



The Business School
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Final report

Investing at the crossroads of biotech & food

12 October 2020

INSEAD MBA 20D (Private Equity AA, Group 6)

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High-level impressions of the biotech x food space



HIGH-LEVEL VIEW

- **Food sector continues to look like an attractive segment** to be focused on, given strong fundamentals (population growth, innovation / premiumization opportunities across most customer segments)
- **Significant opportunity for biotechnology players in this segment**, whether focused on improving current system (e.g. crop yield optimisation) or pushing new innovations (e.g. precision fermentation, cultivation)
- **Key sub-segments of biotech x food are alternative proteins, food preservation / packaging, and enhanced seeds / crops**, many niche sub-segments exist in the broader space
- **Funding is growing quickly in this space**, increasing to €1b+ range within a matter of 5-10 years (together with examples of corporate M&A activity – i.e. exit opportunities – this may confirm that this is a good time to get into the space)
- **There are examples of investors who seem to be highly active in the space** (e.g. SOSV, a generalist investor across innovative sectors, has already made 10+ deals in cultivated meat and fermentation)

PROCESS

- **Finalised view of the broader biotech x food sector / sub-segment end-market map**, based on latest review of technologies in the space as well as start-up review
- **Categorised 150+ top start-ups / scale-up database**, mapping these to end market sub-segments
- **Reviewed at a high-level case studies and biotech x food activity in parts of Asia**, across Singapore, Korea, and Japan

Project scope & approach



Focus for our work

Secondary priority

Implications

Framing the intersection between biotech & food

Mapping relevant start-ups in the space

Review of funds active in this space

Recommendations for a new investment entity

Key questions

- What are the key themes / developments within biotechnology that are applicable to food?
- How do these developments / sub-segments map across the food value chain?

- Which start-ups are known across each sub-segment?
- What are the relative sizes of these start-ups and sub-segments?
- What is the expected outlook for these subsegments?
- What are the success factors of leaders in this space (*case studies*)?

- Who are the key funds invested in this space?
- How do these funds map across powerhouses, sector focused, true vertical specialists?
- How have these funds organised themselves (*i.e. talent, geography*)?
- What are the main exit opportunities for biotech x food start-ups?

- Is there sufficient activity for a fund focused solely on biotech x food?
- What are the key sub-segments, geographies to focus on?
- How should this fund be organised (*i.e. balance of biotech vs. food vs. investment expertise*)?

Activities

- Industry report review (shared by Ambrosia)
- LinkedIn search / outreach for potential experts
- Desktop research (incl. CB insights, etc.)

- Dealroom deal data mapping for biotech companies in food space
- Overlay of industry report start-up data

- Key investor profile review (*names from reports and Dealroom*)
- Desktop research (*incl. FACTIVE news data*)
- Interviews if possible (*INSEAD network, LI*)

- Collate information across workstreams
- Qualitative assessment of growth drivers in sub-segments / geographies
- Benchmarking from other fund structures

Deliverables

Overview of biotech food applications + sector map

Map top 100-200 start-ups
Case studies/success factors

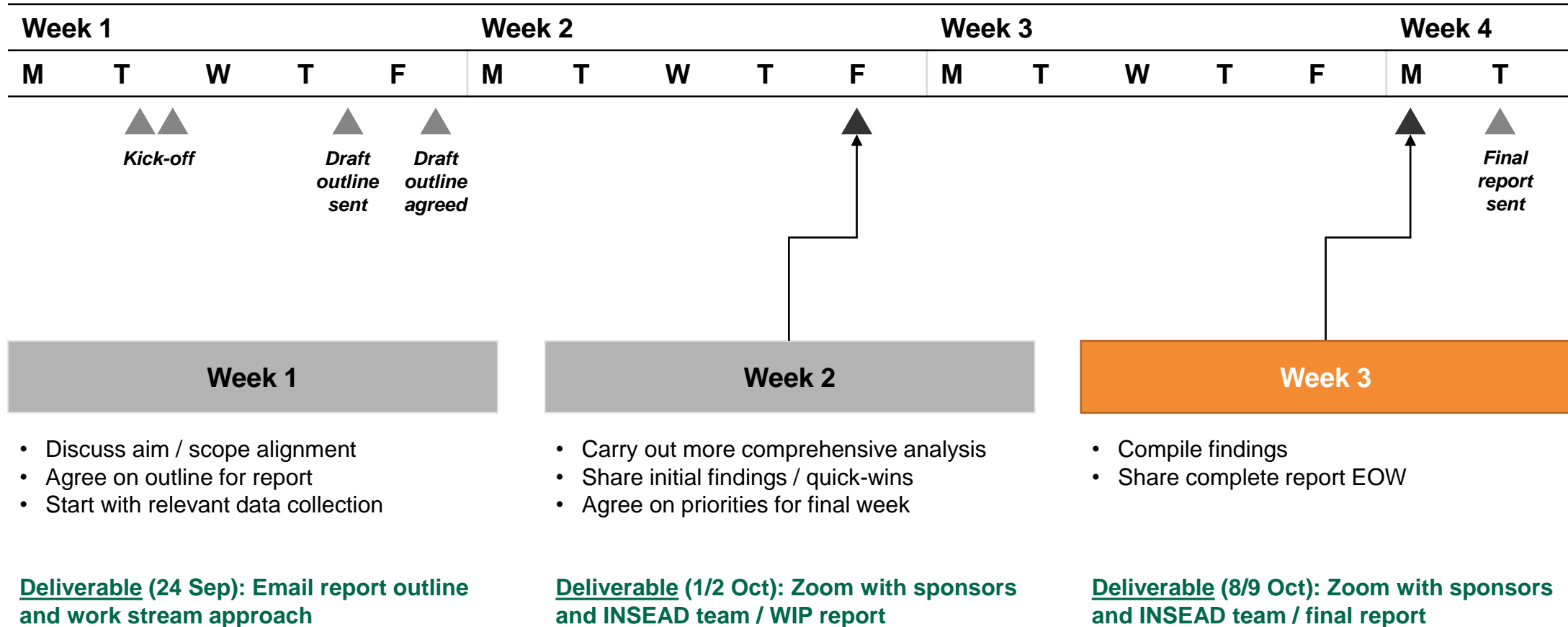
List of top funds
Key fund profiles

Initial hypothesis on potential fund positioning

Priority



Project timeline

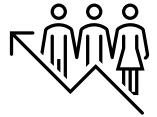


Agenda



- Framing the intersection between biotechnology & food
- Mapping relevant start-ups in this space
- Review of funds active in this space
- High-level recommendations for a new investment entity in this space

