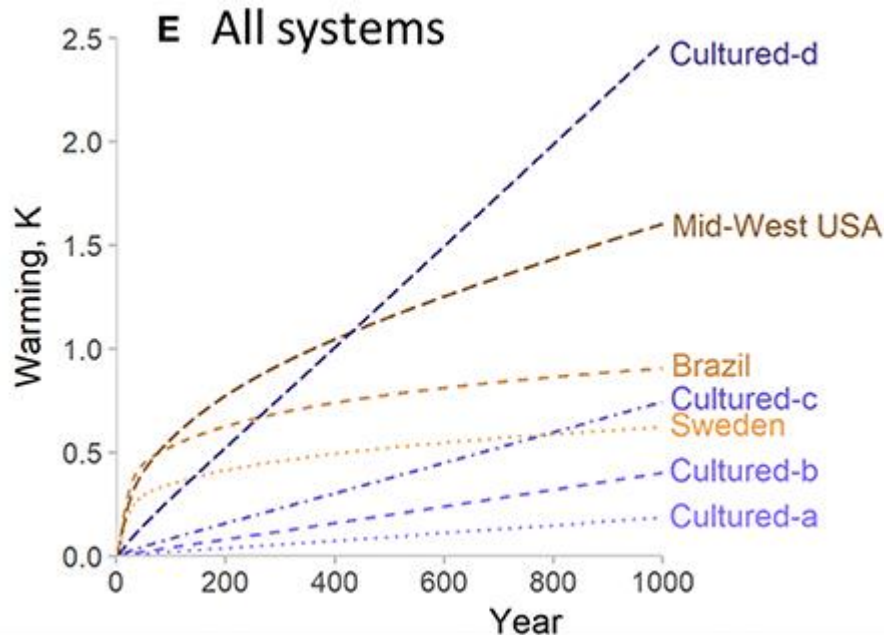
Methane (~12 yrs) < Nitrous oxide (+100 yrs) < Carbon dioxide (+200 yrs)

Environmental Impact



- True cell culture environmental impact is difficult to assess because the industry is evolving so quickly!

Warming impacts for product consumption
(> 250 Mt / yr) in perpetuity (Fig. 1)

