

3 Takeaways Podcast Transcript

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Ep 55: Solving the World's Biggest Problem and Creating the Impossible Burger with Impossible Foods Founder Patrick Brown

INTRO male voice: Welcome to the 3 Takeaways podcast, which features short memorable conversations with the world's best thinkers, business leaders, writers, politicians, scientists, and other newsmakers. Each episode ends with the three key takeaways that person has learned over their lives and their careers. And now your host and board member of schools at Harvard, Princeton and Columbia, Lynn Thoman.

Lynn Thoman: Hi, everyone. It's Lynn Thoman. Welcome to another episode. Today, I'm excited to be here with Pat Brown, creator of the Impossible Burger and founder of Impossible Foods. As a Stanford biochemistry professor, he started thinking about big problems in the world and how he could have the largest impact. He realized that one big global problem was the destructive impact of animal agriculture, as in meat production. Meat production is one of the world's greatest contributors to climate change, not only for the level of greenhouse gas it produces but also the water and land consumption it requires. He started thinking about how to make delicious affordable meat and dairy products directly from plants that would be better for the environment and better for consumers, and so he left Stanford to found Impossible Foods. I'm excited to learn about his journey from Stanford professor to the creator of the Impossible Burger and I'm also excited to learn how he built Impossible Foods into the multi-billion dollar company it is today. Welcome, Pat, and thanks so much for our conversation today.

Patrick Brown: Thanks for inviting me, Lynn.

LT: My pleasure. I am so fascinated that you are a professor at Stanford and you decided to take a sabbatical to see what important problem you could solve. Could you tell us about that?

PB: I was a professor at Stanford. I had a really awesome job where I basically had the freedom to just pursue my curiosity, wherever it took me. And my own responsibility was to try to discover and invent things and help students learn how to do that. And it was exactly the job I would have created for myself if I had had the chance. I had previously done a project that was a little ectopic to my Stanford role, which is I founded a non-profit scientific publisher that was basically intended to disrupt the business model of the incumbent industry, and that was something that wasn't part of my job but I considered it was just like, "Yeah, of course. No one else is doing that. That is something to do."

PB: Well, this was the same thing. I took the time on my sabbatical and I think it's not a bad idea for scientists and people in general to do periodically, to just ask myself, "What's the most important thing I can accomplish? What's the most important and urgent problem in the world that I can contribute to solving?" And it happened that when I did that, I realized relatively quickly, when I started looking into it, that the use of animals in food technology is, by a huge margin, the most destructive technology in human history and that it's catastrophically destructive. It's the biggest thing that, effectively, stands in the way of our being able to have a very fast and substantial impact on the progression of climate change and it's overwhelmingly the driver of some environmental

catastrophe that I think is even more serious and urgent than climate change, which is just an absolute collapse of global biodiversity.

PB: When I realized that and that we absolutely have to get rid of this technology. Basically, that we're in this ridiculous system of using animals in food production. It was also apparent to me that we're not going to solve the problem by regulating it, by pestering people about their dietary choices, educating them about the problem and so forth. All those things have been tried. For billions of people around the world, these foods that we get from animals are one of the great pleasures of their daily lives, and it's not realistic and psychologically naïve to think that you can just ask people to sacrifice that. So that's not the solution.

PB: The problem isn't that people love these foods and they're going to keep wanting to eat them no matter what we say. It's more on using this ridiculous, prehistoric, incredibly destructive, inefficient technology to produce that, which is using animals to turn plants into the meat, fish and dairy foods. And that was a solvable problem to me because my past life was all trying to understand the molecular terms how, whatever, cells work, how viruses work, mechanisms of disease and just trying to understand biology. And the desirable characteristics of the food we get from animals are just an emergent property of their biochemistry, of their molecular makeup, and there's a much less complicated emergent property of their makeup than being a living organism.