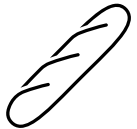
Key themes for food production & consumption



Increasing population (9-10 billion people by 2050), with growth rates higher in developing countries, driving need for increased food and nutrition provision



Increasing meat production, particularly in parts of Asia, where high proportions of people are being lifted from lower income levels



Increasing prevalence of diet related disease and uptake of special dietary foods (e.g. celiac disease and gluten-free products; diabetes and low-GI products; obesity and high-fibre)



Continued growth of educated and aware consumers (e.g. looking to replace animal meat, pushing for decreased use of antibiotics / pesticides)



Increasing adoption of genetically modified crops (incl. US, Canada, Brazil, Argentina, and China)

Key themes in biotechnology



Genetic engineering

Cultivation / cell-based

Precision fermentation

Bacterial resistance

AI and big data analytics

Microbiome research

Improved characterisation

-omics databases

Biofortification

Intersection of food value chain and biotechnology

A look at end-markets for particular biotechnologies



AGRICULTURE

- **Enhanced fertilizer / inputs:** biotechnological / microbial products used to support and/or replace inputs in the farming system, increasing efficiency and/or reducing reliance on inorganic pesticides
- **Enhanced seeds / crops:** genetic engineering applied through biofortification and bio-protection in order to support more nutrient rich, safer foods, and/or higher yield, more resistant crops
- **Enhanced animal feed:** microbes employed during processing of animal feed to improve feed conversion ratios and/or safety of feed
- **Micro-/pro-nutrients for animals:** functional additives and enzymes used to improve the nutritional value of feed and/or reduce reliance on antibiotics (can be non-synthesized or supplementary to animal)
- **Animal gene editing** used to commercialize and deploy technologies that impact human health and longevity, and/or add value to farm animals
- **Characterisation, identification, and safety:** gene technology supporting agriculture (e.g. DNA barcoding used to properly identify and label the organisms and micro-organisms involved in biotransformation, and assess GM crops to ensure safety of consumption)
- **Metabolomics:** analysis of chemical compounds responsible for taste, aroma, colour, quality, and assess harmful of metabolites for nutrition targeting)

FOOD

- **Alternative proteins / plant-based foods:** biotech innovation in plant-based, cultivated meat, insect-/algae-based protein, to reduce reliance on scarce or environmentally harmful raw material e.g. meat & dairy
- **Bioprocessing inputs:** enzymes from fungi, yeast & bacteria acting as biological catalysts for bio-transformation, used for baking, cheese, beer, wine, soy sauce, juice, vinegar
- **Food additives:** Enzymes used to enhance end products in taste, flavour, and texture – e.g. emulsifiers, gels, texturizers, stabilisers, and flavour enhancers
- **Functional food (incl. speciality dietary products):** Enzymatic modification of proteins to change the amino acid profile – e.g. gluten proteins modified; enzymatic processes for modifying fats & oils, including reduction of trans fats and daily ingested foods to improve health (incl. prebiotics, probiotics, syn-biotics & antioxidants)
- **Contaminant identification:** biofilm / pathogen identification through nucleic-acid methods, next generation food matrices, and microbiome characterization
- **Food preservation/packaging:** Functionalized food packaging, employing antagonistic microbial products
- **Food waste management/energy:** Processes to exploit or recover added-value products from food waste, oftentimes looking to manage / recover potential energy

