THE GOOD FOOD INSTITUTE

Pioneers of the Future of Food

PROFILES OF TRAILBLAZING SCIENTISTS AND ENGINEERS BUILDING A SUSTAINABLE FOOD SYSTEM

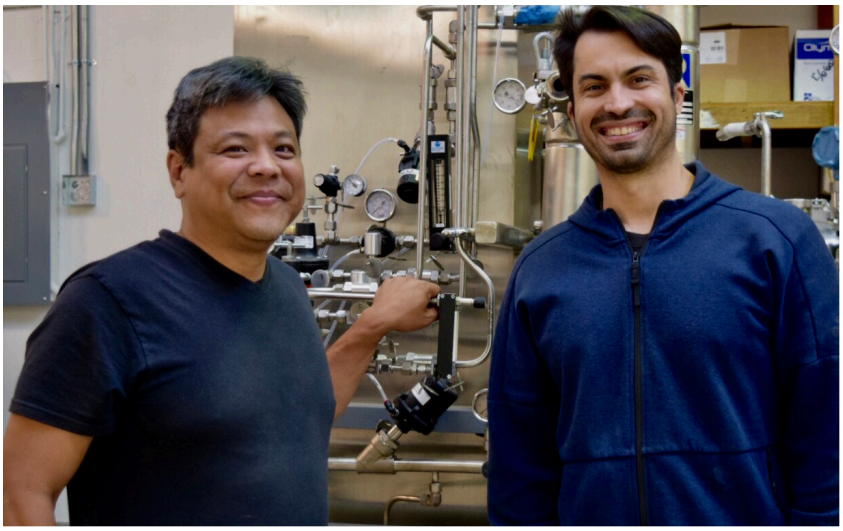


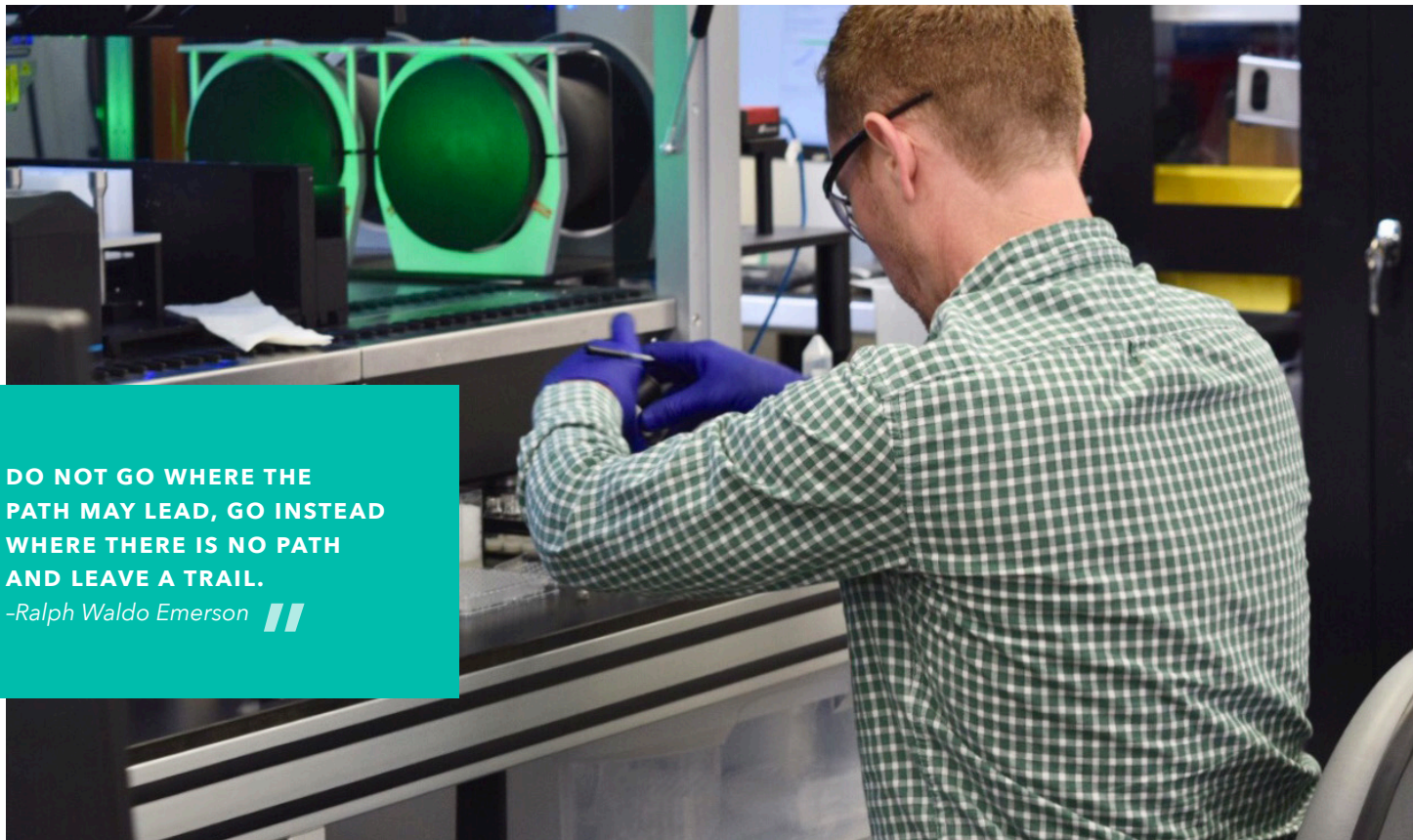
Table of Contents

Introduction

In some scientific and engineering disciplines, the path one should take to land your dream job is rather straightforward. But in emerging, multidisciplinary fields like alternative proteins and cellular agriculture, there is no single path or background that leads straight to a career developing the next generation of meat. All the researchers who have found a role in one of these pioneering plant-based meat, clean meat, or cellular agriculture companies have a unique story to tell. In many cases, they are able to leverage skill sets they learned across many different experiences or academic departments to develop creative solutions to some of the most fascinating challenges facing these fields.

The scientists and engineers profiled in this series represent a broad swath of talent: Some have been immersed in their trade for decades, while others are earlier in their career and have entered their current position within the last few months. These profiles include co-founders and heads of R&D as well as bench researchers who jumped straight into the plant-based or clean meat field after their undergraduate training. The overarching theme is that there is no better time to enter this space than now. Companies at every stage are seeking top technical talent across a wide range of disciplines, and the career opportunities in this sector will only continue to grow.

These scientist and engineer profiles are intended to inspire anyone from undergraduate students to advanced-career professionals to pursue their dream job developing a healthier, more sustainable, and more just food system by joining this sector. The interviews were conducted in the summer of 2018 by GFI scientific communications intern Waverly Eichhorst, a student at Grinnell College, who approached GFI because she was drawn to this cause but wanted to learn more about what it takes to make a career in this field. This resource contains the complete long-form interviews, and condensed snapshots are available as a sharing-friendly series on the GFI Blog (www.gfi.org/blog). Happy trails!



"DO NOT GO WHERE THE PATH MAY LEAD, GO INSTEAD WHERE THERE IS NO PATH AND LEAVE A TRAIL."
–Ralph Waldo Emerson"

Chris Davis

IMPOSSIBLE™

Chris Davis, Impossible Foods

Prior to working for Impossible Foods, Dr. Chris Davis received his PhD in organic chemistry from Oxford and worked for multiple years at startup company Codexis, where he developed ways to use biology to create more sustainable alternatives to traditionally toxic chemistries. Driven by his passion to positively impact the environment and to "do something worth doing," he came to Impossible in 2012 just as the company was being established. As the lead scientist for the R&D team, he has spent the past several years dissecting the question of what meat is, and he continues to apply his findings to the synthesis of plant-based products that aim to replace their animal-derived counterparts in the consumer market.

How did you find your way to Impossible Foods, and what inspired your interest in the alternative protein field?

I started as an organic chemist, doing standard organic chemistry synthesis. I became interested in how biology does chemistry, how to model what's happening in biological chemistry to avoid using the toxic solvents associated with traditional synthetic chemistry. I worked at a startup now known as Codexis, where I did a lot of work on how to replace traditionally toxic old-school chemistry with green chemistries by making drugs in more environmentally sustainable ways. I spent a long time doing that, then I moved into biofuel, where I worked on turning cellular biomass into detergent alcohols as a replacement for palm oil for the detergent industry.

After about 15 years in that industry, I began looking for a new challenge, but I couldn't find anything that felt more important than what I was doing. When I heard about Impossible Foods I thought, "Huh, that's new." It technically sounded like a really interesting challenge because after 15 years of working on strain engineering, protein engineering, and synthetic biology, that stuff felt like a fairly solved problem in my mind. This was a brand-new challenge: How do you make food from scratch, how do you feed the world? As part of the diligence for what I was thinking about, I started to learn about exactly how much environmental damage is associated with animal farming and I thought: "Dang, this is a really interesting challenge. How do you make meat from molecules, and how do you save the planet?"

The prospect of working with Impossible Foods ticked my environmental need to do something worth doing, and from a technological perspective, it required me to wrap my mind around the idea that a cow is basically just a technology to take plant biomass, degrade it into constituent amino acids, fats, sugars, and then reconstitute it up into a material that we then eat and has the properties that we know as meat or dairy. It was a fascinating problem, and I thought: "Well, how do you do that?" I looked at that question and realized I didn't know. Then I did some literature searching and realized that nobody had really asked it before. Given that I had no idea how to do it, I thought I had to take the job.

What was it like during the early stages of working on product development for Impossible Foods?

I came to Impossible in 2012, and in the six years since then, we've become a lot smarter than we were. In the first couple years, we were working out the fundamental stuff, the details of what meat is and what it is that's important in meat to create the desirable taste. One of the early understandings we made was the insight that it's the molecule myoglobin that drives the "meaty" flavors of meat. We normally think of myoglobin as making the difference between red and white meat, based on the amount of the molecule present. From a physiological perspective, myoglobin indicates whether or not the muscle is used in an aerobic or anaerobic manner. That's why the animal has myoglobin, but it turns out that it also catalyzes the flavor you get when you cook meat. The transition in flavor between the mild taste of a tartare and the array of flavors in cooked meat is based on myriad chemistry boosted by heme, the cofactor associated with myoglobin.

After establishing the importance of myoglobin analog oxygen carriers in all organisms, we then started asking how to make it in large quantities to use in our products. In the meantime, we were trying to work out how to make the structural components of meat: the fat, the muscle, etc. It took us three years before we got to anything even vaguely similar to meat, and even after three years, it was terrible but at least meat-ish. That was the first point at which we were able to think maybe it's not just a predicate, maybe creating meat from molecules is something that can be done. We then started iterating using science, trying something and determining, "That's better than this, let's keep going."