PB: Muscle tissue, as muscle tissue, is incredibly complicated. It's precisely regulated to control those movements. It requires exquisite control of metabolism and signaling inside the cells and that requires those proteins and muscles to, in a very controlled way, convert chemical energy into mechanical motion in such a complicated system. As meat, it has to do something much, much simpler, which is it just has to satisfy certain characteristics in terms of its mechanical properties, its texture and stuff like that, and produce the flavor chemistry that generates all these odorant molecules that you were to recognize as meat. That's a complicated problem but it's a very solvable problem, and it's a lot easier to solve than to figure out how a muscle tissue works in a living animal. So that was my perspective on it anyway.

PB: So I felt like, "Okay, well, nobody is trying to do this," and I have abundant evidence that nobody was trying to do this. I'll just tell you one piece of evidence. Obviously, if you're going to try and solve this problem you need to understand how does meat work as food in molecular terms. And so relatively early on, when I had decided to do this, I was starting to explore what would be involved in solving this problem. I had the idea that the unique flavor chemistry of meat might have something to do with this molecule called heme, which is this red iron-containing molecule that actually is in every living cell on earth. It's an essential part of the system that cells use to generate the energy to keep a life. But on animal tissues, it has multiple functions, including its use as the carrier of oxygen in the blood and also in other tissues that's involved in storing and moving oxygen around, and so forth. And animals burn a lot of oxygen unlike plants and so forth. They're very metabolically active, and so they need tons of heme to fuel the system, and so they have more heme concentrations than plant tissues. And it's obvious because they're pink or red. That's the heme in them.

PB: I knew, as a biochemist, that heme is also one of the best catalysts in nature and in fact, it's the business end of the enzymes in your liver that metabolize drugs, that metabolize caffeine, and also in the enzymes that are involved in synthesizing the steroid hormones that protect you against stress, testosterone, estrogen, progesterone, all these steroid hormones, that's been known for a long

time. But I suspected that because there's tons of heme in animal tissues much more than in any plant tissues, and it's a great catalyst, and when you think about the behavior of meat, particularly when you cook it, it behaves like a live chemical system. It has all the signs and there's a catalyst in there because when you cook broccoli, it just gets warm and mushy, basically. When you cook meat, it undergoes this incredibly dramatic chemical transformation. The flavor profile changes completely. In real time, it generates this explosion of aroma molecules and so forth. That is screaming, "There's a catalyst in here." So I suspected that heme might be involved. And once I founded Impossible Foods and we started doing experiments, then it very quickly became obvious that heme is, for all practical purposes, the magic ingredient that makes meat taste like meat.

PB: So this is how I know nobody was working on this because if anyone had tried to look at this problem before, it wouldn't have taken them very long to figure out that heme is the magic ingredient in meat. And one of the learnings from this, which I think was very striking to me and I just am reminded all the time I'm trying to deal with this system, is that the food industry is the least innovative field on earth that humans have ever come up with. There is no meaningful innovation in food and in the agricultural system we use to produce food, and there's no curiosity, because had there been any curiosity, if someone just asked, "Gee, why does meat taste so unlike broccoli?" it wouldn't have been hard to find out. So anyway, nobody was working on this, so I just figured this is the most important thing I could possibly do with my life. It's absolutely essential to the future of our planet. If we want our kids and grandkids or future generations to inherit a viable planet, this is the most important thing that we can do. So bang, I had no qualms about it. I just said sayonara to Stanford and I founded Impossible Foods.

LT: Okay, before I ask you more about founding Impossible Foods and creating the Impossible Burger, can you just quantify, in simple terms, the impact of meat production on the planet in terms of greenhouse gas emissions, land use, water use, collapse of biodiversity? Can you just tell us about that impact?

PB: It's mostly meat production but let's just call it animal agriculture in general. We are in the late stages of the catastrophic collapse of biodiversity. It's amazing how little attention it gets. Repeatedly published over the past several decades... There has been a study going on for more than 50 years that is led by the World Wildlife Fund and Zoological Society of London, and involves hundreds of academic groups. And what they've been doing is, every several years, taking a census of the number of living individuals across more than 4000 species. These are species that were chosen as a representative sample of animal biodiversity. Just as a practical way of monitoring how it's doing.