HEALTH

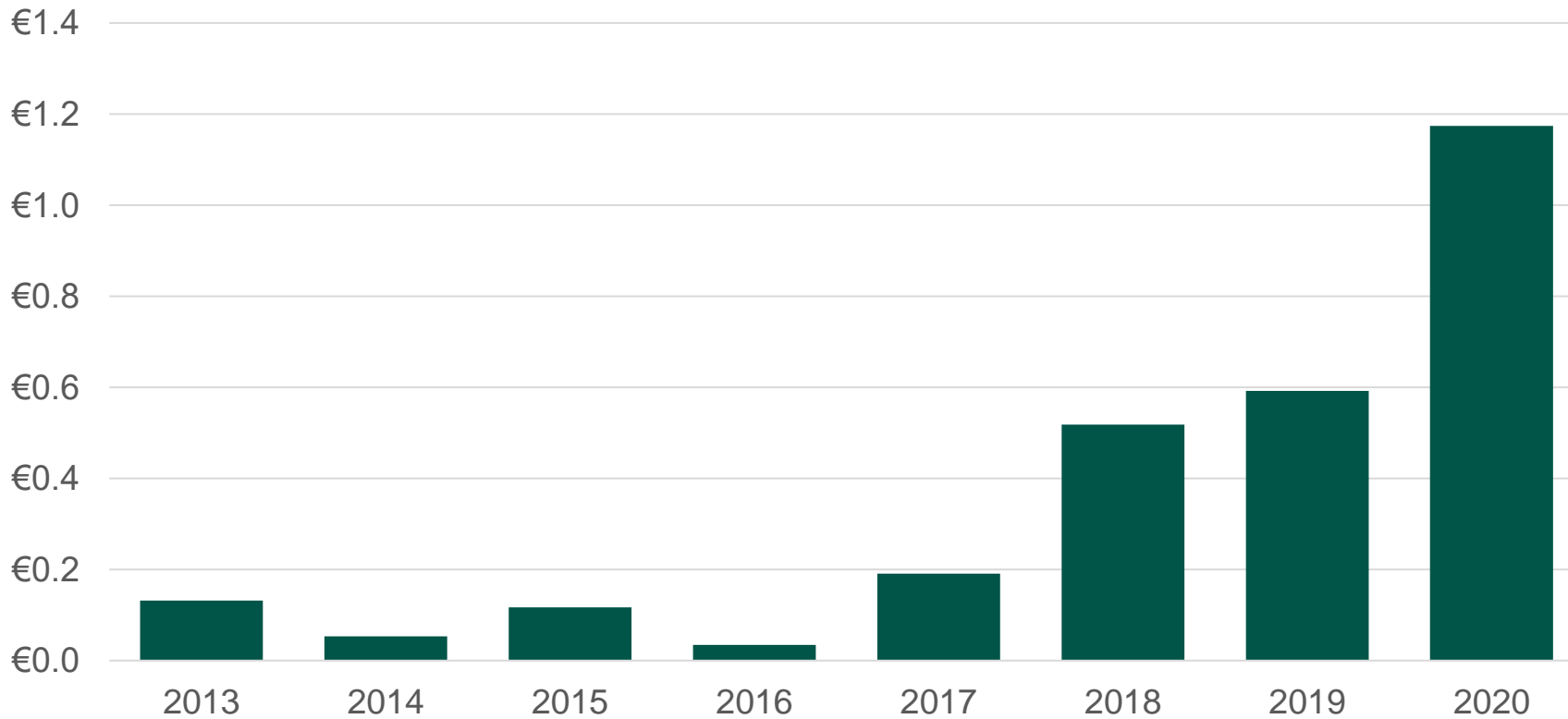
- **Bioactive plant compounds & supplements:** Nutritionally enhanced plants produce vitamins and better absorb minerals, which are better for end consumers
- **Nutraceuticals & pharmaceuticals:** molecules such as vaccine proteins or monoclonal antibodies produced in plants); incl. molecules such as phytonutrients which may have preventative effects with potential diseases
- **Bioencapsulation:** Protection / separation of functional / bioactive compounds from the environment)
- **Microbiome optimization:** Study of microbiome in host, with particular interest on impact of particular compounds on the gut health

Overall funding and growth in this space



/ NON-EXHAUSTIVE

Funding for all Dealroom deals (food sector, tagged as biotechnology)
[last funding round; Billions]



# Deals	2013	2014	2015	2016	2017	2018	2019	2020
	2	9	5	3	13	30	49	45

- **Deals in the biotech food space have continued to accelerate** (in terms of both funding and number)
- **Major players currently valued at \$10bn+, with**
 - 50% of that in 'food'
 - 40%+ in 'agriculture'
 - <10% 'health'

Risks and regulations



Issue	Description
Political opposition	GM crop production in Europe being block by bureaucratic process, despite crops going through thorough risk assessment (human & environmental health)
Health risk management	Concerns over mitigating / minimizing food allergens or toxins, particularly given unproven / limited history of newly genetically modified plants or microbes
Environmental risks	Researchers, industry participants, and regulators need to assess and mitigate any negative implications to biodiversity due to modifications of genetically improved crops
Socioeconomic	Much of the developing world has a diet that is very rich in processed carbohydrates, with limited nutritional value; negative impact on nutrition needs to be considered / managed