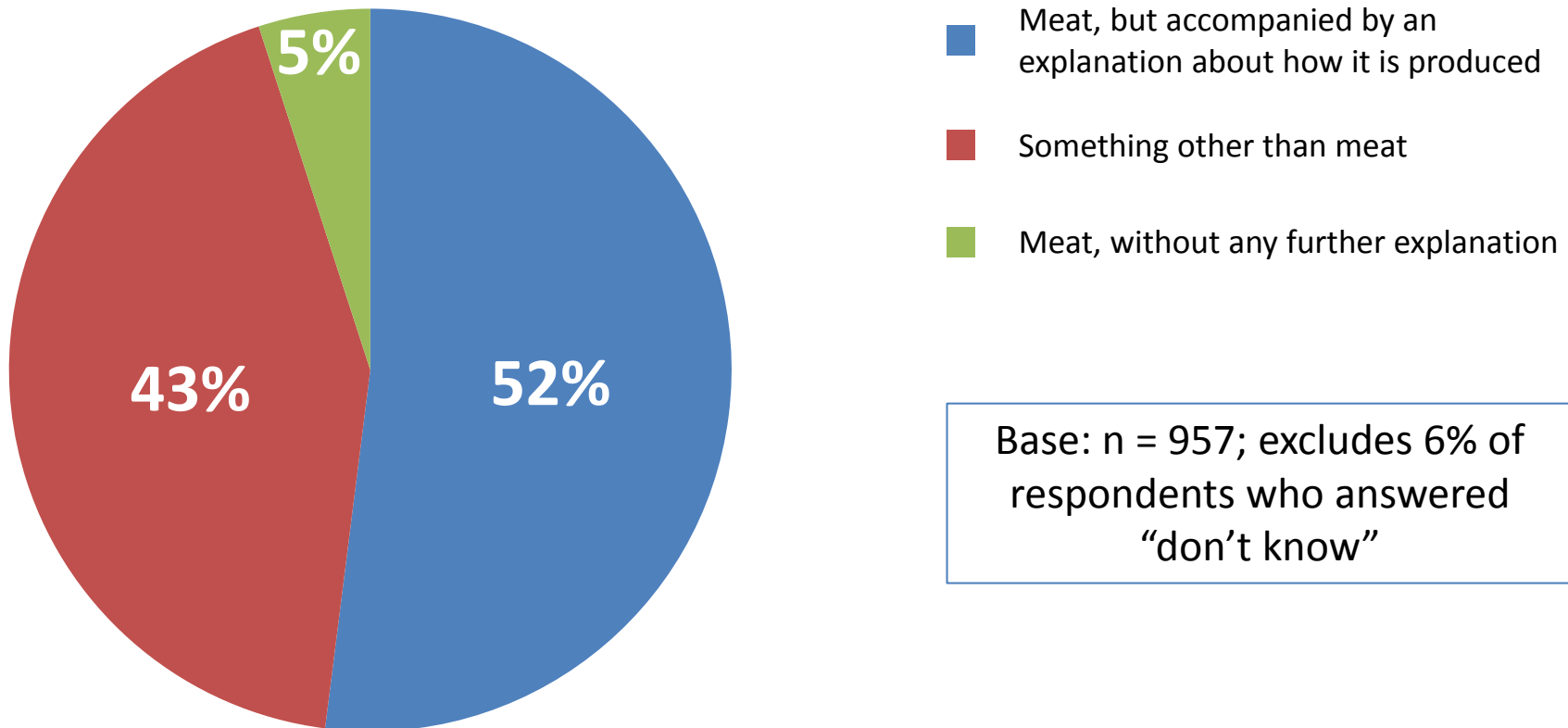


“The scale of cattle production required for the very high levels of beef consumption modeled here would result in significant global warming, **but it is not yet clear whether cultured meat production would provide a more climatically sustainable alternative.**”

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?

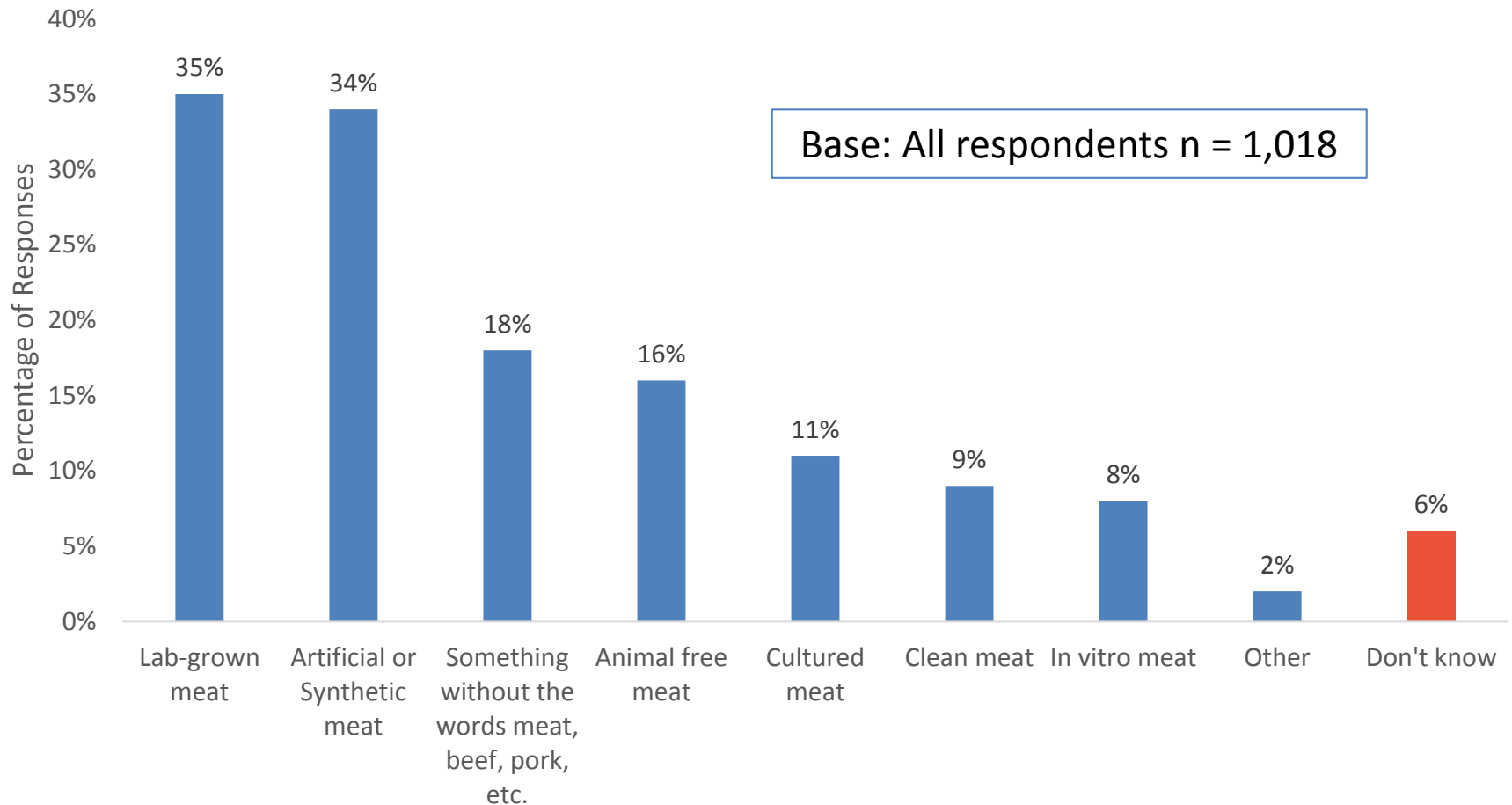


Sourced from: Consumer Reports: Foods Produced Using Animal Cell Culture Technology. 2018 Nationally Representative Phone Survey

Americans Views on Packaging Options



Which, if any, of the following do you believe would be an accurate way to identify this food product in its packaging?



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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