PB: What they have been reporting and reported recently that the total number of living mammals, birds, reptiles, amphibians and fish on earth today is less than a third what it was 50 years ago. That's insane. You should be scared to death of that because it's not just a shame that I like squirrels and what a shame that there are not as many, it's that you're talking about absolutely essential components of what we call the web of life. This integrated system that keeps our planet healthy. The ecosystems that, whatever, forest and grasslands, and so forth, are what keep our planet alive absolutely depend on the whole gamut of biodiversity of those animals that live there to do everything that keeps them healthy to pollinate, to disperse their seeds, to turn over a dead biomass, to eat the insects that might otherwise tear down the forest or whatever, all those kind of stuff, and we've just totally trashed it and it's not showing any signs of stopping. And here's the point, it's almost entirely due to our use of animals in the food system. So for fish, global fish populations,

both fresh water and ocean fish, are down about 70% over the past 50 years, well-documented, and that is not a good thing, and that's almost entirely due to overfishing. For land species, it's overwhelmingly due to habitat destruction and degradation.

PB: And here is what the land footprint of animal agriculture comes in. The estimates of land footprint range from a third of earth's ice-free land area. It's more than 45%. And I frankly believe that more than 45% is more accurate because it actually counts something very important, which is grazing animals that are not in official grazing land but cows and goats, and sheep dung follow boundaries. And when you add all that up, it's 45% of earth's land area that's impacted by animal agriculture, and that impact is huge. And the land footprint of animal agriculture is more than 80% of the entire land footprint of humanity. Everything else that humans do is a tiny fraction of that, and it comes at the expense of the native species. The livestock and the feed crops we've ever feed them are competing with the native species that would otherwise be living on that land and providing a biodiverse ecosystem, and demand for those products is going up. Earth isn't getting any bigger, as you may have noticed, unfortunately. And so the only way you can expand production is by increasing the amount of land to go down to agriculture.

PB: Secondly, for climate change, I actually, just with a colleague of mine at Berkeley, Mike Eisen, just published a paper where we did a deep dive to look at the opportunity cost of animal agriculture with respect to climate, which strangely had not been done. So there's been a lot of work on, "Okay, how much greenhouse gas does this industry emit every year?" What hasn't been done is to look at the opportunity cost, so we calculated that. Basically, the opportunity cost is, "Okay, if we weren't raising animals on this vast amount of land and instead enhance original biomass, how much carbon would it store?" Well, it turns out that if we kick the fringing cows off the land and let the native biomass recover, not only would we start to restore...

PB: Healthy diverse ecosystems that have been displaced by cows, but that process would pull out of the atmosphere between 16 and 18 years worth of current total greenhouse gas emissions. So that's an opportunity cost. We give out the opportunity to turn back the clock on climate change doing this practice. The other aspect of the opportunity cost, and it turns out that two of the major greenhouse gases that are emitted by livestock, methane and nitrous oxide, unlike carbon dioxide... If you lit carbon dioxide basically it just stays there. The only way you can pull it out of the atmosphere, is by photosynthesis, turning into biomass, which is what I was just talking about. Methane and nitrous oxide spontaneously decay, which means if you turn off emissions, you get negative emissions. And if you sum up all of that impact, basically if we could replace animal agriculture over the next 15 years, which is Impossible's mission, I should say, is to completely replace the use of animals with food technology globally by 2035.

PB: And I think it's completely doable, and if we could do that, then that alone, if we did nothing about fossil fuel emissions, would offset more than 50% of total greenhouse gas emissions through the end of the century. That's the magnitude of the impact. And there's something else great about this approach, which is that it happens fast, so that's the climate impact. The bottom line is, it's just an unmitigated disaster. Fortunately, it's a completely solvable problem. The solution to this is to recognize that people think that animals are the only way that you can make meat. It's just the only way we've ever done it before, but they're not even the best way. We can do a much better job of creating these foods that deliver everything that consumers want from them without using animals.

LT: I think most people have no idea of the impact of meat production.