Over time, we built up a body of knowledge about how to make meat. We got to something we thought was good enough to sell in about 2015; then it took us about a year to turn a lab curiosity into something you can manufacture, which is an entirely different thing. We started to sell in a few different restaurants in 2016 and then, after the main factory was built last year, we expanded from about 30 restaurants to about 3,000, and it keeps growing every day.

What was your process of creating "meat from molecules" as you describe it? Would you walk us through the troubleshooting process you went through?

What is it about a protein that makes it suitable for making meat? Meat is a chunk of animal muscle, but from a food perspective it doesn't have to walk and it doesn't have to have the movement properties of muscle. It has to have other chemical and physical properties, and those you can start characterizing as meat transitions from becoming soft and malleable to firm as it cooks. The way meat changes color, the way it leaks water and oil onto the pan to give it a sizzle, the smoke and the aroma that comes up as you cook, and all the things that change with the cooking process – we were measuring these things to determine the flavor and performance envelope of what meat is. Then we had to ask ourselves how to replicate the experience of meat using plant proteins and we posed ourselves questions such as which plant proteins work better than other plant proteins? Is it a matter of how you process the proteins, the structure of the proteins themselves, or the nature of the fat? How do you manipulate the fat, and how does the fat actually work? We asked all those questions and more, and essentially what we were doing was building up a database of all of the things that work and all of the things that do not work for making meat.

There were a lot of interesting times when we would be trying to make meat and end up with something that tasted completely different. We would say to ourselves: "All right, that's not useful today, but let's remember that!" For instance, once we made a really eggy meat, and out of curiosity figured out what it was that made it taste like that to add to the knowledge set of what it is to make materials that we perceive as food. That's what the day-to-day work in our lab is really about: How do we understand what it is to make meat starting from molecules, and how do we make it at a manufacturing scale in a way that is cost-effective and sustainable?

How do you think your background in chemistry and protein engineering influences the way you approach product development?

I think what was and is most useful is the sense of how you take what sounds like a simple idea and turn it into an operational science where you can test hypotheses and work through the testing process. Protein engineering and strain engineering used to be black magic; it didn't really work that well and nobody ever knew how or why it would work when it sometimes would. Over the last 15 years, we've made it into a turnkey technology where you can just walk up and say, "I want a protein or strain that does X," and you can just make it. We've gone from a black art to a technology by application of good science.

There's that same idea of how you simplify the big problem of "that's meat" into a series of small steps and build out the technology to make a bunch of different doable bits and integrate it all together. That's really what's been the most helpful, because in terms of protein engineering, we haven't done any since I got here. But I also didn't come here to do that, I came here to do stuff I didn't know how to do.

What are your primary goals in what you hope to achieve in the coming years?

Historically, we've very much focused on how to get to beef, how to mimic beef. We're broadly speaking there now. So, now we have to start thinking how to be categorically tastier than beef. If you define it in any particular direction, we could make our product more or less chewy, and we could make it more of this or that sort of flavor, but an interesting challenge we are currently thinking about is what constitutes "better"? How do we define better and go get that? Deliciousness, which is obviously the key component to better, is a very subjective thing. Our goal is to be so much better than beef that sure, you could go get some beef, but why would you if it doesn't taste as good? Obviously, we can make it more sustainable and healthier, but eventually it's going to come down to whether we can make it more delicious. It's very interesting to think of how you can apply scientific principles to make something that's simply tastier. That's as much a psychological and societal question as it is a science question.

Our mission is to make animals as obsolete in the food pathway as horses are in transportation. When engineers first started creating steam trains, they weren't any better than a horse. But engineers had so much flexibility to change the pieces of the steam train that they ended up with something that was clearly categorically better than a horse at transportation. I don't see any philosophical or structural reasons why that's not equally possible in food, unless there is some intrinsic reason that a chunk of cow just happens to be more delicious than anything you could ever make. Why can't we do better? Exactly what that means, we don't know yet, just like you couldn't have invented a Tesla in 1830. It's going to be a fascinating period of research for the next many, many years as we figure it out.

As the alternative protein field transitions into later stages of development, how do you see the need for technical talent evolving?

We're still at the stage where what we really need is wicked smart people. We need people who are wicked smart and nice because this is an intensely collaborative research effort and we're feeding each other all the time. You need to get along with who you eat with! We can teach you how to use any of the tools, but we can't teach you how to be nice. So basically, wicked smart and nice are the key things you have to have.

Beyond that, a fundamental understanding of science is what I believe you need to have. A curiosity, drive, and passion to innovate rather than any particular incoming skill set. Talent from fields such as material science, classical biochemistry, and all types of chemistry are all important as well. Especially as companies go more and more into manufacturing, there's a whole bunch of associated engineering requirements that engineers will need to step in to help figure out. There's also a lot of food science around how you package and optimize the process, how you turn insights into a sellable product. We've got a lot of hardcore, insightful food scientists looking into how you actually make a product out of something because it's easy enough to make a lab curiosity, but it's a lot harder to make an actual product. I think we'll also see the need for sensory science increase, the concept of "better than beef" is really driven by sensory science. That's a fairly small subset, but we need a whole bunch of different skill sets to come together to make good food.

You mentioned that your interest in working for Impossible Foods was driven by your desire to make a positive impact on the environment and do something that had never been done before. Can you remember a specific instance in the time since you began working for Impossible Foods that you felt you were successful in reaching this goal?

When I saw the burger being sold for the first time and people were lining up to pay for it, that was awesome. It was the moment that I realized that it wasn't just me or the people that I work with, most of the people who had eaten the burger up until that point, saying they like it. To have people line up around the block just to eat it, then come back during the next days and eat it again multiple times, that was the first time I thought: "Dang, maybe we have something here, maybe people are ready for this concept and we've created a product that has a place." After that proof of concept, in the past two years since we've been on the market we've seen people consistently coming back to eat our burger, people really seem to like this stuff.

It was a huge breakthrough because up to that point, we had no guarantee that people would actually eat our product. People could have just said, "No, that's weird, I'm not eating that," which would have been sad and could've happened, but it didn't. It's not just vegans or vegetarians eating our burgers either, it's everybody that's fundamentally interested in trying this thing, and they don't appear to have a problem with the concept of eating meat that didn't happen to be a part of a cow. That led me to one of my most exciting discoveries, which is that the fact that a burger is a piece of cow is not why people eat burgers. Previously, that was not a known thing. Once you know that people will buy meat not because it's a piece of cow but because it tastes good and is at the right price, that tells you that there is no structural problem with our method of production. If we make a good enough product, people will buy it.

What do you see as the biggest challenge in making your products impactful on a global scale?

In order to get people to transition away from animal products, we need to make a better product. People aren't willing to make sacrifices surrounding food, and why should they? If you think about the next 30 years, the biggest problem is going to be as China, India, and Africa get rich they will want to do what rich people do, which is to eat meat. We have to find a way to give them something that is better than that, so they can show off their success without causing damage. That's part of why we started in America, because everybody aspires to the American diet.

We currently are selling in Hong Kong and Macau, which started as proof of concept to show that the popularity of our product is not just an American thing. It turns out that it's not, and what we're finding is that in various places around the world, our Impossible product is being incorporated into restaurants in completely different and novel ways. In places like Hong Kong, we're seeing dumplings and baos, as well as tacos in one of the biggest Mexican chains. East Asia is not really burger country, so although they still do make burgers, most of their sales are not in burger form, but rather in things like pizzas, meatloaves, meatballs. In San Mateo, there's even a place that even makes a gyro sandwich, packing our Impossible product around a spindle and shaving off slices.

A lot of people have challenged me, saying that they'll believe we know what we're doing when we can start selling steak in Argentina. I've thought: "All right, good challenge, let's do that!" We're not ready for that yet, but that's an excellent challenge; can we make a version of steak that's good enough that people in Argentina will line up at the bar to eat it?

Daniel Rauch & Rose Bechtel

MIYOKO'S

Daniel Rauch and Rose Bechtel, Miyoko's Kitchen

Daniel Rauch and Rose Bechtel, two food scientists in the product development team at Miyoko's, transitioned into their work on the creation of plant-based dairy alternatives from completely different backgrounds. Daniel Rauch spent many years learning about food as a chef before deciding to pursue food science to make a larger-scale impact. Similarly, Rose Bechtel, a recent graduate student at UC Davis, left behind a potential career in opera to pursue a degree in food science, enabling her to unleash her longstanding love for food creativity. Now, both scientists work hand in hand with the rest of their team to engineer products that are winning space in the dairy aisle of grocery stores across the country.

How did you learn about the clean meat and plant-based animal product industry? How did your initial impressions of the industry change with time?

Daniel: I first heard about the industry in connection with Impossible Foods – that was the first real big plant-based company to get my attention. I thought what they were doing was ambitious and sounded really exciting. It definitely struck a chord with me. This industry is the wave of the future, and it is necessary for so many reasons. Impossible Foods piqued my interest, and then a few years after that I heard about Miyoko's, who happened to be hiring. I thought it would be a great opportunity to join the movement.

Rose: Growing up in California, I was surrounded by a lot of vegetarians and vegans – as well as people who just happened to eat Tofutti Cuties and other plant-based foods like that. I heard about Impossible Foods and Beyond Meat when I started studying food science, and the plant-based animal alternative industry was really exciting to me from an almost chemical engineering perspective. I became vegan later in my life, and the industry became very relevant to what I hope succeeds in the future.

Daniel, what motivated you to shift away from being a chef into the food science sector?

Daniel: I became a chef because I wanted to learn how to cook and I was really passionate about food. After a couple years in that world, I realized that I would have a much bigger impact if I was cooking on a really large scale, and the natural transition was to get into food science.

At that point in my life, I had an undergraduate degree in physical science from UC Berkeley, but I hadn't studied food science. I applied for a few jobs as a product developer but at that time companies wanted people with food science backgrounds in their product development departments. So, I went to UC Davis, got my master's in food science and started working as a product developer at Mattson. I also did some product development work for Safeway, as well as a few other food and food tech startups, before ultimately landing my current role at Miyoko's.

Does your background as a chef influence the way you now think about product design?

Daniel: Working as a chef teaches you how to taste, how to be discerning about food, and how to think about and critique food. You don't just mindlessly eat. Successful food scientists and product developers ultimately learn that, but I believe I came into the field with a head start. Working as a chef also trained me to work fast at my bench, whereas other people I met who started out in food science worked a lot slower but more meticulous and detail-oriented than me. As a chef, I had a bad habit of moving really fast to make food taste right without weighing ingredients and writing everything down, so I had to learn how to slow down and be more meticulous as a food scientist. However, because I'm used to the face-paced energy of a kitchen, it feels natural to me to move quickly and have multiple projects going at once.