Agenda

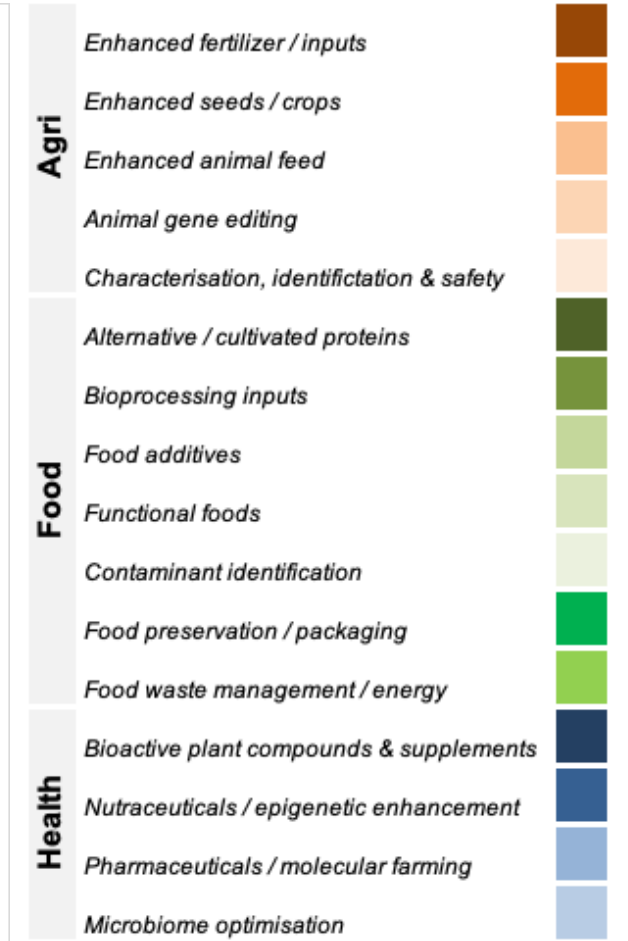
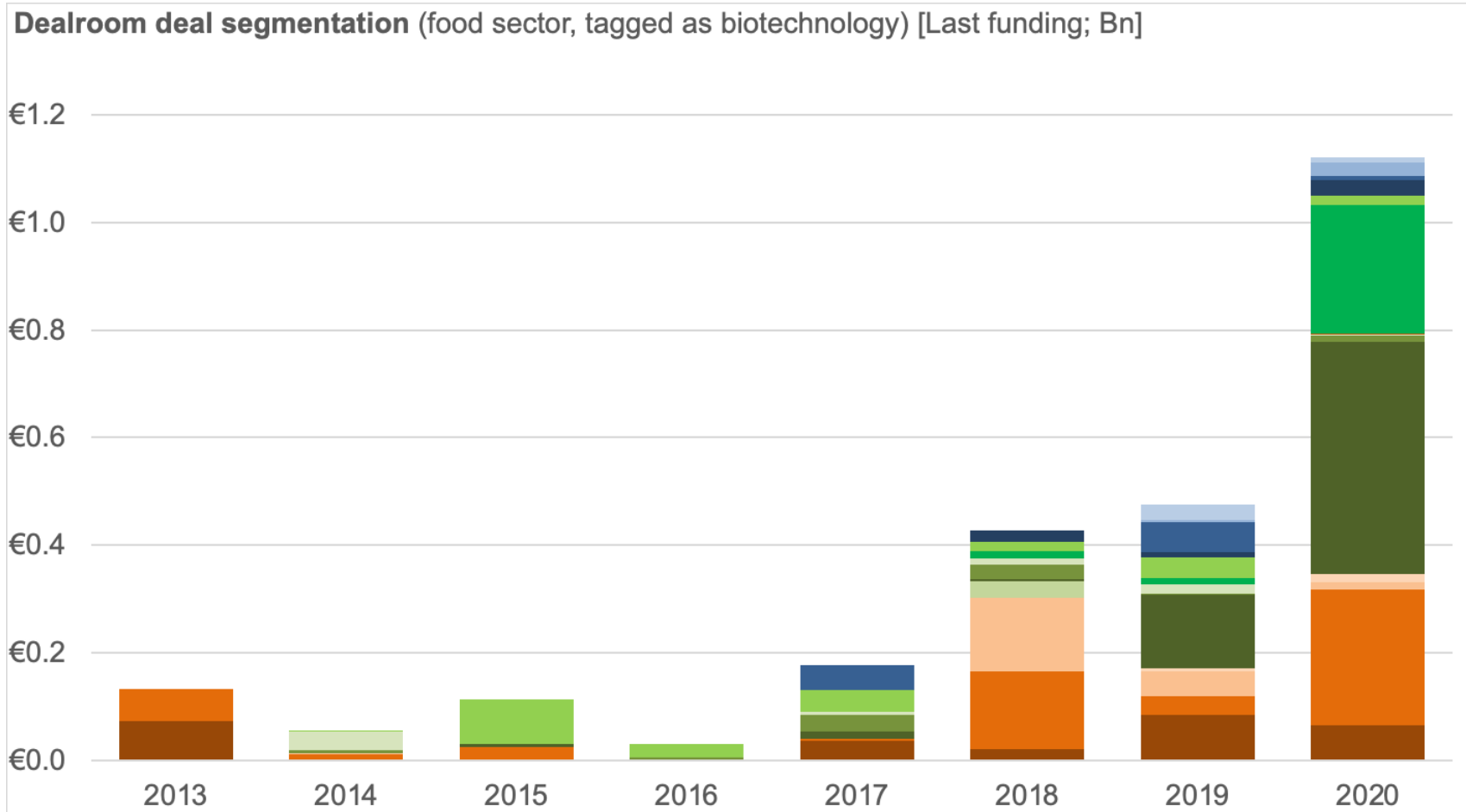


- Framing the intersection between biotechnology & food
- Mapping relevant start-ups in this space
- Review of funds active in this space
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Funding by sub-segment over time



