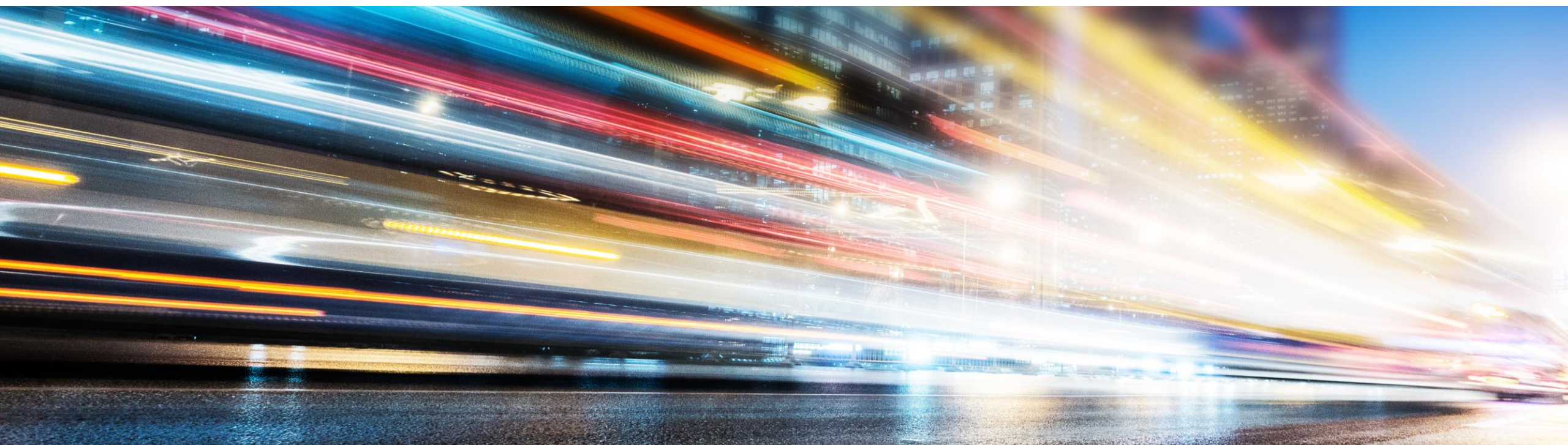


Future Foods – A Patent Landscape Study

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The Patent Landscape in the Future Foods Area

- Animal-free foods are here
- Health benefits from reducing animal protein intake and consuming more plant-based proteins:
 - Bolster interest from investors; and
 - Drive further R&D in the field
- Humane arguments
 - Environmental damage
 - Destruction of animal species
- Environmental arguments
 - Calorie for calorie, raising livestock is far more environmentally taxing than growing plants
 - Space, energy, methane
- Plant-based calories are more efficient to feed 7 billion people

The Patent Landscape in the Future Foods Area

- If the alt-meat tastes the same, then people may switch
 - More environmentally friendly
 - Healthier?
 - Potentially a cheaper option
- Investors desire to transform consumer demand for meat into a desire to consume meat replicas
- Who are the big players?
- What types of patents / who has patents and on what?

Non-Animal Meat / Lab-Grown Meat – 1/2

- Plant-based
 - Eating less meat is the answer
- Cell culture-based
 - Growing meat in the lab – not eating less meat – is the answer
 - Cultured meat – biologically it is meat (for meat eaters); new kind of meat developed from advances in biology and engineering
 - Cell culture
 - Bio reactors
 - Avoids environmental degradation and mass slaughter
 - Relatively early stages – VC's typically don't invest in tech that's decades away
- Good Food Institute
 - Funds research, political muscle for the industry, fight to limit restrictions on cultured meat products

Non-Animal Meat / Lab-Grown Meat – 2/2

- Technical challenges and solutions
 - Growth media
 - Stock
 - Fetal bovine serum
 - Marine stock
 - Scaffolding
 - Bioreactor design
 - Large scale cellular agriculture behavior
- New Harvest
 - Not-for-profit, funds research on large scale / industrial scale bioreactors / large fermenting chambers
 - Current bioreactors are single-use and plastic
 - New Harvest helped launch Perfect Day and Clara Foods

Overview

- Animal-free meat is hot
- Beyond meat in the news – KFC offering plant-based chicken
 - People for the Ethical Treatment of Animals named Beyond Meat as its company of the year in 2013
 - Sold in the meat section of supermarkets
 - Right next to competing brands from the retailer
 - Food product label?
 - How patentable?
 - How secret?