How about you, Rose, what led you to Miyoko's and this area of product development?

Rose: Well, as I assume most food scientists do, I started out studying opera... that's pretty standard, right? I studied classical vocal performance for about five years, before I realized it wasn't the right path for me. Since I was a kid I have been obsessed with baking, cooking, and experimenting in the kitchen. When I was around 13, I remember thinking: "One day, I'll have a lot of time and I'll just bake cookies and have every single variable of a chocolate chip cookie recipe. I'll figure out how it all works, and I'll tell everyone how it works." Then, I found out that food science existed and I didn't have to make thousands and thousands of cookies!

So, I earned an associate degree in chemistry at a lovely community college and then transferred to UC Davis where I completed a bachelor's degree in food science. Having that initial exposure to a "DIY approach" and trying to just figure it out before I actually earned a science degree fostered in me a much more curious approach and characterizes how I approach my work as a food scientist. I have a lot of passion for this work, and maybe because I studied music first, I'm not afraid to ask weird questions and be creative.

What is one of the biggest obstacles you face in your work?

Daniel: I'd say one of the biggest challenges is going from small- to mid- and large-scale production while trying to stay true to the original product. This company originally started out in Miyoko's garage, from all her knowledge as a chef. Translating that knowledge into products that are consistent at scale is a huge challenge; there are so many things you can do on a small batch that you can't do on a big batch. You physically can't even pick up and move a big batch, so all of the little things you used to do to manipulate the food can't be done. Especially with a fermented product like ours, it never really scales up linearly the way you expect it to, so we are constantly troubleshooting our products and processes through a food science lens. You really have to think through everything on the bench before trying a larger batch in the plant in order to be successful.

Daniel, based on your experience with eatsa and Luvo creating low-cost food products that are quickly and easily accessible, how do you plan to expand Miyoko's to reach a broader consumer base?

Daniel: We just launched our cream cheeses and our roadhouse cheeses, which are definitely at a more accessible price point. I think we're going to continue playing in that space while also launching products that stay true to Miyoko's roots and the artisan cheese maker she is. Every day she comes to us with a new, "We've got to try this, we've got to try that, I just had this thought about this, I was thinking about this last night before I was going to bed, etc." The everyday products don't have that same artisan touch and aren't as sexy as the cashew-based blue cheese that we age and use the right penicillin with to make a true blue cheese, but they are just as important because it really does help to spread the message and enable eating plant-based proteins and foods in place of animals. That's basically why we're here.

How do you see research opportunities in the alternative protein field evolving in the coming years based on areas in need of continued innovation?

Daniel: Food always comes down to taste and texture. I think that refining plant proteins to make them more neutral and more functional will be important. It would also help to develop stabilizers and other things like that to make plant proteins act a way that more closely mimics animal-based dairy and meat. It's definitely an ongoing process because food is so incredibly complex that you can't even model some of the things that are going on. Sometimes you arrive at a point where you've solved a problem and just have to accept that you've solved it without knowing what the actual solution was!

Rose: The alternative protein field is a very open and multimodal field that I think is one of the more exciting areas for research because it's so uncharted. For example, with the fermentation of cashews in a nut cheese situation, there's so much we don't know about how they are fermenting compared to dairy fermentations. Metabolically, it just hasn't been looked at yet, nobody's looked at the flavor volatiles and nobody's looked at any sort of sensory research. It's growing incredibly quickly but people aren't researching it fast enough because the funding doesn't exist for it in the same way as it does for dairy research because of the National Dairy Board. It can certainly be done, and you're already seeing a lot of exciting publications about plant-based things in countries like the Netherlands and Denmark where they have public funding and not as much research is driven by industry.

At this point, it seems like a lot of the different meat and dairy analogs are advanced enough that the issue with adoption might be solved in the sensory science realm where focus groups and descriptive analysis can be used to determine what is working and what isn't working.

What have you found most rewarding about working at Miyoko's in particular?

Daniel: One of the most rewarding things about working here is working with a founder who is so passionate and so involved. Miyoko is just incredibly inspiring, a great visionary and such an inspiring leader. It's been awesome working for her, and I had missed the same degree of passion at other food companies I've worked for. Some of those companies were in the industry for the wrong reasons, and it's really refreshing to be at a company where I am so aligned personally with everything we are doing.

Rose: This is my second job in the food industry, and I definitely appreciate all the things that Dan mentioned. My previous employment was in sensory science research at UC Davis, and in moving from a science-driven workplace to somewhere that's very values-driven I've found that there is a totally different atmosphere. It really feels like we're working towards something, and we're surrounded by people who really believe in our company's mission statement. I read about companies' mission statements a lot, and I feel like you often don't really see those statements in their actions or company culture. Here, you walk around the office and hear people talking about the half of the administration that's at an animal rights conference and it's like, "Oh, these people really do what they're talking about." That's really incredible to see.


Parendi
Birdie
JUST

Parendi Birdie, JUST

Unlike many scientists conducting research in the alternative protein field who transitioned into the field after years spent in a different sector, Parendi Birdie began working as a cellular agriculture research associate for JUST immediately following her college graduation. After interning with Clara Foods and Baylor College of Medicine during her undergraduate career and keeping up with the state of the clean meat industry while completing relevant coursework in cell biology, Birdie joined JUST in 2017. She currently spends most of her time in the company's cellular agriculture lab screening for cell lines that are most viable for clean meat production.

How did you become interested in pursuing work in the alternative protein field?

My dad actually was the one who introduced me to the field of cellular agriculture, around the time when Mark Post's burger was revealed in 2013. I remember sitting in the living room when he showed me a newspaper article that he had just read. I had spent the past few years talking to him—and anyone that would listen—in search of a career that would allow me to have the largest impact possible. I explored everything from medicine and law to activism. But nothing felt big enough.

As I tried to wrap my head around growing meat without harming an animal, I recalled a late-night chat with my brother-in-law while we were visiting my parents in Kansas. During this conversation, it became clear that this technology actually had the potential to make the world more humane for animals, healthier for people, and much greener for our planet. I was so allured by its absolutely game-changing potential.

After our 3:00 A.M. chat, my brother-in-law connected me to Josh Balk (a visionary of the field of cellular agriculture) and Isha Datar (another pioneer and the executive director of New Harvest). After these conversations, I was 100% committed to pursuing a career in cellular agriculture. I immediately started changing my coursework and lining up relevant research internships. I decided to dedicate my life to advance this groundbreaking technology and I have never looked back.

I noticed you took a break during your college career to help out on the business side of a Montessori school founded by your parents. How do you think that experience impacts the way you now think about your work?

Overnight our school grew from 10 students to 100 when we opened the doors to our new facility. I had a staff of 30 who reported to me and 200 demanding parents. I had to learn to wear many hats, quickly. I learned that sometimes life throws crazy things at you, and you have to learn to adapt. We worked with business consultants and I would pack our sessions full of questions. I would study the answers and worked on developing strategic and critical thinking skills. I learned to trust my instincts. The experience helped me realize the importance of asking the right questions and finding people you trust. And of course, to take failure in my stride.

I also read you worked as an intern with Clara Foods for a summer while still in college prior to starting at JUST. How has that experience translated into your current work, and how did it inform your career goals?

In early 2016, I emailed every startup or researcher who was somehow, in any way, working on developing cultured meat in hopes of finding a summer internship. No response. I wrote countless follow-ups. No response. Mailed in hand-written letters along with my resume. No response. I called and left voice mails. No response. I persisted for weeks and I eventually received a few polite emails stating that they were looking for interns with lab experience. I eventually was connected to lead scientists from Clara Foods and three months later I was on a plane from Houston, TX, to San Francisco, CA.

I worked nonstop for two months on their strain engineering team as a molecular biologist designing DNA constructs and generating microbe strains with high protein yields. Many of the skills I gained at Clara Foods I use every day at JUST. I fell in love with molecular biology and that love allowed me to explore how we can use molecular biology to enhance the metabolism of the cells in our meat products.

My time in San Francisco also afforded me several networking opportunities. If I wasn't in the lab, I was pushing my way into meetings with every single person in the Bay Area who was working in field. I was at every networking event and visited every cell ag startup. During one of my visits at JUST I met Josh Balk, co-founder of JUST, who I convinced to arrange the meeting between me and JUST's CTO. I recall asking the CTO, "If I was a robot, and you could program me to do anything between now and when I would apply for a job what would it be?" I took notes, kept in touch, revised my research plans to ensure I was gaining the correct research skills. I kept in touch with the CTO and a friend of mine who was leading the cellular agriculture efforts at JUST.

What do you consider your favorite aspects of your current work in JUST's clean meat lab?

I enjoy isolating new cell lines from a variety of species, breeds, and tissues in search of cells that have the greatest potential. It's fascinating when I discover subtle differences between each cell line and what causes those differences.

How do you see research opportunities changing in the coming years as companies transition to later stages of development?

We definitely need more expertise in large-scale production. We will require engineers who can translate our small-scale processes to a much larger scale. We also need social scientists working side by side with us to help ensure that the consumer is comfortable with our meat.

I would also like to see more computational biologists working to accelerate our research. Computational biologists can use our biological data to develop models to understand the complex metabolism of cells in an effort to develop a cheap media for the cells. I'm sure there are cheap and effective media that can be formulated with this perfect balance of nutrients that offers a synergistic effect between lipids, salts, trace elements, amino acids, vitamins, etc. The problem is, we simply can't screen through all of the combinations of media components at various concentrations. I would love to see a computer program effectively screen through countless combinations for us.

What milestones do you believe the industry will need to achieve in order to foster consumer acceptance?

Trust is everything. We are developing a safe product – but if the public doesn't trust us, none of this matters. Building partnerships with big traditional meat companies will be key to fostering consumer acceptance of cultured meat. I believe it's important for consumers to understand that many meat companies also have trust in this technology. If consumers see a cultured meat product sold in partnership with, let's say, Tyson or McDonald's, it will feel very different than some "biotech startup from Silicon Valley."

What personal characteristics do you believe would make a scientist particularly well-suited for work in the field?

We need scientists with deep knowledge and experience coupled with grit, creativity, and the ability to think outside of the box. We need scientists who truly understand that this is a multidisciplinary field requiring collaboration between stem cell biologists, engineers, food scientists, and more.

We need scientists who can envision this as a food product, who understand that we will have many, many challenges and naysayers along the way. We need scientists who won't be satisfied by selling this as a specialty product at Whole Foods, and who won't be satisfied until it is sold at McDonald's around the world.

What do you consider most rewarding about your work?

I love seeing this vision that's been trapped in my imagination for years become a reality. I love talking to big meat companies and hearing them say that they want a healthier, more sustainable protein to feed our growing world. I love eating our meat and watching others eat it while they realize that it's truly meat – the same meat they grew up eating, the same delicious, savory meat they enjoy every day.