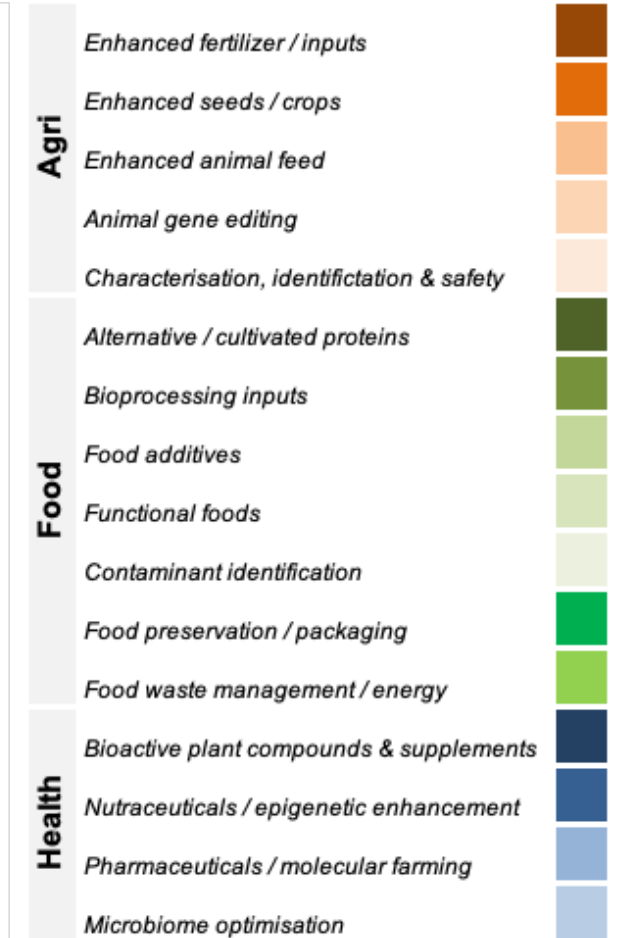
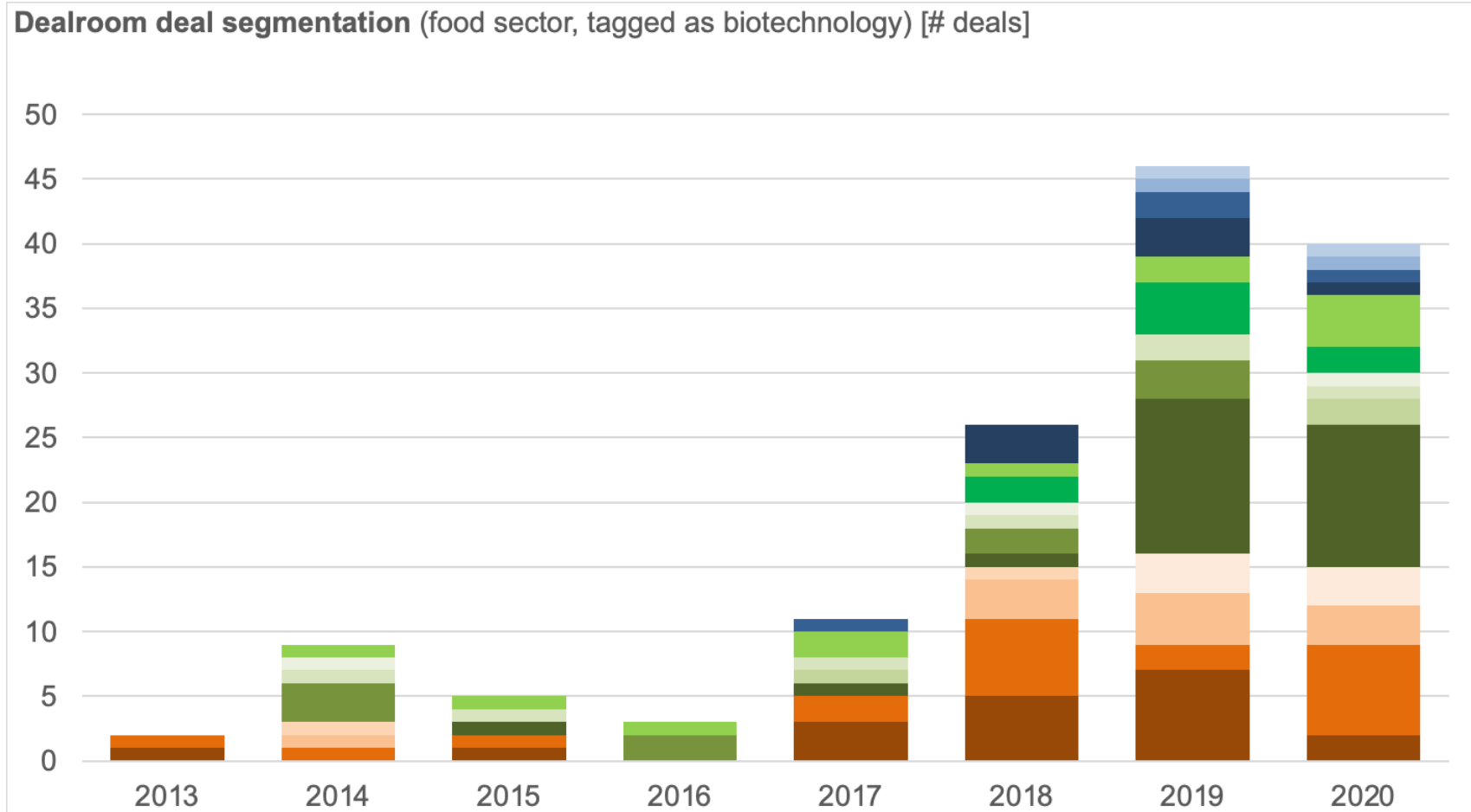
/ NON-EXHAUSTIVE



Funding by sub-segment over time



/ NON-EXHAUSTIVE



Intersection of food value chain and biotechnology



AGRICULTURE

 **PIVOT BIO**
The future of fertiliser
Raised **\$170M+**

Raised **\$155M**  **Ynsect**
Farms insects to make high-quality ingredients for animals

AGBIOME
Products for crop protection
Raised **\$124M**


Raised **\$120M**  **INARI**
Plant breeding technology company

FOOD

 **Apeel™** Raised **\$327M**
Plant-derived shelf life extension technology

 **MEMPHIS MEATS** Raised **\$164M**
Developing meat produced directly from animal cells

 **NotCo** Raised **\$105M**
Plant-based food

 **motif** Raised **±\$120M**
Ingredients for the next generation of healthy foods

HEALTH

 **soylent** Raised **\$67M**
A food supplement that can be personalized

 **FRONT RANGE BIOSCIENCES*** Raised **\$45M**
Agricultural science for cannabis and hemp

 **DAY TWO** Raised **\$44M** Microbiome precision medicine

Case studies: PIVOT BIO

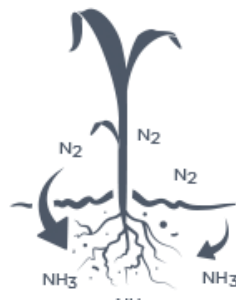


BUSINESS OVERVIEW

- Found date: 2010
- Founders: Alvin Tamsir, Karsten Temme
- HQ: San Francisco, the U.S.
- Pivot Bio develops and produces nitrogen producing microbial product 'Pivot Bio Proven' to replace synthetic nitrogen fertilizer
- ✓ Synthetic nitrogen fertilizer causes \$150B of negative economic, environmental and human health impacts
- Pivot Bio's product improves yield rate as well as protects environment

How it works?