Overview – continued

- Multiple fast food companies offer plant-based food options
 - BK – Impossible Whopper
 - Subway – Beyond meatball marinara
 - Carl's Jr. – meatless burger by Beyond Meat
 - White Castle – Impossible Slider
 - KFC – Beyond meat chicken
 - TGIF, Applebee's, Cheesecake Factory – offering plant-based options
- Nestle is planning the Awesome burger; Tyson is planning on offering plant-based meats
- Plenty of competition

Overview – continued

- Relatively low barriers to entry?
- Patents can provide a moat to competition
 - Compare with other food trends?
 - Organic as growth driver; big players come in, prices drop
 - How is alt meat different from other food stocks?
 - Like organic food? Or like flavored soda?
- Future?
 - One view: plant-based meat will be as popular as beef burgers today in 10 years
 - Valuations?
 - Beyond Meat is valued near Tyson
- Demand > supply
 - Beyond meat
 - Impossible

Background – to the patent landscape

- Plant-based
 - Ancient / Roman cuisine – falsification and disguise of ingredients
 - Anchovy casserole w/o anchovies
 - Turnips processed to look and taste like fish
 - Foodstuffs have been very diverse for a few thousand years
 - Disguising and creating faux foods have been known for a few thousand years
 - Food composition claims – *In re Levin*: need a showing of coaction or cooperative relationship between the selected ingredients which produces a new, unexpected and useful scientific function.
 - Still good law or surpassed by section 103 – obviousness?

Background – to the patent landscape

- Clean meats / cell cultured meats / lab-grown meat
 - 1930s Sci/Fi
 - 1990s - Dutch research
 - 1990s - NASA work on in-vivo fish flesh
 - 2010 Cell-cultured meat
- Patent examiners are not food scientist or culinary experts

Investing in Food Innovation

- Opportunities for investment in food and agriculture innovations
- Need for innovation remains
- Different breed of startup
 - Agritech is closer to biotech and less like traditional industrial segments
- Boom in consumption of plant-based meats
 - Beyond meat, Impossible, Memphis meats
 - Tyson
- Market size
 - Food innovation: \$USD 700b by 2030 (current 135b)
 - Plant-based meat market \$USD 4.6b in 2018; projected to be \$USD 85b in 10 yrs
- Diversify
- Likely consolidation within 3-5 years
 - M&A opportunities

The Big Players and the Patents

- Relatively few patent families
- Patents are at very early stages
- Less IP barriers to entry
 - Safeway sells competing Organics brand next to Beyond Meat's products
- Ripe for a shake-up?
- Impossible, Beyond Meat, and Just are leading the meatless meat revolution; Memphis Meats and others are also close behind

Impossible Foods – 1/4

- Plant-based
- Founded in 2011
- Not a public company
- Holds many patents – but sold only in restaurants
- BK offers Impossible Whopper
- Bleeding and meaty flavor secret is iron-rich Heme – isolated from leghaemoglobin, isolated from soy plants
- Texture: isolated and purified proteins from plants to replicate muscle, connective tissue, fat and flesh
- Patent assets – 197; 139 active; 51 grants; 16 granted U.S. patents; 36 U.S. pending applications
- Patents cover method of extracting and purifying non-denatured proteins, genetically engineering methylotropic yeast, soy-based cheese and ground meat patents