Jess
Joslin
MEMPHIS
MEATS

Jess Joslin, Memphis Meats

As a chemist with a background in analytical, physical, and materials chemistry, Dr. Jessica Joslin has always been interested in applying her expertise to ameliorate pressing environmental, human health, and animal welfare concerns. Before coming to Memphis Meats in January of 2018, Joslin worked on projects ranging from analyzing biomaterials to developing water treatment technologies. As the analytical development scientist at Memphis Meats, she works to characterize cell-based meat to aid in the company's product development.

How did you initially learn about the clean meat and plant-based animal product field? What piqued your interest in working in it?

I have been aware of some of the challenges facing modern meat production for a long time, but it wasn't until 2016 when I first learned about meat grown from animal cells. I am on an email list for Mercy For Animals and I remember receiving a post about The Good Food Institute when it launched. I immediately was fascinated with the idea that there could be a way to address some of the challenges of animal agriculture that would allow people to "have their meat and eat it too!" – but without the undesirable environmental, health, and animal welfare issues. Aside from being interested from an animal welfare perspective, I also was immediately intrigued by the science. My background is in chemistry and at the time I was just out of grad school and involved in some mammalian cell culture projects. The thought of growing animal cells to make meat was so fascinating! I knew right away that I needed to be involved.

Given your prior experiences working in roles across various technology platforms, you seem to have a strong interest in developing innovative technologies that benefit both the environment and human health. How do you see your current research intersecting with this interest, and how do your previous work and research experiences inform the way you approach your work for Memphis Meats?

My interest in science has always been application-oriented. I care a lot about the environment, people, and animals and have always wanted to apply my scientific interests to improve the world. In grad school I worked in a group developing biomimetic materials to improve patient outcomes, and then with a startup company in Fort Collins working on an aqueous plasma reactor technology for water treatment and other therapeutic applications. I learned a lot about how to apply core scientific principles and processes to understand systems in order to better optimize them for different applications. I love investigating new fields and attempting things that have never been done before. This experience translated well to the work I am currently doing with Memphis Meats, where I develop analytical assays to better characterize the meat that we are making, with the goal of making the most delicious and sustainable meat that we can.

This field truly can unify folks across all scientific backgrounds as well as communications, policy, and infrastructure roles.

What makes your work with Memphis Meats distinct from your previous research experience? What aspect of your current research have you found to be the most fascinating?

My work at Memphis Meats has connected with me on a much deeper emotional level than any of my previous work – the thought that a single field could truly change the planet in so many positive ways across human health, environmental sustainability, and animal welfare makes me so pumped! Aside from this work aligning the most with my true passions, I have enjoyed the opportunity to apply assays in a unique way and to think about meat in a way that hasn't been done before. It is so fun and inspiring to be a part of a revolutionary field that gets so many people from different walks of life excited and united.

What is the biggest obstacle you have encountered in product development or another aspect of your work? How does your expertise in chemistry aid you in the troubleshooting process?

It has been fun and challenging to consider how people think about meat. How do we define our process to make the most delicious meat possible? I operate at a fun intersection between conventional meat science and tissue engineering. We are applying conventional assays as well as completely new assays that have never been used before to characterize meat. The scientific process has been key to this, especially my background as an analytical scientist. I have had to be creative in previous roles when analyzing complex, multiphase systems and using those results to optimize the platform – and the same is true of what I am doing now. An understanding of assay sensitivity, selectivity, feasibility, cost, and scope is critical as I establish, troubleshoot, modify, and validate various assays to better characterize our product.

How do you see multidisciplinary research opportunities in the alternative protein field evolving in the coming years?

I am excited to see what the future holds for this movement. In the short time I've been with Memphis Meats, we've made such exciting strides. The field is growing, with new companies popping up on the radar. I see the field as being connected through a common vision, even if the approach to get there might be different. As such, it will be exciting to see processes scale to reach commercial capabilities and see what products become available on the market and the regulatory paths that are taken to get there. This field truly can unify folks across all scientific backgrounds as well as communications, policy, and infrastructure roles. There will be important players across industry, academia, and the government. I am excited to see what the next few years hold!

What do you consider to be the most rewarding aspect of your work?

As I've mentioned already, the ability to be involved in such cool science is so rewarding. Even more important, though, is the fact that this work has such potential to revolutionize the health of the planet, people, and animals. A few years ago, the challenge of feeding over 9 billion people by 2050 seemed insurmountable. Now that this movement has gained such traction and is exploding in the public eye, people are truly rooting for this to become a reality. It is so encouraging to think that someday we really could change the trajectory of how meat is made. To think of people getting delicious food in a more sustainable way is what inspires me the most every day!


Jennifer
Tung
Finless Foods

Jennifer Tung, Finless Foods

Currently working as a senior cell biologist for Finless Foods, Dr. Jennifer Tung previously conducted research in a range of biological research topics both as a doctorate candidate at Columbia University and as a postdoctoral fellow at UC San Diego. After working at ScienCell Research Laboratories, Tung was drawn to Finless Foods in early 2018, as their work combined her love for animals with her passion for biology and the protection of coastal environments. As a scientist for the company, she now works on pioneering research into piscine cell lines to work on the development of Finless Foods' first product – bluefin tuna produced using cellular agriculture techniques.

Could you speak a little as to what drove your interest in working for the alternative protein industry?

Since I was very young I have liked animals and been scientifically inclined, so I was aware early on of the alternative protein field. In college, I explored the science of the field a bit more as I majored in biology and concurrently worked in two labs, one studying the echolocation of fruit bats and the other working on malaria genotyping. Engaging with this kind of research has always been a passion of mine and dovetails well with my traditional science background.

More recently, as research on climate change has come to light and we've gotten to know more about what's causing it and how to combat it, it seems more and more important that people do something about it. For me, the changes in the United States' regulatory policies, as well as the global impacts of not paying sufficient attention to biodiversity, conservation, and the effects of global warming, should not be ignored. The call to action that I feel is what prompted my interest in a career in this field.

I noticed you have background experience in quite a broad array of biological research subjects. What piqued your interest in doing research for Finless Foods, and what aspect of your research do you now find the most fascinating?

Several aspects piqued my interest because cell-based meat development is such a new and undeveloped area of research. It's thrilling to think that what I'm doing actually may have a definable impact on the field. Beyond that, the field itself is quite new, so the same impact may translate into an impact on the eating habits of the nation or the world.

The research techniques I developed from my previous training translate well into working for Finless because we are at such an early stage of R&D development. Even though the subject is quite unique, lots of research from other fields is applicable. It's very fun and intellectually stimulating for me, trying to figure out how to do something that other people haven't figured out how to do before. The mission is also important to me, and it's gratifying to use the skill sets I've learned throughout my life on something I've been very passionate about on a personal level.

Could you speak a little more as to how your past research experience has directly translated into your work for Finless Foods?

Basic research on fish cell and molecular biology is not as well-developed as the cellular and molecular biology of cells from organisms commonly used for biomedical research. Beyond that, fish are a group of diverse animals, so things that may apply to zebrafish, for example, may not apply to bluefin tuna, which is a very different type of fish. Figuring out the basic cell biology of different fish species is a major area of focus for us, and it's fun to apply the techniques of mammalian cell culture research to see what's similar and what's dissimilar.

What are the biggest obstacles you currently are facing in product development or another aspect of your research?

Although some research on mammals may apply to fish, it frequently does not. Trouble-shooting when there's not a lot of existing knowledge to rely on is very difficult, and there's only so many papers you can read before you just have to try things and see what happens. Often it's not just one factor that makes something not work, so solving problems can be quite difficult. For example, if you try cells in a certain kind of scaffold and they don't grow in the intended fashion, it may have nothing to do with the scaffold. Maybe the temperature or the media you're using is wrong; it could be so many things and you're not quite sure which one. This industry requires a lot of hard work and it can feel daunting because we're trying to solve problems with no predefined solutions and no real clues on how to get there.

What do you find most exciting about your work for Finless Foods?

The mission itself feels hugely important to me because I've lived most of my life either on the East or West coast, and ever since I was a child it was obvious to me how much human activity impacts marine ecosystems. The fact that I am in the position to contribute positively towards keeping those ecosystems healthy is very rewarding. Each personal success I have is compounded by that knowledge in the back of my mind. It's also interesting because Finless is currently only seven people, so my personal failures and successes directly impact the failures and successes of the company. That in itself is pretty thrilling, and I think about that frequently. I lose sleep and gain wrinkles thinking about it, but it's fun!

Beyond that, an exciting factor for me is being one of the first or the first to do something that could be useful not only in cellular agriculture but in basic research that can be used to study subjects such as fish diseases. Even if these products don't ever become a thing – which I think and hope they will – the research that comes out of it will help advance the study of diseases to enable conventional fish aquaculture to become more efficient and healthy as well.

Nick Ouzounov

Geltor

Nick Ouzounov, Geltor

Before founding the cellular agriculture company Geltor with his co-founder Alex Lorestani, Dr. Nick Ouzounov conducted cell biology research both as a PhD. student and postdoctoral fellow at Princeton University. After concentrating for years on the study of protein structure, he decided to transition into his role as the scientific lead for Geltor to apply his knowledge to the development of animal-free gelatin. As his company moves into the later stages of manufacturing, Dr. Ouzounov is now beginning to work with other companies within the consumer goods industry to tailor their products for specific applications.

How did you become interested in working in the alternative protein industry and creating a product to replace animal-derived gelatin?

I looked at the industry from the side of production. I knew a lot about do-it-yourself biology and I was inspired by the idea of not simply following a pharmaceutical route or a biopharmaceutical route but rather doing something new. I wanted to start a business that could have an impact on the world and I was interested in the potential of applying biotechnology to address areas of need in the consumer market. Biotechnology has been used for pharmaceutical purposes for a while, but it has rarely been applied to consumer goods such as the cosmetics industry. I was a vegetarian at the time, and my co-founder Alex Lorestani and I discovered an unmet need for animal-free collagen and gelatin, which are effectively derivatives of one another. The field is very young, and although we thought it seemed crowded when there were only a handful of companies, it's now obvious that we were one of the first ones to enter.

I read that you chose to focus on animal-free gelatin because of the potential for animal gelatin to contribute to antibiotic resistance. Can you speak a little more about that connection and why you were inspired to create a product that replaces animal-derived gelatin?

What I initially liked about gelatin is that it is a derivative of collagen; it's basically just a broken-up version of collagen. There's a lot of function that you can get from one protein sequence: You don't have to make 10 proteins and then combine them to get one function; rather, you can make one protein and have it perform 10 different functions. So that was attractive – the simplicity and versatility of it. We can effectively apply machine learning approaches to study the sequence to understand the function. Without the technology, that would be immensely difficult to do. We also have the flexibility to work across species; for instance, we're not limited to using pig collagen sequences because we can use any DNA sequence that's out there for a species and develop it into a product. By removing the animal agriculture aspect, which the majority of antibiotic use currently goes towards, we can have a significant impact on the environment and human health.