- 1 Pivot Bio PROVEN is applied in-furrow at the time of planting
- 2 As roots grow, Pivot Bio PROVEN adhere to the epidermis of the roots
- 3 The microbes feed off the exudates of the plant and delivers nitrogen



FINANCIALS

- Fund raised: \$186.6M (Series C)
- Key investors: Breakthrough Energy Ventures*, Temasek Holdings, Monsanto Growth Ventures and Data Collective DCVC

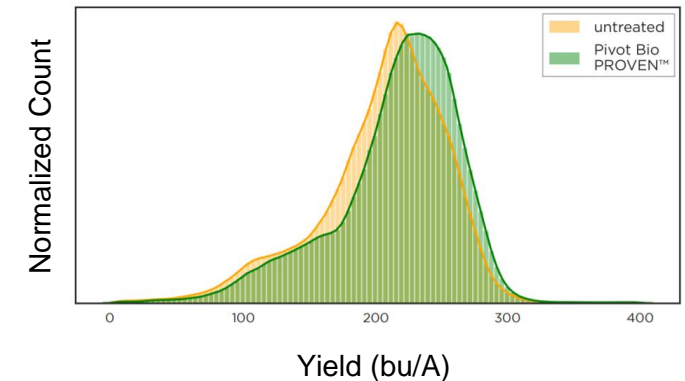
Date	Stage	Size	Lead investors
2020.4.30	Series C	\$100M	Breakthrough Energy Ventures*, Temasek
2018.10.2	Series B	\$70M	Breakthrough Energy Ventures
2016.3.23	Series A	\$16M	Data Collective DCVC
2014.10.1	Seed	\$750K	Data Collective DCVC, Monsanto Growth Ventures (MGV)

*LPs: Mukesh Ambani, Jeff Bezos, Bill Gates and Masayoshi Son

- Revenue/ Profit: N/A

KEY SUCCESS FACTORS

- Benefit: It benefits not only environment but also farmer's revenue by improving yield rate
- ✓ Pivot's sales remain consistent during the economic downturn by the COVID 19



- Strong R&D: It identifies millions of microbes and precisely fine-tune microbes which results in right products
- First mover's advantage
- ✓ Joyn Bio, a JV of Gingko Bioworks and Bayer is developing a microbial-based nitrogen fixing technology but has yet to come to market

Case studies: Motif FoodWorks



BUSINESS OVERVIEW

Aim: to improve taste, texture and nutrition in plant-based alternatives through ingredient innovation

Using synthetic biology, it engineers specific ingredients from microbes which can then be added to plant-based proteins to replicate taste and texture of animal meats

Highlights:

- Founded in 2019
- HQ: Boston, USA
- Spinoff from Gingko Bioworks, a biomanufacturing firm

FINANCIALS

- Funds raised: \$118.3M
- Key investors: Alumni Ventures Group, General Atlantic, Fonterra Cooperative, Louis Dreyfus

Date	Stage	Size	Lead investors
15.10.2019	Series A	\$800k	Alumni Ventures Group
15.08.2019	Series A	\$27.5M	General Atlantic, CPT Capital
26.02.2019	Series A	\$90M	Fonterra Co-operative Group, Louis Dreyfus Corp

- Revenue/ Profit: N/A

KEY SUCCESS FACTORS

Demand for plant-based meat alternatives is on the rise, but current options do not offer the same experience (taste, texture) as animal meat. Ingredients that can address are in high demand.

- Motif is preparing for commercial scale production of its beef ingredient

Strong R&D: rather than replacing core proteins in plant –based foods, these ingredients are added at low concentrations but deliver high impact on the eating experience

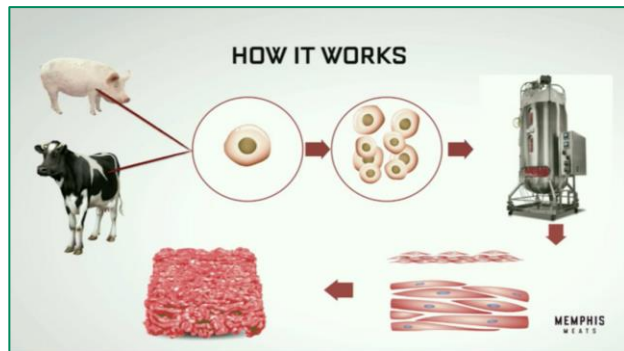
Case studies: Memphis Meats



BUSINESS OVERVIEW

- Memphis Meats, founded in 2015, has been **the world leader in cell-based meat**
- Develops **meat produced directly from animal cells without the need to raise and slaughter actual animals** by infusing a combination of vitamins, minerals, and glucose

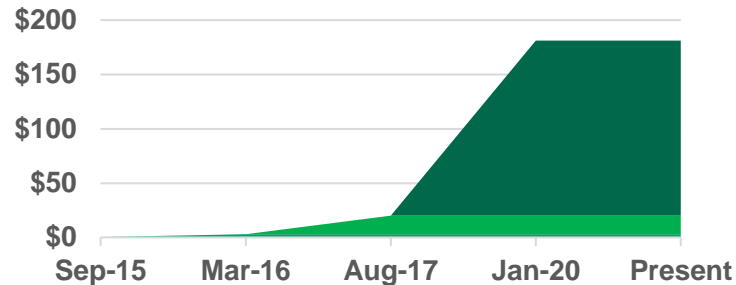
Illustrative Meat Production



FINANCIALS

Has raised a total of **~\$180M** in funding since its foundation

Funding history (in \$mm)