Impossible Foods – 2/4

- U.S. 10,327,464 M & C for affecting the flavor and aroma profile of consumables
 - Covers a food product comprising:
 - .01-5% heme-containing protein;
 - Glucose, ribose, fructose, lactose, xylose ..
 - At least 1.5 mM of a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof
 - One or more plant proteins,
 - Wherein the food product contains no animal products that contain heme; and
 - Wherein cooking the food product results in the production of at least two volatile compounds
- 10,314,325 M & C for affecting the flavor and aroma profile of consumables

Impossible Foods – 3/4

- 10,172,380 – Ground meat replicas
 - Method for imparting a beef-associated aroma to ground chicken, comprising adding a non-animal heme-containing protein to raw ground chicken to a final concentration of about 0.5% to about 1% (wt/wt), thereby producing heme protein-added, raw ground chicken, wherein cooking the heme protein-added, raw ground chicken results in the production of an increased amount of at least two volatile compounds that have a beef-associated aroma relative to the amount of the two volatile compounds produced upon cooking raw ground chicken lacking the added heme protein
- 10,172,381 – method and composition for consumables
 - How granted in view of *In Re Levin*?
 - *Levin* – additional test for / in place of section 103 obviousness
 - Impossible pushed back against the *In re Levin* rejection
 - Shows that ingredients coact in unexpected ways
 - Cucumis juice extract to increase the perceived meat flavor of the product
 - Examiner: “no reference was found for a meat replica containing ... Cucumis juice
 - Added tallow fatty notes that are enhanced with cooking
 - Food ingredients must coact unexpectedly