How do you envision your gelatin product replacing and changing the way we use gelatin in the future?

Off the bat, when we compare what we produce versus animal-derived collagen, we have a much higher purity. We make a very pure product with effectively no smell and no color. The smell actually limits how much animal-derived ingredients can be used because the collagen smells like the animal it came from – fish collagen smells like fish, pig collagen smells like pig. In terms of color, animal-derived gelatin often has a yellowish tint to it but ours effectively has no color. Additionally, the high purity in our product allows us to find functionalities that are masked by all the other impurities found in animal-derived ingredients. We are currently partnering with companies in the cosmetics and food markets to design forms of collagen and gelatin that are particularly well-suited for their intended applications.

Which skills among those you developed as a result of your experience with molecular biology have you found to be the most pertinent to product development for Geltor?

To begin with, the genetic engineering skills that I developed during graduate school have been very important. These skills provide me with the ability to prototype new proteins and new targets quickly, and I am able to go down the funnel of possibilities until we have an actual product. In graduate school I studied how to break proteins apart, have another protein attach to them, then have them all refold and function properly. That really enabled me to focus on the structure-function relationship of the sequences, which is partly what we focus on now at Geltor: the structure-function of collagen.

Generally speaking, what makes your research for Geltor distinct from your previous research experience?

My role at Geltor is similar to a principal investigator in a university. I don't really do much on the bench anymore, I'm mostly on the computer and in meetings for the majority of my day. Rather than performing the bench work, I am leading the scientists doing the bench and the scale-up work. Although I've had a very good experience in both my undergraduate and graduate studies where I had a lot of freedom to operate, I now have almost unlimited freedom. If I find a particular protein target interesting, I am able to conduct focused research into that specific protein. It's exciting for me to have the ability to lead what research is happening.

What milestones do you believe companies in the alternative protein industry need to reach in order to become more impactful, and how do you see the future of the field evolving in the coming years?

One thing that we try to achieve at Geltor that I think is important for the other companies in the field to address is what are the early, potentially smaller markets to address as they scale? Scale-up is going to be a major issue for everybody because when you're creating a new technology that hasn't existed before, you have to either build the infrastructure for it or utilize what's existing already, which might not be perfectly suited for your process. I believe it will be essential to find applications where you can make an impact that's not all the way at the end of the road. Right now, food is a huge area for innovation but, in general, consumer products have potential for a lot of innovation.

Also, if you look at what previously has been considered as the typical career path that people take from graduate school to faculty positions, that's now only followed by a small fraction of everybody that goes to graduate school. I think it's important to keep in mind the possibilities outside of the typical graduate-school-to-faculty path and the falsehood that exists around the safety of that path. I don't think there really is any "safe" path. I believe that people should pursue the path they consider the most personally rewarding.

In terms of the effect that biotechnology can have on consumer goods, I think it will be similar to the effect of synthetic chemistry on many consumer products and areas of material science back in the early 20th century. I think that's where we are today with biotechnology. We have such a vast amount of data out there – protein sequences, functionalities, and everything like that – which currently are not addressed but could easily be applied.

Andra Necula

NEW AGE
MEATS

Andra Necula, New Age Meats

Despite being a new face in the cellular agriculture industry, New Age Meats co-founder and CSO Andra Necula has an extensive background in cell biology research, entrepreneurship, and the intersection between international relations and public policy. Prior to deciding to found her own clean meat company, Necula did a PhD in interdisciplinary biosciences at the University of Oxford, conducted research on pancreas production from stem cells at the Andalusian Regenerative Medicine Center, and investigated autoimmune type 1 diabetes at St. Vincent's Institute in Melbourne. She also holds a diploma in international relations and affairs at the University of London, and she has worked in leadership positions for a number of nonprofits and charities dedicated to advancing diversity in educational opportunities and innovating educational curriculum. Currently in the seventh batch of companies in the synthetic biology accelerator IndieBio, Necula is working closely with her co-founder Brian Spears to develop a company that will incorporate automation to enable rapid scale-up in production and consumer access to their clean meat products that is both equitable and widespread.

Do you remember how you initially learned about the alternative protein field and how you became interested in getting involved?

Once you start learning about synthetic biology, you start thinking that some ideas that initially seemed crazy are actually possible. Although I can't remember the exact moment I initially heard about the alternative protein field, I remember that I learned about some of the early proofs of cellular agriculture concepts as an undergraduate student through projects put forth in the synthetic biology competition International Genetic Engineering Machine. Driven by my own interest, I went back to look more into the synthetic biology field as I progressed through my PhD. to better understand the state of the industry. It was amazing to see how fast things progressed from just a few rounds of people doing things in the lab to actually having an industry that has started to produce and market products.

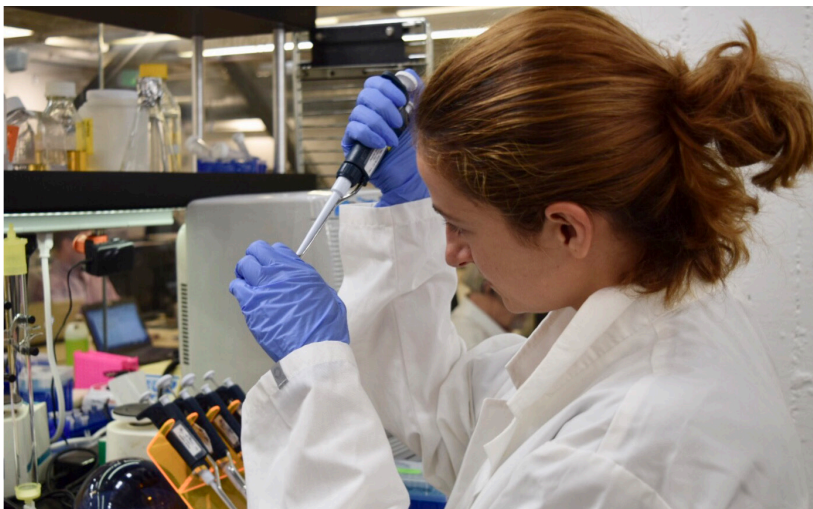
I personally became interested in working in the alternative protein field while working on my PhD. at Oxford, where I began to understand that this space has the potential to make an enormous impact. I had started thinking about how I could make a positive impact through effective altruism, which is based on the philosophy of an Oxford professor who identified the most effective ways for us to put a dent in the universe through our career by creating frameworks to quantitatively measure the effect of altruistic acts and their potential impact. One area the professor highlighted was creating alternatives to protein production; that was what introduced me to the idea that this field has a lot of promise to have broad-reaching impacts, including ameliorating the environment and improving animal welfare.

What led you to the decision to found your own clean meat company?

For me, I think entrepreneurship came before I knew that I wanted to be in the cellular agriculture field. Since a very early age, I've been interested in the idea of how to have the most impact with what I do in my life. I went into research because discoveries have so much potential to touch people's lives and for a long time I really thought that I would stay in research. However, the longer I stayed, the more I realized that there are many barriers to progress that are not research-related, such as policy, regulation, commercialization, and financial interests that will completely kill certain projects. A lot of progress depends on how you sell something and how you brand it, so to me, entrepreneurship became a way to actually bring research to the market, any type of research. I realized this about a year into my PhD., and I knew at that point that after completing my PhD. I would become an entrepreneur, but I didn't know exactly what this would be like.

After my PhD., I joined a program in London called Entrepreneur First, which is a program that allows you to do self-exploration for a few months in different markets. It gives you the space to think about your background and where you might have the most impact given your skill set and expertise. It also teaches you about different aspects of the market and to consider things such as how commercially viable is this thing? Is this something that actually suits my interests? It was during this program that I got the chance to really roll up my sleeves and do a deep dive into the clean meat field. There were many questions that I didn't have an answer to when I started my exploration, and really there are a lot of questions that nobody in the field has the answers to. That in itself is quite intriguing and scary in many ways, to realize that there's so much that we don't know and so much that we are only starting to discover in terms of long-term cost projections and how technologies are going to change. I kept on pushing my exploration into the clean meat field until I felt I had enough answers to be able to make up my mind and convince myself that producing clean meat is actually technically doable and there are paths to get there.

In the meantime, I found my co-founder Brian Spears, who had also been in search of a field in which he could make an impact. As he learned more about the alternative protein industry, he also decided he wanted to found a company. He put his details on the monthly GFI call to find a co-founder, which is how I found him. We interviewed each other a lot, then he also was accepted in Entrepreneur First and we decided to work together. After Entrepreneur First, we both decided to move back here to the Bay Area because most people in the space are here, which makes forming connections much easier. I've found that it really helps to go through the design process with someone else, to bounce ideas off each other and get to a point where we are both comfortable with our vision for the company and how to get there.



Why did you and your co-founder Brian Spears decide to initially focus on producing clean pork?

As of now, there isn't another company focusing on clean pork as its main product, and there aren't many companies looking into it yet. We came to pork because ultimately the vision of our company is to become a platform where we do research different from day one, where we integrate a lot of automation and a lot of data acquisition to create a process that allows us to get to optimal protocols much faster. With that in mind, pig research already is advanced because of medical applications relating to disease treatment, so there is a lot of literature to jumpstart our understanding of how to optimize our systems and create an automation pipeline. We can move faster because of this knowledge and, at the same time, working on pork can be incredibly impactful because it's a $300 billion market and the most consumed animal in the world.

Every founder also has a personal narrative and there is one for me as well. Pigs are some of the smartest and most relatable creatures and, although it's debatable about whether you think that matters, Brian and I think it does and it would make us feel good to help save these animals. I grew up in the countryside and we had at least 20 pigs every year. Each Christmas, every single year of my childhood, people would come to buy pigs to be sacrificed. Sometimes I saw it, and sometimes I would just hear the shouts. It's very hard for a child to have that disconnect. I would believe all year round that I was friends with these animals, but then I would have to watch them die and be sold because otherwise, my family couldn't afford to live. Never in my life until very recently did I believe that this was something that could be changed. I think it's very important to acknowledge that currently many of the people who don't eat meat are people who are lucky enough to be able to afford not to do so. There are many societies in which eating meat is a way to live, and I saw that in my family. If we get to a point where we can actually change that and enable people in places such as where I grew up to do things differently, then that's even a bigger win for us.

How does your background in entrepreneurship and policy work influence your leadership style and what you hope to now achieve with your company?

I think the clean meat space is so important because it is so closely linked to the vast majority of the human population. You have a massive responsibility as a founder in this space, and the more your company grows, the bigger that responsibility becomes.