Has supports from **the world-class investors as well as food industry leaders**



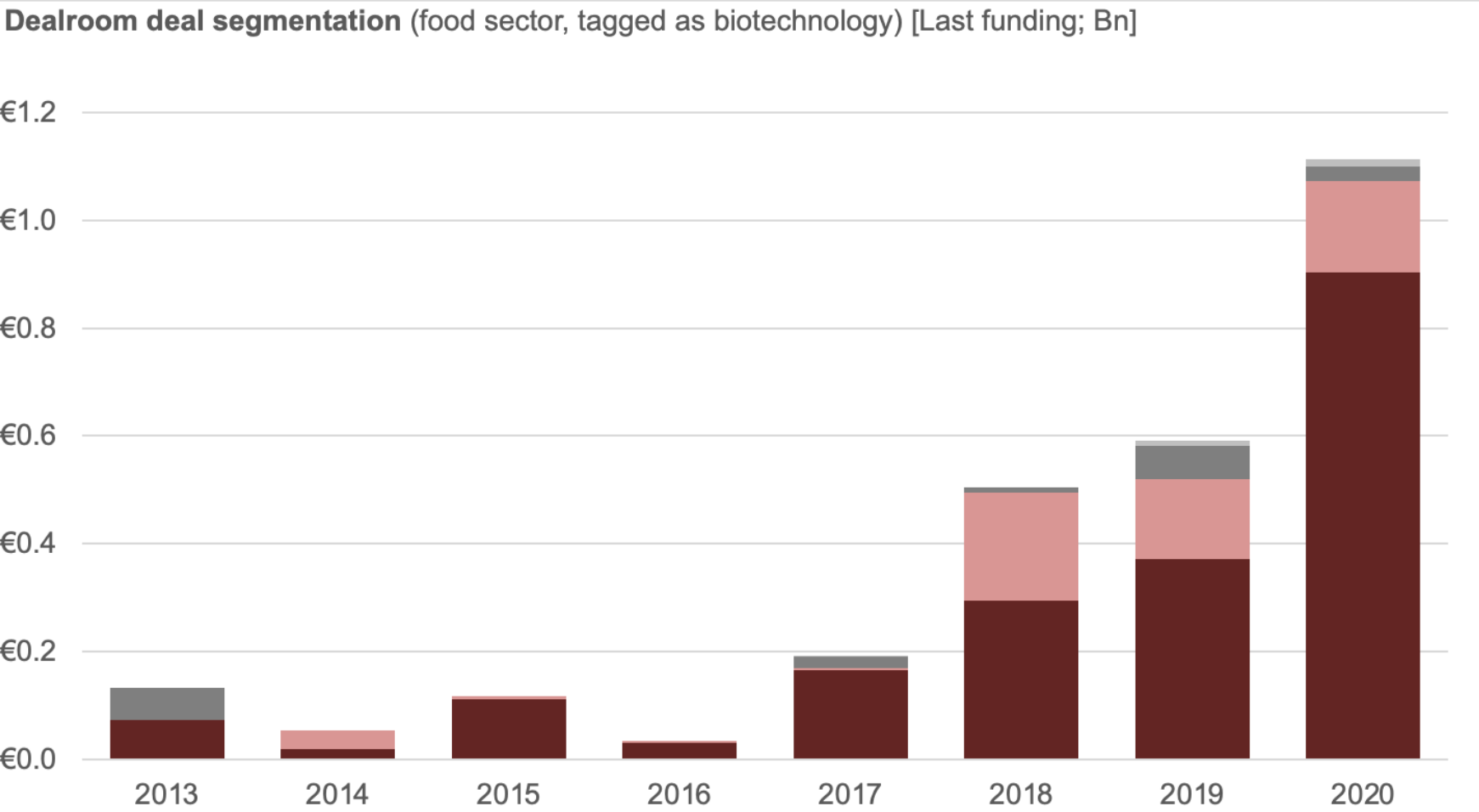
KEY SUCCESS FACTORS

- **Lab-grown meat is soaring in popularity, with millennials and Gen Z consumers:** increasingly shunning beef, poultry and pork for environmental and health reasons
- **Differentiated approach - Meat produced from animal cells:** different from other lab-grown meat (e.g. plant based meat by “Beyond Meat”)
- **Support from food industry leaders:** will enable Memphis Meats to take advantages of existing food supply chain

Funding by geography



/ NON-EXHAUSTIVE



- Americas
- UK & Europe
- MENA
- Australasia

Asia overview



SINGAPORE

Main focus in the biotech x food space is agritech - \$177M raised in 2019 Primary driver is government support to bolster local production of food and reduce dependence on imports.

Focus areas: alternative proteins R&D, cellular agriculture

KEY PLAYERS

- Shiok meats: cultured seafood, \$20.4M raised, founded 2018
- Life3 Biotech: plant-based protein developer, government backing

KEY INVESTORS

- SEEDS Capital (govt): \$65M for agri-tech
- Temasek

SOUTH KOREA

Interest in biotech x food space is weak because Korea agriculture and food production market are not sizable and farming and food production re regarded as unreputable job for a long time.

Many entrepreneurs and investors mainly seek pure biotech because of irrational valuation and exit opportunities.

Regarding food space, startups focuses on kitchen tech, delivery, and eCommerce (Non- production)

Only smart-farm gets interests in the ag-tech industry.

KEY PLAYERS

- Gikuin company: plant-based meat developer, \$4M raised, Found year 2017
- Cosmic Green: bioactive supplements, \$800k raised, Found year 2018
- GreenLabs: Smart-farm, \$10M+ raised, Found year 2017

KEY INVESTORS

- Yellow Dog (AUM ~\$100M): impact investor and biotech x food space is one of main areas

JAPAN

While Japanese biotech x food industry is growing and large food/pharma companies have started entering the market, investments in startups remain relatively small (med investment size: \$0.5m)