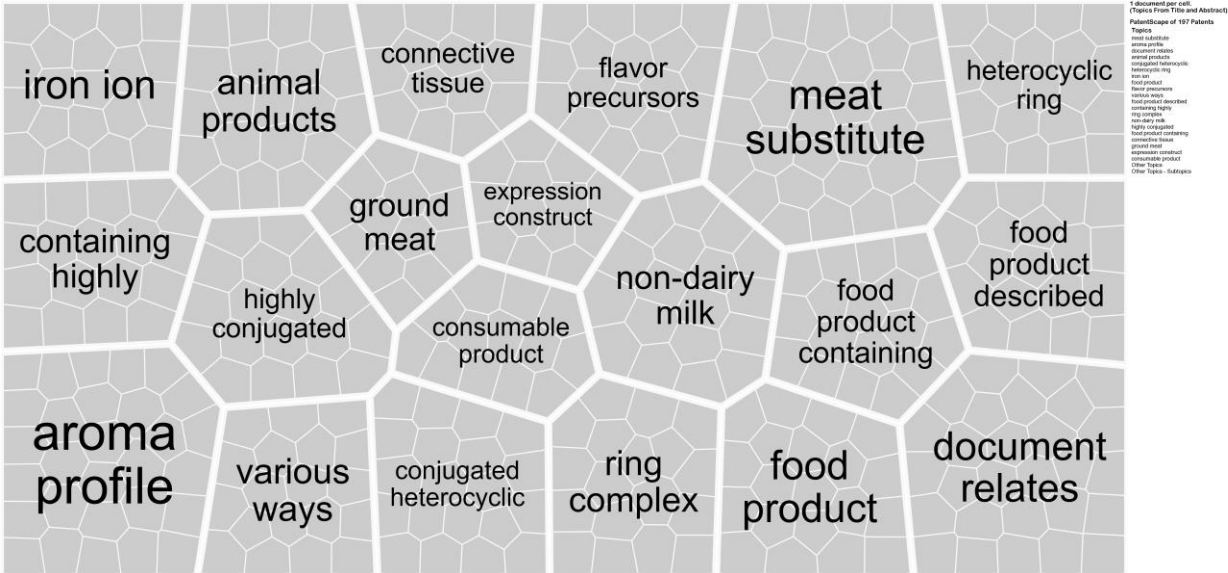
Impossible Foods – 4/4

- Maraxi patents –

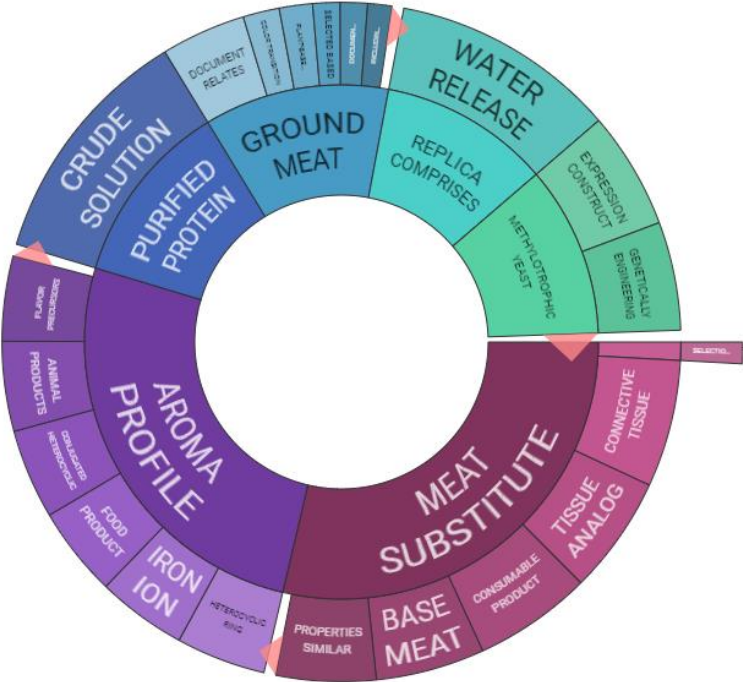
- A meat replica product, comprising:
 - a) Muscle replica comprising 0.1%-5% of a heme-containing protein, at least one sugar compound and at least one sulfur compound;
 - b) Fat tissue replica comprising at least one plant oil; and
 - c) Connective tissue replica;
 - Wherein said muscle replica, fat tissue replica, and connective tissue replica are assembled in a manner that approximates the physical organization of meat, wherein, upon cooking of the meat replica, two or more volatile compounds that are associated with a cooked meat aroma are produced in an increased amount relative to cooking a meat replica product lacking the heme-containing protein.

Impossible Foods

Patent Wordscape



Text Cluster



Beyond Meat (Savage River) – 1/2

- Building meat directly from plants
- Founded in 2009
- Public company
- Develops plant-based meats (chicken, and beef and pork sausage)
- Patents on meat structured protein products
- Cargill (pea protein supplier) invests an additional \$75 million
- KFC offering the plant-based chicken
- Patents – 35 total assets; 8 pending U.S. applications; one U.S. grant;
 - U.S. 9,526,267 – Nutrient-dense meat structured protein product
- A few abandoned, one application alleged as obvious – not a *Levin* bar to patentability