One thing I obsess over is whether people will have equitable access to the meat alternative world. I fear that we are going to end up with the massive meat conglomerates just as we have now, but with meat that is just made differently, and that we will continue to have inequality in lots of countries with extreme poverty who will have to import all of their meat. Brian and I constantly discuss how to ensure that all countries at some point will be able to access this technology and resources internally. Although the skill set to go and farm is widespread, that skill set is very different from being a scientist who goes and farms. There are countries who can afford to train people as farmers and food technicians, but it's very different to train someone to be a scientific technician and make sure that they can do the process in their own country in an environment that is able to supply them with what they need to make clean meat.

At the same time, I also think it is incredibly important for the industry to have the right messaging. I want to avoid ending up in the same place as genetic modification, with a lot of associated controversies that do not have to do with the genetic techniques themselves but rather the unethical things companies have done that have destroyed the reputation of the techniques. A couple of years ago, through a project on genetic modification regulation I was doing with the European Union, I researched how people react to hearing about

genetic modification and how they react once they actually understand much more about what's happening. From what I gathered, the more transparency you give to people the better. That's what we want to do at New Age Meats: We want to create transparency, and that will be challenging because it's much simpler to just hide behind nice packaging.

However, I believe it's incredibly important because biology will become such a big part of our lives in the coming years, and we're going to see more and more technologies being developed in biology. We need to start having conversations to empower people to understand the manufacturing process and all the details of it. People should be able to make informed decisions, not because of any sensationalism that might come from lobbying or press. As co-founders, Brian and I are working to be transparent from day one, and we're thinking about that in our marketing strategy. We're going to start doing more and more outreach to allow people to ask hard questions and not give PR answers, but instead give answers that people deserve to hear.

What barriers do you think will be most important for the clean meat industry to overcome in the coming years in order for it to be the most impactful it can?

In terms of adopting of the technology and relevant regulation, which are some of the big initial challenges we are currently facing, I think there will need to be a few big economic forces becoming interested and actively starting to support this space. I think the rest will follow, and that in itself will enable a lot of development in terms of seeing more and more countries buying clean meat. I don't know if the United States will actually be the first space to see clean meat come to the market, just because there is a lot of ambiguity surrounding regulation in the United States and there are other large countries that are equally or even more interested in supporting the space who could become actively engaged to define regulation and clear the path for clean meat to be introduced. It will be interesting to see which smaller countries become the first players to buy clean meat from abroad, and how clean meat will change the perception of meat in those places. For this whole space to advance, we're going to have to see the kind of government support that there has been for other technologies such as renewable energy. I think the field is going to need to get to a place where governments understand that this is something that will be positively impactful on the economy, that it really is worth engaging in, and demonstrate that by providing subsidies to support the clean meat market.

For that to happen, we really have to start thinking systematically. It's not about just the process of creating meat in the lab, it's about where we get all the supplies from throughout the process. It's really about understanding the needs of every single system we can to see how we can work with people to make them observe the advantages of clean meat and want to get engaged with something like this. At the moment, clean meat seems very foreign to a country like New Zealand, which has some of the best animal agriculture practices in the world. Many of their animals are not farmed in conditions we see in other places, and they naturally take pride in that and perceive animal farming differently. How are we going to position ourselves to say, "We're going to completely disrupt current meat production practices"? It's going to take a lot of planning to make that messaging work.

When did you decide you wanted to transition to work in industry rather than continue in academic research?

I started the transition a while back. While working on my PhD., I started getting involved with different kinds of projects, precisely because I understood that you needed an entrepreneurial mindset in order to be impactful. I was spending time at the business school at Oxford, and I founded a startup to give students access to healthy, nutritional food on campus. I was also involved with several NGOs in project management roles. Those early experiences taught me that you need to get out of your own head in order to obtain as much information as possible. Very often the solutions don't lie in your head, and you have to accept that rather than try to be the "genius" that comes up with things themselves. That's not how things work.

I think the second wave of my transition started when I joined Entrepreneur First. Through that program I became much more confident because I was actively pushed to get out of my own boundaries. In a very short amount of time, I got to do things that felt very scary, such as reaching out to people who I never thought I'd meet and trying to make connections with them. I learned how to think high level about markets and how to do lots of financials. There's a lot to get your head around and it's a lot of learning by doing. Many of the people here at IndieBio are scientists coming at this for the first time, and I feel lucky to have had a year immersing myself in this before coming here.

What is the most notable difference you have found in doing academic research versus doing research for product development within the context of a startup?

In terms of the research itself, I think you learn to think about research differently in the context of a startup. In an academic research lab, you have a very specific path and you're working on a very specific type of project with limited resources and a strict timeline. It's very rare to actually pivot in zigzag like you do in entrepreneurship where the scope is much wider. You can make assumptions and say, "This is where we could be in a year with this, and here's where we could be in a year with this other thing." The way of thinking and planning gives you much more flexibility in terms of the techniques you can use, the equipment that you require, and the team that you can build. It's still long nights of work, and I often joke with people in the whole cohort here at IndieBio because many of us have been through PhDs. Building a company requires the same kind of dedicated lifestyle.

The vision of the company is to go to the edge of what's possible in terms of technology, not just with biotechnology but through combining engineering and computing to try and advance the field much faster. One of the things I realized in retrospect is that there is a lot in our current vision which comes from frustrations that I've experienced in the past with research, specifically aspects that I always thought could be done differently in a different context. Part of my PhD. was actually making a comparison between old-school systems of analysis which combine different methodologies and different machines to do experiments at different time points, and systems that use novel technologies to do an integrated analysis and look at everything at the same time. Using the latter approach turns out to be much more informative to allow you to conduct research much faster and achieve your goals. I was also working with cell culture then, so it was very much the same kind of challenges that I face in my work now. The similarities formed a seed in my mind that had been planted, but I didn't really realize that it was the vision that I'm now bringing to life until later, once we had everything planned out and said, "OK, this is what we want to do and this is how we want to do it." Then I realized it was what I did in my PhD.

How do you see research opportunities developing and changing as the alternative protein field evolves?

I think it is a field that should be interdisciplinary, it shouldn't be just a biotechnology field. I think we will start seeing a lot more opportunities for engineers and computational people to join in, and I would be very thrilled to see more postdoctoral fellows or full-research fellows join the space of clean meat. A lot of what we are doing is very translatable from other fields, and in the same way as we've seen with regenerative medicine, it's been a field that has slowly started to attract people from different areas. Now, it's becoming a field that uses engineers and people with materials expertise, scaffolding experts, physicists, and biologists. We've all slowly moved together to work on the same solutions together.

I would like to see more of that happen and I think an academic environment would actually be ideal for that, to actually start discussing paradigm shifts that we might need to do in the space. I think we also need to create a basic toolset that people in the space should have for when they start doing this kind of thing. It's a very immersive experience to do research into this for a few years, understand what tools are already available in adjacent fields, then join a company in the space. I think we're going to move towards that, but it's a slow process of doing outreach and making sure that there's funding for this kind of research, which is another challenge in itself. I imagine that in three years' time it's going to be the beginning of something that's quite different from where it is now.

What do you think will be the moment that will tell you that you've begun accomplishing what you've set out to do?

I want to taste our own sausages and think, "Yep, that's some good sausage." We hope we're going to be there in the next couple months and that's what we are now working tirelessly towards.

Ron Shigeta

WILD EARTH

Ron Shigeta, Wild Earth

As one of the founding fathers of the movement dedicated to solving global problems through the application of biology, Dr. Ron Shigeta is widely known for his work founding both IndieBio and Berkeley Biolabs, two biotechnological incubators that act as support systems for alternative protein companies in their early stages of development. After becoming fascinated by cellular agriculture in his time as an advisor and CSO for IndieBio, Shigeta and his co-founder Ryan Bethencourt, decided to found their own company focused on engineering products to meet the untapped need for clean protein in pet foods. Based on his extensive experience in the alternative protein space, Dr. Shigeta has a nuanced understanding of the state of the industry and offers a distinctive vision for how he sees the future of biotechnological food production evolving.

What sparked your interest in the alternative protein field?

I think what's so great about the alternative protein field is that it's the intersection of lots of different people who have come for different reasons. Some of the first people there were animal rights people, and a lot of them were vegans. Ryan Bethencourt and I got involved when we were making investments in small biotech companies and a company making egg whites without chickens called Clara Foods came to our attention through that vegan network. As a biologist, the method that they were using to make it was fascinating to me! It completely changed the way I saw biotechnology, and it was very exciting.

What aspect of Clara Foods' work fascinated you the most?

Clara Foods was working to produce something exactly like an egg white by taking the egg white gene, putting it in yeast to have the yeast make the same protein that is in the egg white, and then linking those proteins together. In four months, their team learned so much about egg whites that they became the world's repository on egg whites. They learned much more about how the proteins functioned through what they did during that time than all the literature that was out there that science had done heretofore. They found all kinds of errors in the papers of the past, which is a great sign as a scientist that you're doing something interesting, seeing something in a new way, and making new discoveries.

From the great experience Ryan and I had with Clara Foods, who raised $1.7 million as the fastest fundraiser in the class and grew very quickly, we went and made a whole bunch of investments in food. We were privileged to work at a biotechnology accelerator called IndieBio, which has a fresh look at what food is, where it comes from, and where its problems are. In the process of working with IndieBio, we saw companies such as Clara Foods learn so much trying to solve problems to make both a product and viable company. When it came time for us to make our own company, we knew we wanted to contribute to this whole sea of change in the way that the human race eats food. That's essentially how it all happened; it was an amazing evolution but it was ultimately only four years or so.

I noticed that following your graduation from Reed College you earned a PhD in chemistry from Princeton, then went on to pursue postdoctoral training at both Stanford and Harvard medical schools. What led you to transition outside of academic research into work for industries?

I have to say, stepping outside of academia has been an amazing experience for me. Academia has become very competitive: Even though something like 30%-40% of graduate students today want to continue in academia and basic research, less than 5% of them will. That trend away from academic jobs started when I was in school. A lot of people have a problem leaving academia because it's a place with pure thought and all these attractive things. But, at the same time, having left it, I have a broader vision of what science is and what I can do.

It's an amazing thing to say, "I'd like to study something with a microscope and focus on it for years and really get to the bottom of it"; that is really satisfying. At the same time, taking discoveries and all that we know and actually bringing it to people – this Promethean idea of bringing light to people and really helping the human race with what we discover – is something that every scientist promises to do whenever he or she writes any grant proposal but often doesn't actually follow through on that promise.

Now that I've moved away from academia, and after having written several grant proposals myself, I see it as kind of lame that those in academia are not really trying to do anything immediate in any reasonable amount of time. Although there will always be a place for basic research and development, there is a great need to leverage scientific work and technology to actually solve some of the problems facing the human race. I am flabbergasted that the idea does not have any kind of fashionable shine to it, and I think it must be because in academia we don't actually think about the potential to make something incredible and positive out of all the stuff that we have. That's something I would like to see change very much.