PB: Yeah, it's unfortunate, but it's very well-documented. All you have to do is look.

LT: Actually, not really. I think it would be surprising to most people to find out, for example, the impact on biodiversity. I think most people simply don't know, or haven't thought about it enough to realize the harmful impact.

PB: But you can find the data. So if any of your listeners are interested, there's a lot of other scientific research on this, but there's a report that the World Wildlife Fund publishes every couple of years called The Living Planet Report, where they actually report out their tracking of wildlife populations, and that's where this figure of now more than two-thirds of the wild animals that lived here 50 years ago have been lost. And just to give you an idea of just the magnitude and the utter absurdity of the system that we're using to produce meat. If you took just the cows living on Earth today, and put them on a scale and weighed them all, and compared them to the total weight of every wild terrestrial vertebrate, basically every wild mammal, bird, reptile, left on Earth, the cows outweigh every remaining wild mammal, bird, reptile, amphibian by more than a factor of 10. They massively outweigh all the wild animals left on Earth. And it's no coincidence because they've displaced them.

PB: And the pigs living on Earth outweigh by more than 50% all the wild animals left on Earth. So do the sheep and goats. The birds being raised for food, poultry, outweigh every remaining wild bird by more than a factor of three. So we've basically replaced nature with the animals that have been raised for food, although you won't read in the New York Times, and shame on you, New York Times, it's not like the data are hidden. They're published, they're available.

LT: That is eye-opening, and horrifying, Pat. So you set out to create substitutes, and what were your criteria as you set out to create a meat substitute?

PB: Basically our goal here was, not to be in the food business per se, it was to remove the economic incentive to cover our planet with livestock and basically destroy the planet in the process. And the only way we could do that, was by making foods that can compete successfully in the market for consumers of animal products. i.e, we are not interested in making foods for vegans and vegetarians. We need to make foods that outperform the animal products for hardcore meat eaters, or people who love those products. So that was a very important criterion, and that's something that really had never been tried before. A lot of people have made, "Oh, this is a meat replacement product," but it's basically just mush together some beans and barley, or whatever, and call it a burger. Those things don't appeal to meat consumers. They're not competing against the animal industry. They're fine for vegans and vegetarians. But the problem making something that is meat to a meat lover, and is better meat to a meat lover, that's a completely different problem. I knew it was a solvable problem, but I didn't know what the solution looked like, and so when I founded the company, we basically started out by building this awesome R&D team of just basic scientists.

PB: These are not people from the food industry, these are people who are otherwise going to be professors in biochemistry departments or working at a biotech firm, or something like that. The people who could actually dig in and understand how meat works as a system and how fish and cheese and so forth work in molecular detail, because that's what it's going to take. We aren't fooling ourselves, nice try isn't going to succeed. You have to have something that literally

outperforms for the meat consumer. And there was another element to it, which was, we were being strategic. The idea here is, we don't want to just make a plant-based version of everything that is currently made from animals. We wanted to deliberately make products that compete against the most important products in keeping the incumbent industry alive.

PB: The first target was the beef industry, which as I said, is by far the most destructive. From a climate standpoint, if you get rid of cattle basically, you've solved 80% of the kind of impact of animal agriculture, so we went after beef first. And in the US more than half of the beef produced in the US is sold as ground beef and about a quarter of the beef produced in the US can only be sold as ground beef because it's just these nasty little scraps of meat that no one wants to look at. So you grind them up and call them a burger and now you can sell it. That's a pivotal part of the business model, that's why we chose that first. Also, it's iconic. We felt like it's a perfect vehicle for sending the message to meat consumers that uncompromising and delicious meat doesn't have to be made from animals. And my thesis is that if we just made the most delicious, healthy, affordable burger and the same for one kind of steak, the US beef industry is dead because we never have to make beef liver, we never have to make Rocky Mountain oysters, we never have to make tripe, because... Maybe we'll do it anyway just for the fun of it but you can't sustain the beef industry selling those things. Our goal was, again, to put this industry in the rearview mirror to save our planet.