Beyond Meat – 2/2

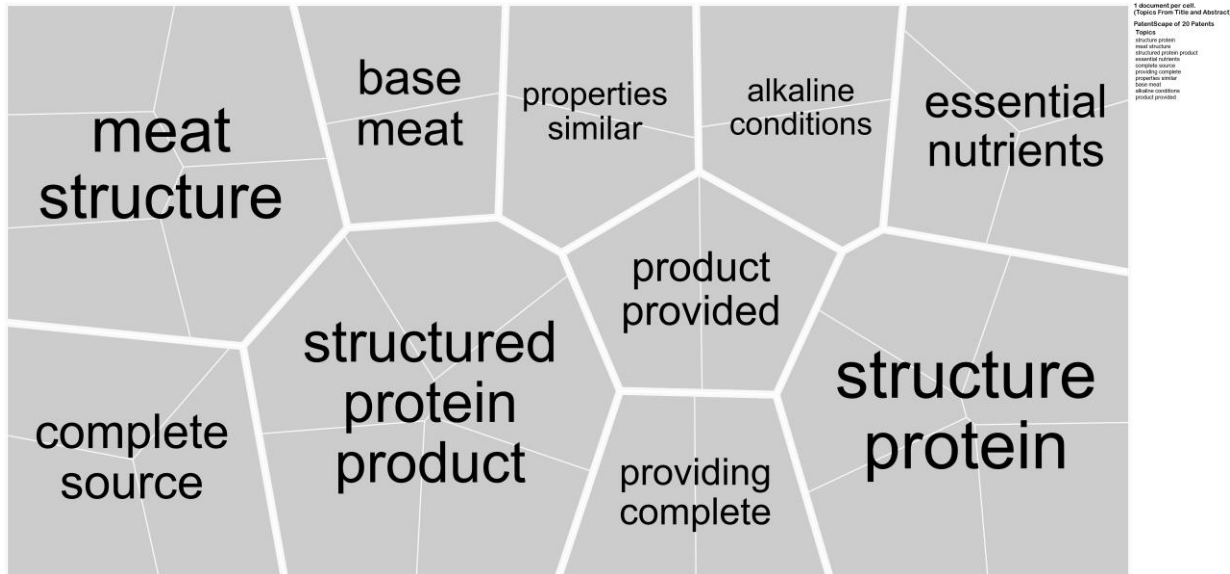
- U.S. 9,526,267 – Nutrient-dense meat structured protein product; claims to:

A process for producing a nutrient-dense meat structured protein product comprising protein fibers that are substantially aligned, wherein the process comprises:

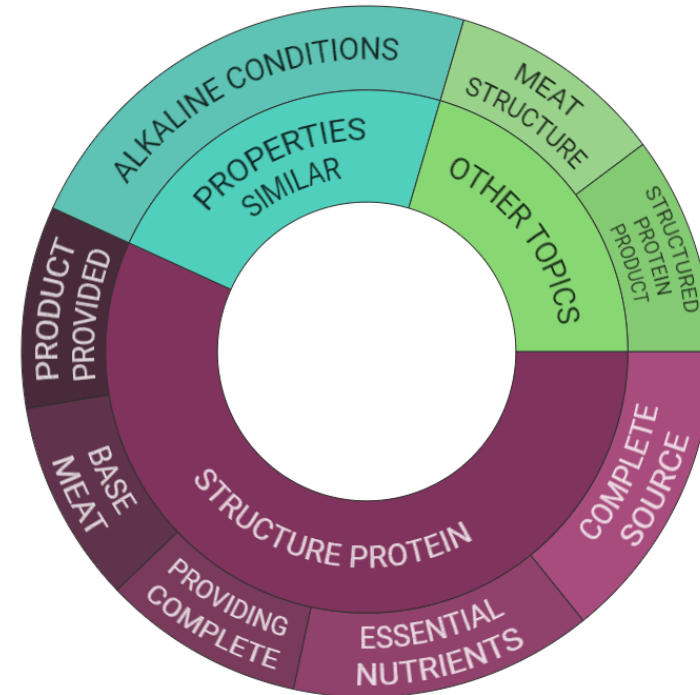
- a) Combining a non-animal protein material and water with at least one heat-stable nutrient to form a dough
- b) Shearing and heating the dough to denature the proteins in the protein material and produce protein fibers that are substantially aligned in a fibrous structure
- c) Setting the dough to fix the fibrous structure previously obtained, thereby obtaining a nutrient-dense meat structured protein product having a moisture content of at least 30% by weight and comprising at least 5% by weight of a non-animal protein material and at least 0.25 mg of heat-stable nutrient per ounce of the nutrient-dense meat structured protein product
- d) As a post-processing step, adding at least one non-heat stable nutrient to the nutrient-dense meat structured protein product