I think the newest scientists coming out of academic environments all feel a tremendous amount of pressure about what's going to happen to them and the planet in the next four years. The consumer does too, and certainly I do. The most amazing thing happening now with biology and food is that it's becoming more and more clear that there's something we can do right now to have a profound effect on the future of the entire human race and all of the other species as well. That's an incredible gift for this generation to have, and I just hope that everyone understands that and takes advantage of it.

Why do you believe working on scientific research from the vantage point of within a company can be so beneficial? Could you provide a specific example of how you have seen industry bolstering research development?

Funding for academic research is harder and harder to get. Academic research is becoming more conservative; you can't put out more creative research ideas and hope to get them funded. The funding agencies are constantly looking for justification to cut you off, and it is clear this trend will continue. At the same time, the science that's being done within companies is bigger and bigger. The amazing thing about building a company firmly rooted in science is that the company depends on getting more and better data, and the amount of funding that is in the industry for this stuff completely dwarfs academic research. I think that a lot of the important discoveries in the 21st century will come from public-private partnerships where the companies involved have very strong scientific foundations.

Clara Foods' rapid research development serves as a phenomenal example of this because it was one of the first companies in the alternative protein space with research into the chicken egg white and this presented the company with amazing opportunities for new research. The chicken egg white is a very simple system because it is about 98% protein, meaning that almost all of the matter in there is a mix of nice proteins that fry up and do lots of things. When Clara Foods started playing with the proteins, they discovered that by changing the proportions of the different proteins they could get the egg white that behaved in different ways. They were able to make formulations of meringues with whipped-up egg

whites that do not deflate or have a liquid drip to the bottom after sitting on the counter for hours. They were able to make meringues that never deflate, that can stay wet for days and don't weep, and even meringues that have 30% additional volume, literally making the same amount of protein go further. All of this without changing the taste.

From a scientific point of view, it was a fantastic discovery demonstrating that the proteins that constitute the egg white have the functionality of changing the texture of the food. There's a relationship between the individual molecules of proteins and the texture and shape of food. The way that proteins interact with your mouth, that relationship is a direct relationship, a structure-function problem. That was an insight that maybe some other people have had, but it became a completely concrete thing with Clara Foods. That company has now moved forward and raised over 15 million dollars in funding because it is able to make all these fantastic products out of a food we know and that feels very familiar, but that has never existed before because it could not be made with previous technologies. That's an amazing thing to discover.

Could you speak a little more as to how you envision the place for science in society evolving in the coming years?

Looking back at the history of science, there have been several times, some famous moments, when scientists have been called to answer an existential threat against the nation or people. A couple of examples are the formation of NASA, suddenly putting a man on the moon, and Bletchley Park in the UK, where computer science was essentially created in order to crack German intelligence codes. The power to do that is in your watch now, but at the time it was astronomically difficult because people were working with paper and pencil. By developing computer science, they cut tens of thousands of casualties out of the war, the war ended more quickly, and they saved an incalculable cost both emotionally and economically.

Yet, in the 40 or 50 years since those times, science has become kind of a passive, monastic endeavor. I feel like something's been lost there. What I love about what's happening with the alternative protein sector, and different people are in it for different reasons, but from a science point of view, we are confronting literally the greatest threat to the human race. Collectively, everybody is facing this threat, and it is at a substantial cost. Scientists have projected that the earth will become uninhabitable by human beings; some places will disappear under the ocean and entire nations, cultures, and lands will be dispersed into the diaspora and ended. Many, many species will become extinct, and yet, for some reason, none of this is enough to get us out of our chairs and to go do something about it. To the extent that I have met many scientists who are comfortable and passive about this, I can only think it is because there is an overwhelming feeling that this is somebody else's problem or that they themselves are not empowered to do something about it.

What I'd like to try and make clear today is that all of the ingredients are in place where almost anybody can get involved in this fight and collectively join a "Manhattan Project for climate change." Everybody needs to be there, and there's a place for everybody now in terms of understanding what we buy – what the real costs are of the things that we use and we eat and we consume – and why those problems are there and how to solve them. Biotechnology has this incredible capacity to respond to so many of those problems and diminish the economic and ecological costs. There isn't any reason for everyone to not be at least interested and involved in some way with this effort. Instead of having the world's lead scientists stuck away in the desert developing a bomb, everybody can be involved and turn the tide of the fortunes of the planet. It sounds crazy, but it's very easy to spell out step by step.

What advice would you give to a scientist looking to get involved in the alternative protein field?

Let's talk about science then, speaking to the scientists. I first want to talk a bit more about the experience of doing science that's applied because I think a lot of people are afraid of going into industry.

I remember thinking, "Oh gosh, it must be boring in industry," but it isn't! When you're doing research for a company, people and venture capital are willing to fund you to find an answer to a problem you're passionate about and to go about it in a rigorous way. I think every scientist should look at themselves and say, "When I talk to people, do they feel excited and part of what I do? These people are paying me for a life of introspection and research, they're providing all this for me, do they feel rewarded for what I do?" The reciprocity between scientists and the public has been broken since around the 70s or 80s, and as a result, we rarely get an increase in funding for academic scientific research. I think the public is turning away from science because they don't feel like science is doing anything for them. If you have a certain kind of rational thought about it, you realize that maybe they have a point. I believe that some of us need to become the point of the spear that will actually take all of the stuff we've learned, enormous libraries of journals and articles, and turn that into something that people are going to need.

For instance, look at clean meat, where the idea is that we are raising cells to transform them into enough biomass to make some meat that someone can eat them. The production cost needs to be lowered substantially, so a lot of people say it's impossible. But I just don't understand that because science doesn't need to admit impossibilities. I am from the side of science where you don't look at what cannot change and just validate that. Science is there to make new discoveries, and if you really closely examine a problem that nobody's touched, it's very easy to find ways to change the economics or efficiency of a process. Science and technology create new realities when they're at their best. Nobody has tried before the last few years to really lower the cost of cell culture, that's why it's moving so fast now.

When I worked with Memphis Meats at IndieBio, they made a $3,000 pork meatball, which was about a 30-fold cost drop from the $300,000 hamburger prototype previously made by MosaMeat in 2013. Memphis Meats has since gotten funded several million dollars, done more work, and the cost has continued to drop. Recently, they fed 20 people a dinner made of a solid chicken or duck breast cooked by a gourmet chef! The capacity for clean meat companies to produce large amounts of meat at lower cost has been changing every few months because people actually went out and looked to change something.

What do you believe is an essential skill that scientists navigating the alternative protein field should have?

I believe that all scientists should learn how to communicate effectively with people. As a scientist you are often in the lab and don't have an outward-facing personality. Despite being a bit fearsome, learning to communicate is a skill worth learning in order to truly have an impact on society. We're doing so much work, discovering so many things and creating such amazing efficiency, but the impact that research has depends on who listens to it. People aren't hearing about this fantastic work worth doing and they don't see it touching their lives directly, so they're finding less and less funding each year. That funding would not be diminishing if we were better communicators and scientists.

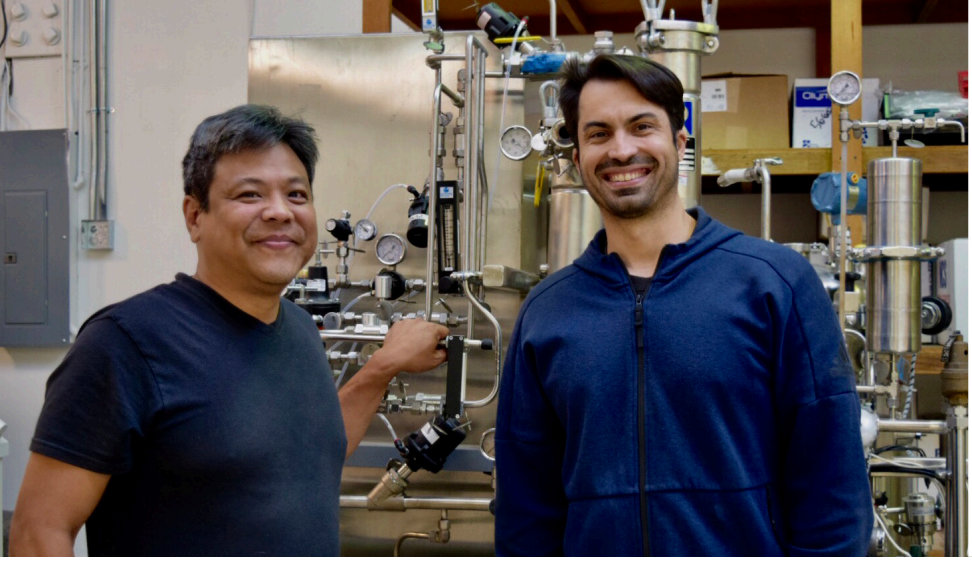
How do you see the future of food evolving in the coming years?

For somebody really looking to make a change in the world and have the exciting experience of making a change, a place where nobody's done research before is a fantastic place to go. We are just now beginning to see the cockpit of this gigantic alien spaceship with all these alien controls, and we don't know how to push the buttons to control or fly the ship. Amazingly, that spaceship is our body. I believe an incredible thing will happen in the 21st century where we will begin to develop food that will be able to improve human health. Without using a pharmaceutical, but by using food that people can eat every day, food that can be reproduced, grown, and distributed to all 7 billion people on the planet at a reasonable cost – that kind of food would be something worth creating. I hope that people will understand that if they have an inclination toward working on food there almost isn't a more interesting problem out there. If you want to work on a problem that is going to touch everybody you've ever met and everyone you ever will meet, food is perfect. Food production results in 30% of our greenhouse gases, most of which come from animals, and if we can cut back people's meat consumption by making alternative foods that they love and crave, that makes them healthier and diminishes the scale of large-scale pharmaceuticals, that is as big of a contribution to reducing climate change as stopping driving.

I believe that creating products people haven't seen before will be very important. Anybody that has an idea like that should really be thinking hard about doing something about it. If you start looking at future trends, you will see there are places of need. What if we could create a concoction of plants and meat that were "perfect nutrition," that could slow the aging process? That would be an amazing discovery to make, far more interesting than most biomedical research happening now, truly preventative and accessible to everybody. People are already working on this kind of stuff, and I know also that there are major food corporations in the world that are looking for more and more ideas along these lines because they understand that there's a wave of innovation in food coming, even today when the public doesn't quite anticipate the extent of it.

Returning back to your own early-stage pet food company, Wild Earth, what inspired you and Ryan to found a startup dedicated to clean, high-protein pet food?