LT: I've had veggie burgers before and they were pretty unappealing, so I was so surprised when I had my first Impossible Burger. It was delicious. How do you create deliciousness, texture, smell, essentially the sensory properties of meat?

PB: The answer is complicated but the way we approach it is we took it seriously as a scientific problem to understand what are the biochemical mechanisms that underlie the deliciousness. The flavor and aroma, for sure, but also the mechanical properties. The way the meat firms up when you cook it. The specific mechanical properties that you experience when you chew it and the mouth feel, the juiciness. All of those things are basically just emergent properties of the biochemistry and things that can be understood. And once you understand what are the essential features, you can then recreate them. And it turns out that none of the essential features require products from animals to create them.

PB: Most of the systems in a cow muscle cell are pretty much the same ones that are essential for survival of a plant cell. Obviously, there are some differences but the point is that when you understand what are the specifications in terms of the biochemical properties and the physical properties of the molecules that produce these sensory properties, then you can go shopping for corresponding ingredients from plants that allow you to recapitulate them. And in fact, one of the things that I think may sound counterintuitive but really, a cow did not evolve to be delicious. A cow just evolved to try and make the next generation of cows, and people just were able to domesticate it and developed a taste for it and stuff like that, but it's not working on the problem at all.

PB: So when we have the most delicious beef on the planet, we can make it better the next day. That's the point. We can continue to understand, "What is it about this product that you don't like that can be made better?" And iterate and iterate and iterate. That's just the same thing that happened when we replaced the horse with mechanical transportation. The thing is that the first mechanized transportation actually famously lost a race to a horse, it was a locomotive. But the point is it never lost again because the horse never got any faster and now you have moved to a new

technology platform that you can continue to improve on every axis, and that's the same thing what we're doing, is now we're in charge of the flavor and texture and nutrition and so forth, that means we can improve and optimize.

LT: You talked about competition of the horse and car. The 1976 judgment of Paris Wine Competition was of course very famous. It was a blind taste testing with the most renowned French wine experts and they were blind taste testing the California wines against the French wines, and the California wines won. Would you ever do something similar with Impossible Burgers or another Impossible product?

PB: Oh, absolutely. We've done it, we've had a product on the air, on TV, for people to do the blind taste test and then a lot of people, with no involvement with Impossible Foods, have done it themselves and posted it. There's one of my favorites, there's a guy... We weren't involved in it all but there's a right-wing pundit named Glenn Beck. His producer pranked him and gave him two burgers from a Texas burger chain, one of which was an Impossible Burger and one was made from a cow, and asked him at his sidekick to figure out which was which. And lo and behold, they picked the Impossible Burger as the real burger. This guy is a Texan, a rancher, an unapologetic anti-vegan and he picked the Impossible Burger. So yes, I think that's a very good idea. It's one of these things, as a scientist, any small number of people that you do that test... We do these kinds of tests actually behind the scenes ourselves because we're constantly measuring ourselves against the most popular ground beef. And we have a project under development that has substantially beat the most popular ground beef. But anyway, we're happy to do that. Bring it on.

LT: You've said that your goal is to replace all animals as a food source ending animal agriculture, as you call it, by 2035. Looking ahead in the shorter term over the next couple of years, what are you hoping to accomplish?

PB: Well, first of all we have a great R&D team that we're actually continuing to build all the time. We're constantly learning and getting a better understanding of how to do the things we want to do and so forth, so I want that to continue. We've been relying heavily on the already available supply chain of ingredients, which was never optimized for what we're doing. It was optimized largely for feeding pigs and cows and stuff like that, most of the agricultural system, but we figured out ways to leverage that to make our products. But I'm definitely interested in rethinking what the agricultural raw materials are to make a more... Not just lower environmental impact but better food security in terms of the agricultural system. We're so heavily dependent on a small number of crops. It's a setup for food security disaster, basically.