Beyond Meat

Patent Wordscape



Text Cluster



JUST – 1/2

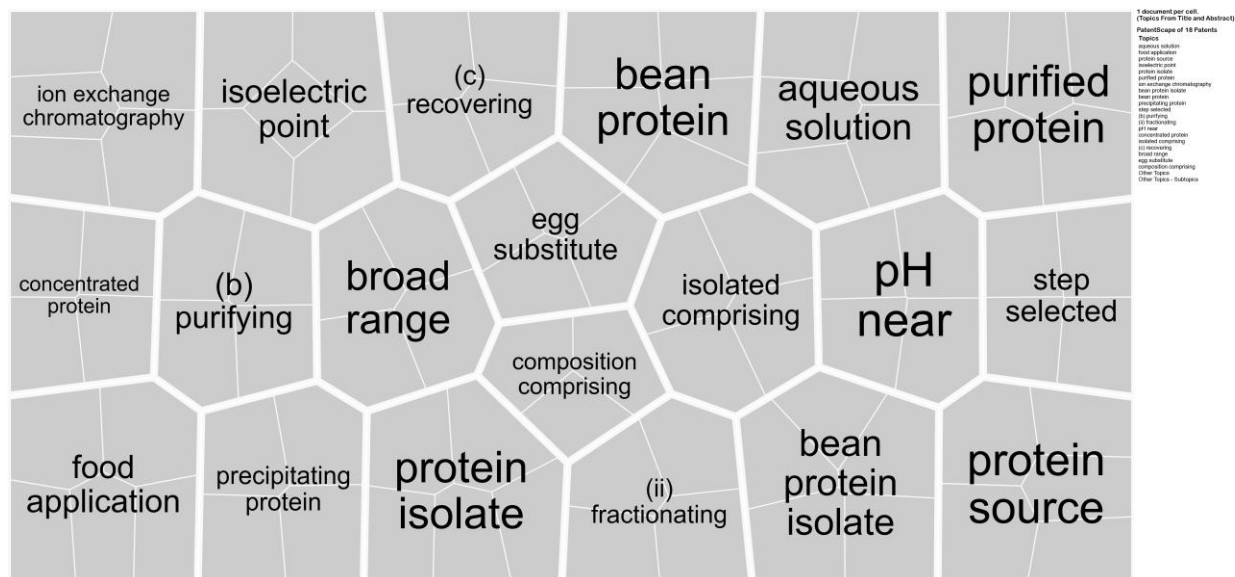
- Founded in 2011
- Making healthier food better for the environment, and more delicious and cheaper
- Most-funded food and beverage startup in the field of synthetic biology
- Makes plant-based egg substitutes; eggless mayo and cookie dough
- Licenses ingredients to direct competitors to make vegan versions
- Plans for cultured meat?
- Patents refer to isolating adzuki and mung beans for meat-like creations
- Hampton Creek – 18 total patent assets; 12 active; 3 grants (HK, CN and EP);
 - A few U.S. Grants
 - U.S. 10,321,705 – Functional mung bean-derived compositions – granted on 18, 2019
- 2 active U.S. applications
 - Functional adzuki bean-derived compositions – pub 2017
 - Functional mung bean-driven compositions – pub 2019

JUST – 2/2

- Just Inc.: 36 total patent assets; 8 patent grants; 5 U.S. grants and 8 pending U.S. applications covering functional mung bean-derived compositions and plant-based egg substitute
 - U.S. 6,835,390 – Method for producing tissue engineering meat for consumption 2000 priority
 - Method of providing nutrition .. consuming meat product produced by culturing non-human muscle cells ex vivo
 - U.S. 7,270,829 Industrial production of meat using cell culture methods
 - U.S. 9,760,834 Discovery Systems for identifying entities that have a target property
 - U.S. 10,321,705 – see above assigned as originally assigned to Hampton Creek
 - U.S. 10,212,326 Notification for control sharing of camera resources Microsoft as original assignee

Just (Hampton Creek)