KEY PLAYERS



Making nutritiously balanced noodles

Making perfect balanced supplemental products



KEY INVESTORS

Future Food Fund

CVC backed by JPN banks and food manufacturers

Vision fund invests in ag/food tech companies



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Top 10 funds by activity



	# Investments	Total funding of fundees (\$) in database	Typical Investment stage	Headline Investments		Investment thesis
European Innovation Council	70	247	Grant	Lactips	Microphyt	Grants (typically €500k) to a broad spectrum of companies across biotech and food based in European/Israel
SOSV/IndieBio	25	219	Seed	Mephis Meats	The Not Company	Seed investments to North America based startups across both Biotech and food
Syngenta Ventures	7	308	Seed to Series B	AgBiome	Greenlight Biosciences	Focus on Crop Biotech investments primarily in USA
CPT Capital	7	178	Seed to series A	Motif FoodWorks		Investing in the Future of Protein from plant-based proteins, Recombinant proteins to cell culture across the globe
S2G Ventures	7	592	Series A to Series C	Apeel Sciences	Greenlight Biosciences	Investing across food and biotech to innovate in the food and agriculture sector. EU, USA and Israel
Agfunder	6	50	Seed to series A	Mycoventures		Focus on investing across the food value chain
Demeter Partners	6	227	Seed to IPO	Ynsect		France focussed new energy and ecological transition startup focussed investor
MassChallenge	6	93	Seed to Series B	Hyasynth Bio		Accelerator program with broad investment focus
Temasek	5	416	Series B to Series D	Pivot Bio	Provivi	Sovereign Wealth fund investing broadly including later stage food and biotech
New Crop Capital	5	181	Seed to Series B	Mephis Meats		Alternative protein investments across the globe

Example of investments / exits in biotech segment



Nestle investment in biotech x food

Nestle investing both through M&A (e.g. Aimmune acquisition) and independent corporate venture capital organisation – Inventages Venture Capital (focused on agriculture, biotechnology, and healthcare)



\$2.6bn acquisition (no sales, FDA approved product)

Aimmune makes peanut allergy treatment and has therapies in its pipeline for tree nut allergies



\$145m series D (post-revenue)

Ripple Foods is a California-based brand of pea-protein dairy alternative products



Undisclosed

Developed a proprietary extract from sugarcane molasses which lowers the GI of carb-based products / decreases sugar spike

Unilever investment in biotech x food

Unilever is using biotech to improve sustainability, using alliances & CVC (€450m AUM / over 40 direct investments); Unilever also uses an incubator – **Unliever Foundry** (access to pilots, mentorship, and financing)



Strategic alliance

Bio-on is an Italian bioplastic producer, focused on develop more environmentally friendly packaging



Undisclosed (early stage investment)

Thryve help people with customized probiotics & food recommendations to support their immune system



Undisclosed (early stage investment)

Gallinée focuses personal care on supporting the microbiome on skin, promoting good bacteria that live on the body and that are essential to healthy skin

Example of exits in bioagriculture (Novozymes)



Novozymes acquired expertise in bioagriculture (and probiotics more recently)

2016		Focus on probiotic cultures for Food, Feed and personal care
2015		Focus on probiotic cultures for animals
2013		Focus on biofuel and pharmaceutical enzymes
2013		Focus on Bioagriculture
2013		Focus on enzymes for papers, textiles and Feed
2012		Focus on Bioagriculture
2010	Turfal	Focus on Bioagriculture
2007		Focus on Bioagriculture
2006		Focus on Bioagriculture
2006		Focus on the biopharmaceutical industry

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High-level recommendations



- **Ultimately, we think the biotech x food space looks like an exciting space**
- Whilst there are a number of niche opportunities, **we believe this would ultimately require investment focus on alternative proteins, crop enhancement, and some applications of fermentation** (e.g. food additives or preservation)
- Although we have not seen pure biotech x food specialists, **the investor area is likely to get increasingly crowded as VCs, CVCs, and M&A all play a role in funding**

Appendix



Full project team



INSEAD project team



Gavin Evans



Ruchi Hotchandani



Tadahiro Maeda



Oliver Towndrow



Hoon Cho

INSEAD team profiles



**Hoon
Cho**

Corporate VC & Analyst of the senior care market

Global startup investments and an analysis of tech industries and VCs

This summer, Hoon investigated the investment of senior care market with the Singapore senior care service provider



**Gavin
Evans**

Consulting manager, focused on Private Equity & Healthcare

Responsible for leading CDD for major PE firms, with experience across a number of sectors, including healthcare and tech

Developed healthtech site with insight for VC, startups, & students (healthtechbase.org)



**Ruchi
Hotchandani**

Healthcare consultant specializing in emerging markets

Expertise in industry analysis, market sizing and strategy for diagnostics and pharma

During the summer, Ruchi developed the internationalization plan of a healthcare consumer good for US, EU and SEA markets



**Tadahiro
Maeda**

Experienced Investment Banker & Summer HF Investment Analyst

Expertise in industry analysis and corporate finance, and equity investment in Japan and the US

In his internship, Tadahiro worked on investing in tech and healthcare startups in Asia



**Oliver
Towndrow**

Ex Derivatives Trader, Ex Startup founder, Summer intern at Amazon

Expertise in industry competitor analysis, business development and operations

In his internship, Oliver identified efficiency improvements in Amazon's customer fulfilment operations

What We Can Deliver



We are a team of five, with a diverse set of backgrounds and a shared passion for healthcare / investing

1	A black line-art icon of a stethoscope.	Passion for healthcare investing	<ul style="list-style-type: none">• Our team has passion for healthcare investing given the potential impact this can have (e.g. increased access, new technological development) and financial return (i.e. attractive, resilient sector)
2	A black line-art icon of a Venn diagram with three overlapping circles.	Blended expertise	<ul style="list-style-type: none">• We bring deep and diverse industry expertise, which will help deliver reliable and comprehensive outcomes• <i>Industry expertise includes PE/VC, healthcare, consulting, tech, consumer products, banking, and BtoB services</i>
3	A black line-art icon of a globe showing the continents.	Global world view	<ul style="list-style-type: none">• We are a truly global team (i.e. background, experience / market knowledge) that brings broad perspectives to this research project• <i>Select geographical experience: Portugal, Spain, France, UK, South Africa, India, Singapore, Korea, Japan, and the US</i>
4	A black line-art icon showing two stylized figures holding hands in front of a clock face.	High productivity	<ul style="list-style-type: none">• Our team members are split across Asia and Europe; ‘teamlets’ can maximise working time in relevant time zones, but will also employ tools/process to stay connected & work seamlessly together



The Business School
for the World®

Europe



Asia



Middle East



North America