That was also coming from looking at vegan trends. In particular, Ryan and I believe that dog food acts as a bellwether for the rest of the food market. Dog food started in the 1920s when members of the MARS corporation noticed that at the slaughterhouse, after all the cuts of meat were taken for human consumption, there was still a lot of meat left. At the time, they would grind up what remained into a paste, add a little flour, and bake it into a meat kibble. Those bags would be sold to feed dogs and cats, and it cost nothing because the slaughterhouse would have otherwise thrown it away. However, in the intervening time since then, food science has continued to improve and they have digital and electronic butchers that will calculate how to cut the meat off, they have sprays that will take the meat off and improve it to make it for chicken nuggets and things like that. Now, all of the meat scraps are being used and put back into the market. It's gotten to the point where you can buy bone broth, this really thick and very delicious flavorful soup, that is formed with the tiny amount of protein left in the bone after the slaughterhouse. Even that is now being extracted and given to people to eat, so the remaining food that's left over for the dog is literally a dry piece of bone with nothing nutritious about it. The companies are being more efficient, the credo "waste not, want not" is happening, but the animals at the bottom of the food market waiting for stuff to fall off our table are literally getting nothing, and as a result they found other ways to make protein from less desirable sources, that people can't or won't eat as of now, and are putting it in the dog food.



The extra efficiency in the animal butchering technology has been reducing the nutritional quality of food given to pets for decades. As a result, the premium pet food market is taking off, and in the last 10 years, the high-end price for a pound of dog food has gone from $1.50 a pound to $6 or $8 or $10 a pound! Dog food doesn't cost very much, so if you love your dog, and you can afford to pay $200 a month rather than $20 a month to feed a dog it might be no big deal, but just imagine if that happened to our own food budget. That's a crisis that's going to be coming to the rest of us in human food as well, because the segmentation of the food from high quality to low quality is becoming more and more important and the spread from high-quality to low-quality food is becoming larger and larger. As our global population grows and there's an increasingly competitive international food market, we will have to pay for good quality more and more. Technology is the only thing that can change that, can change the rules of how much it can cost to make food, or make anything while improving the quality for the same cost or low cost. We need a fundamentally different way to get high-quality food for less money, we can't just get it the same old way.

I hear you are planning to bring clean meat technology to produce clean meat pet food?

It's true, we saw an exciting opportunity to take clean meat into pet food. However, there's no denying that there will be quite a few boundaries because pet food has quite a lower unit cost than regular meat. We're going to have to work hard to make clean meat pet food products feasible, but the landscape is constantly shifting radically, and we believe it will be possible given the number of discoveries being made each month. Over the next few years, after some of our other products are successful, we hope to leverage new technologies to deliver clean meat mouse products for cats, or maybe even a lamb chop for dogs. We'd love to do that, and we have a lot of confidence that in the long term those costs are going to drop to the point where we can feed that food to our pets without compromise. The whole idea of cellular agriculture and alternative proteins such as we're doing is that there is no compromise, and that's what we're delivering on. We're not cutting out the good parts of the koji, the fungi protein we use in our current pet food products, to give to people and giving the crummy part to pets. The pets get the same koji that a human being would eat. The nutritional value is passed on whole to them, it's a whole food.

Is there anything else you would like to add?

I want to add one more thing, and that is about the future of science itself. I don't think anybody really sees how far biotechnology is going to go in the 21st century. The kind of contributions that scientists can make, with the kind of training you can get today, they're almost boundless. I hope that people will grasp that opportunity, just like computer science did 30 years ago, and rebuild the global economy so that we can live on the planet and leave something for other people when we're done with it.

Adhithi Lakshmikanthan

Adhithi Lakshmikanthan, Wild Type

Adhithi Lakshmikanthan, a tissue engineer for Wild Type, represents the type of technical talent that is increasingly in demand as clean meat companies transition into later stages of development. Prior to leaving her role in R&D product development co-op at MTF, Lakshmikanthan studied biomedical engineering at Rutgers University as a graduate student. Now focusing on applying her background in bone scaffold design to the engineering of scaffolds for clean meat production, she offers an interesting perspective on how she sees her current role as an exciting opportunity to creatively explore areas of uncharted research.

How did you initially learn about the alternative protein field?

I am a biomedical engineer focused on tissue engineering and I didn't know of the alternative protein field until I had my first talk with Justin, one of Wild Type's two co-founders. He was looking for employees with backgrounds in tissue engineering, and only after speaking with him did I learn that tissue engineering could be used in this field.

Prior to your conversation with Justin, what kind of tissue engineering research were you focused on?

My thesis in grad school was on 3-D printing bone scaffolds, so it was more of a hard-tissue-based approach, but I also have previous experience in wound care with allografts, which is a soft tissue-based experience. My background is completely in tissue engineering, and at Wild Type I'm working to find ways to use scaffolds to grow cells in three-dimensional rather than just two-dimensional space. Currently, we are using traditional tissue engineering techniques, but I think in the future we might explore bioprinting, which is another field in which I have experience.

What is the biggest challenge posed by your current research into engineering scaffolds and what has your experience been like so far with little past literature to build upon?

The biggest challenge is that the scaffold has to be edible. All the material for bone scaffolding theoretically could work, but when it comes to working with salmon cells for Wild Type, we have to use a completely different approach because it has to be ingestible. So, our scaffolds have to be made from completely different materials.

This is my first month at Wild Type and so far I've been just beginning the basic research, which is hard because I don't have any past literature to build upon, as you mentioned. On the other hand, tissue engineering is a vastly creative field; when you don't have past literature it's actually a good field to be in because it's challenging but at the same time there is a huge arena where you can just explore whatever you want to. Having said that, we always start out with materials that are already on the market and regulated by the FDA, so we're not starting with something that is totally new with respect to the material.

What appealed to you the most about working for Wild Type?

There are a multitude of reasons why I joined Wild Type. I've always wanted to be involved in a field that contributes to society, which is why I took up biomedical engineering – to use whatever skill set I could leverage toward bettering people's lives. After talking to Justin, I went back and read up on the field, referencing the profile The Good Food Institute has on all the pros with respect to culturing meat. A lot of the reasons spoke to me, both the animal welfare considerations and the environmental concerns. Another reason is that, as I mentioned, tissue engineering has been around for a while, but tissue engineering in the food space is something very new. It gives you a lot to play around with and, from an engineering perspective, it's a gold mine because you can establish a lot of protocols and you can dive into the field as much as you want to without having to say, "Oh, this has been done before." Another reason is that Justin and Aryé, the co-founders of Wild Type, are really nice people to work with.

My interest in the field really grew once I started drawing parallels between the biomedical engineering field that I was in and this field because both of them are multidisciplinary. As a biomedical engineer in the medical field, I had to talk to a surgeon who wants a particular implant in a particular part of the body. I had to talk to people who deal with materials and scientists who know more about the cell function and how the body will react to it. In the medical field, the person you want to talk with constantly are either the clinician or the surgeon, because ultimately they will use bioengineered products in their surgeries to help people. An interesting correlation is when I was talking to Justin, even in the beginning stages of the interview process, he mentioned that Wild Type plans to keep talking to chefs and restaurants, so that there's a feedback system established right from the start. As a tissue engineer, it would be nice to get active feedback on the product I'm making.

How do you see the need for engineering talent in the clean meat field developing over time?

Right now, most companies are in the molecular and cell biology stage. Tissue engineers like myself are just beginning to join in this field. I think in the future, once the field is more established and proves that clean meat works, I think chemical engineers and automation specialists – people who know how to run the process from start to finish through just machines – will be essential. As production scales up, we will have an increasing need for a multidisciplinary approach.

Resources for Aspiring Good Food Pioneers

If these stories have inspired you to pursue a career in developing the future of meat, check out these resources to make new connections, keep tabs on opportunities, and continue to expand your knowledge of the plant-based and clean meat sector.

GFIDEAS COMMUNITY

We host an online community of entrepreneurially minded folks who are either looking for their next venture or are in the early stages of launching a company. Members give updates on monthly calls, where we also invite outside speakers to educate the community on various aspects of starting and growing a company. In our directory and Slack channel, members can connect to suggest solutions to challenges, find a co-founder or consultant, and coordinate attendance at various conferences and food industry events. Find out more here: https://www.gfi.org/introducing-the-gfideas-community

GFI STARTUP MANUAL

The Good Food Startup Manual is a one-stop shop for information on the ins and outs of starting a plant-based or clean meat company. Check it out here: https://www.gfi.org/StartupManual

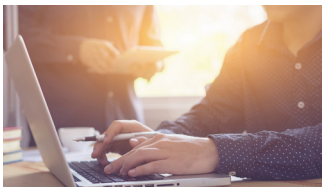
GFI TALENT DATABASE

If you're actively job searching (for full-time positions or part-time consulting), enter your information in the Talent Database where you'll be visible to dozens of plant-based and clean meat companies ranging from stealth-mode startups to companies with millions of dollars in annual sales. Join the database here: https://tinyurl.com/y8xoln5a

JOBS AT GFI

GFI is constantly expanding our team. Keep an eye on our jobs page, where we list currently open positions as well as positions we'll be opening soon. We also periodically post freelance research projects and internships on this page. Bookmark this one: www.gfi.org/jobs

STAY IN THE LOOP



Enroll in our e-newsletter to stay up to date on the latest news across the sector at www.gfi.org/e-newsletter. To enroll in our detailed Monthly Highlights subscription list to receive a more granular sneak peek at the most exciting activity across all of GFI's departments, email ubeb@gfi.org and put "Monthly Highlights" in the subject line. You can watch these resources to find hot leads on new grant opportunities, the latest GFI resources, institutions that are launching relevant courses or research projects, and developments from companies in the plant-based and clean meat sector.

THE GOOD FOOD INSTITUTE

CONTRIBUTING AUTHORS

Waverly Eichhorst
Scientific Communications Intern
waverlye@gfi.org

Liz Specht, PhD
Senior Scientist
lizs@gfi.org

ACKNOWLEDGEMENTS

We would like to thank all of the interviewees profiled in this series for being so generous with their time and insights and for their willingness to share their stories. We would also like to acknowledge several additional members of the GFI team not listed above for their input, feedback, edits, and assistance with design and formatting. Finally, we are grateful for the support from our generous donors who make this resource and all of GFI's work possible.

ABOUT THE GOOD FOOD INSTITUTE

The Good Food Institute is a 501(c)(3) nonprofit organization dedicated to creating a healthy, humane, and sustainable food supply. Our work is 100% powered by gifts and grant support. GFI's team of scientists, entrepreneurs, lawyers, and policy specialists are laser-focused on using markets and food innovation to transform our food system away from industrial animal agriculture and toward plant-based and clean meat. To learn more, please visit GFI.org.

The Good Food Institute ©2019