Patent Wordscape



Text Cluster

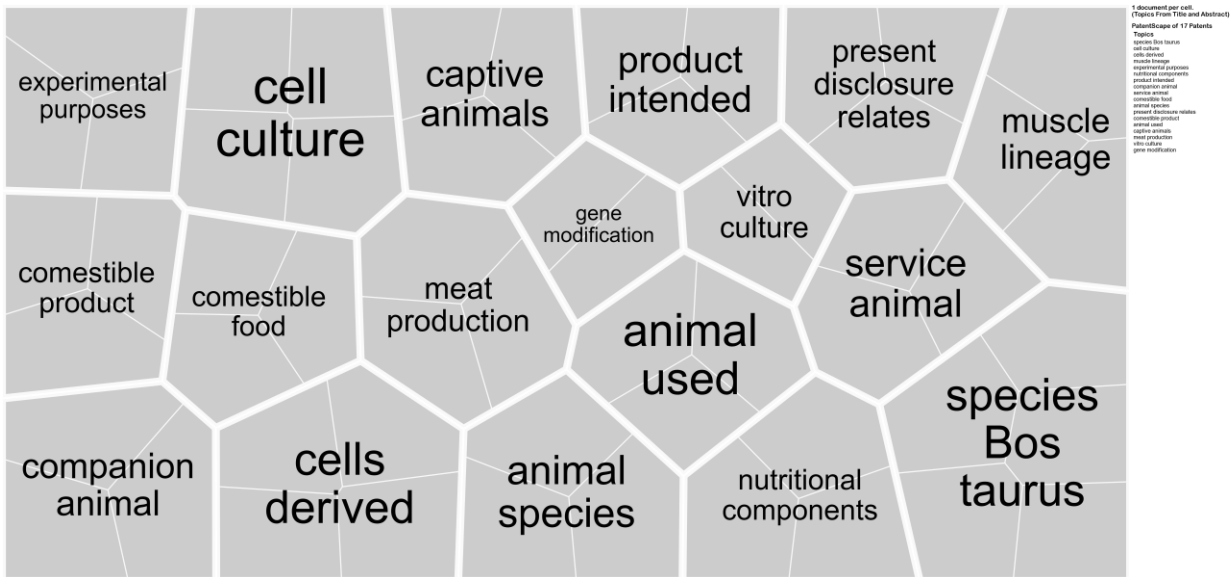


Memphis Meats, Inc.

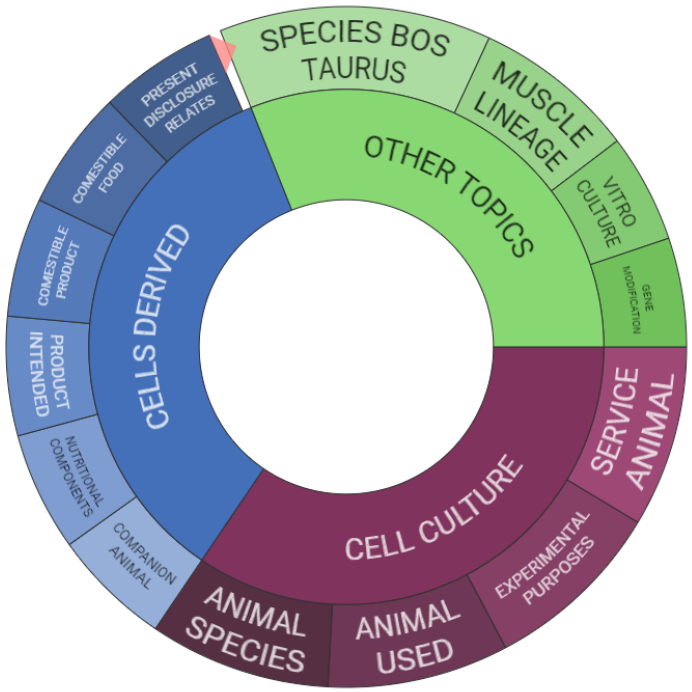
- Founded 2015
- Grows meat in small quantities using cells from cows, pigs, and chickens. Its products include hot dogs, sausages, burgers, and meatballs.
- Cultured meat from animal cells – chicken meat and beef
- Serum from unborn calves and chicks
- Patents on skeletal muscle cultivation
- Backed by Tyson and Cargill and others
- VC-funded growth
- Patents – 17 total assets; 15 active; 3 active U.S. patent application; none granted
- Three pending cases:
 - Method for scalable muscle lineage specification and cultivation – pub 2016
 - Method for scalable muscle lineage specification and cultivation – pub 2016
 - Method for extending the replicative capacity of somatic cells during ex vivo cultivation process – Pub 2019

Memphis Meats, Inc.