PB: So we're interested in, also, it's a longer-term effort, developing a more robust supply chain of ingredients that are more optimized for our products. But I guess the first short-term goal is we would like to compete successfully against the US beef industry and make it a losing proposition to be artificially inseminating any more cows. And that I think is something that we can potentially do within maybe five years or so, fingers crossed. We're also expanding internationally, we're in the process of getting ready to launch in some international markets, we have new products. We've made both a pork and a chicken product, that blind taste tests have beaten their animal competitor, not in a public test but in our own testing. We have a lot going on and it's all great and it's all fun and it's absolutely essential for the future of our planet. We have literally the best planet and we take it for granted, and we're letting it just basically go down the drain by being so negligent.

LT: So you have pork and chicken and a different way of raising crops on the horizon. What do you see as the challenges to doing those?

PB: There are so many challenges. First of all, it's serious science to figure out how these foods work and to figure out what are the essential principles that you can use to guide choice of plant based ingredients and replace it and so forth. That's hard, and then finding and scaling the necessary ingredients. We're operating in an industry where if some company grows 5 % in a year, it's like, "Wow, that's our best year ever." It's just so static and so uninventive. To achieve our mission we have to double in size every year, that means we have to double the size of our supply chain, our production capacity, distribution, all of that. Totally doable, but what we're realizing is that it's so alien, any kind of real innovation and growth in the food industry and the ag industry, and so forth, they just don't do that. We're realizing that we have to actually reinvent a lot of how that system works, because we can't rely on the incumbents to move fast enough for us and to see the opportunity and really go after it.

PB: So that's a big challenge for us. I would say the big problem for us is we need the best engineering talent in the world to build this entirely new kind of infrastructure and system. So if anyone who happens to be listening to this, who is a brilliant visionary engineer and wants to change the food system and do an even better job than Rosie the Riveter in Richmond, California, call me.

LT: What are the three key takeaways you'd like to leave the audience with today?

PB: Number one, the absolute best planet that we know of in the universe and the only one that any of us are ever going to be able to live on or our children, is in dire shape and absolutely needs action to save it. Number two, the system that is overwhelmingly responsible for getting us in this state is the use of animals as a food technology. And if we can replace that technology, we can literally, effectively turn back the clock on climate change. We can turn back the clock on all the historical damage that this industry has done. And I'm not qualified to be doing this, or let me put it this way, I am qualified but I'm not qualified in any usual sense. I'm not, by nature, a business guy. I've literally never even balanced my checkbook. I have no interest in that kind of stuff. And I'm not interested in food, actually. I'm perfectly happy to eat delicious food but I spend no time thinking about it.

PB: I've never taken a picture of food in my entire life. So why am I the CEO of a food company? The most important thing, which is that I realize that this problem needed to be solved no one was solving and I stepped up. And I think the take home message there for people is, if there's a big problem that you care about, don't assume that someone else is solving it, because they probably aren't, if you don't see it. The fact is, the thing that makes it your job is when you decide it's important enough for you to try to do something about it because the biggest thing that stands in the way of these things getting done is just the initiative.

LT: That's two takeaways. What is your third takeaway?

PB: For me, the most important determinant of what I did with my life was follow my curiosity. I find the most valuable trait that I have is curiosity and a willingness to follow it wherever it goes, not put myself in a box. Not say, "Oh, I'm a biologist so I shouldn't read books about history," or something like that. I think it's a mistake that people will say, "You need to focus on what you do.

Focus, focus, focus." I can't tell you how many times I've been slammed for not having enough focus, but I feel like focus is really overrated. The way that you discover things that you weren't looking for, which is most of the interesting stuff in the world, is peripheral vision. If you see something interesting, I think the critical thing about diving into it is the best kind of problem to work on and the way you're going to have the most impact is to do something you don't know how to do and to work on problems that you don't know how to solve. Because there's a huge advantage being the outsider because you're not zeroed in on what they think is important and you can see things that the experts don't see. And so I would just say follow your curiosity wherever it takes you and embrace problems that you don't know how to solve.

LT: Pat, this has been terrific. Thank you so much for our conversation today and thank you for creating and building Impossible Foods and solving such a big important problem for all of us.

PB: Thanks, Lynn.

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