Patent Wordscape



Text Cluster



Perfect Day Foods (Muufri)

- Founded on 2014
- Produces animal-free dairy milk
- Milk protein made from yeast instead of from cows
- Patents disclose formulations comprising casein protein, lipids, flavor compounds, sweetening agents.
- Patents: 14 total assets; 4 pending U.S. application; 1 granted:
- U.S. 9,924,728 - Food compositions comprising one or both of recombinant beta-lactoglobulin protein and recombinant alpha-lactalbumin protein
- Claims to compositions
 - Wherein the food composition has one or more characteristics of a dairy food product selected from the group consisting of: taste, aroma, appearance, handling, mouthfeel, density, structure, texture, elasticity, springiness, coagulation, binding, leavening, aeration, foaming, creaminess, and emulsification; and
 - The food composition does not comprise any other milk proteins than those in (i)

Other Players – 1/4

- Ripple Foods, PBC
 - Founded 2014
 - Produces plant-based milk
 - Patents – 13 total assets; 2 pending U.S. applications pub 2019
 - Method for obtaining a yield of refined protein component from a non-animal natural and/or modified non-animal natural source
 - A refined protein component, wherein the refined protein component is obtained from a non-animal natural and/or modified non-animal natural source by the method
 - A plant-based yogurt analog comprising at least one of between 1% to 10% by weight of a plant protein, and between 1% to 90% by weight of a plant protein isolate

Other Players – 2/4

- New Wave Foods

- Shrimp substitute made from algae and plants
- One patent family – 3 total assets; none granted
 - Algae or plant based edible compositions:
 - An edible composition, comprising: a hydrocolloid material; a protein material; and an algal extract

Other Players – 3/4

- Wild Type Inc.
 - Founded 2016
 - Sustainable meat using cellular agriculture technology
 - 1 patent family – ex vivo meat production; filed in 2018
 - High-end meats – sushi-grade fish and foie gras
- Alpine Roads, Inc.
 - Founded in 2016
 - Develops and produces animal-based food substitutes by using plants
 - Focuses on transforming plants into bioreactors for producing protein
 - Patents – 1 family to cover a transgenic arabidopsis plant comprising a recombinant DNA construct; filed 2018/2017

Other Players – 4/4

■ Clara Foods

- Founded in 2015
- Produces baking products, food and beverages ingredients, nutrition supplements, and animal/pathogen/salmonella free egg white products
- Its egg white products are used in food cakes, meringues, and macarons
- Patents – 6 total assets; 1 patent family; none granted
- Compositions, proteins, polynucleotides, expression vectors, host cells, kits, and systems for producing egg white proteins
 - Recombinantly expressing a first egg white protein in a first host cell

■ Zimitech Inc. dba Sugarlogix

- Founded in 2012
- Manufactures sugar with prebiotic functions
- Patents: 1 patent family – Engineered Microorganisms for Enhanced Use of oligosaccharides

Conclusions / Summary

- What did we cover?
 - The patent landscape in the future food area
 - Relatively few bigger players
 - Relatively few patent families
 - Relatively early in their lives
 - More opportunities for innovations
 - Likely to see consolidation
- How can audience benefit?
 - Learn what the patent landscape looks like
 - Recognize opportunities for innovation and investments
- What surprised me about the research?
 - Relatively few patents on the subject matter
 - Recipes and process know-how are kept a secret?
 - Many big players are supporting the early startups
 - Plenty of \$; and much technology innovation remains to be developed



Questions?

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