



TECHNICAL RESEARCH FOR ANIMAL PRODUCT ALTERNATIVES SKILLS PROFILE

November 2020

CONTENTS

SUMMARY	3
INTRODUCTION	4
HOW DOES THIS WORK HELP ANIMALS?	5
IS IT RIGHT FOR YOU?	8
WHAT DOES TECHNICAL RESEARCH FOR ANIMAL PRODUCT ALTERNATIVES LOOK LIKE IN PRACTICE?	12
WHAT OPTIONS WOULD YOU HAVE IF YOU WERE TO LEAVE THIS PATH?	14
HOW TO PREPARE FOR TECHNICAL RESEARCH ROLES FOR ANIMAL PRODUCT ALTERNATIVES	15
USEFUL RESOURCES	19

SUMMARY

By reading this profile we hope that you can build a better understanding of whether seeking to develop technical research expertise for animal product alternatives seems like one of the best ways for you to use your time in order to help animals.



HOW DOES THIS WORK HELP ANIMALS

Developing and scaling up the production of high-quality animal product alternatives will reduce the number of animals that are bred and killed for food.



WHO IS THIS WORK A GOOD FIT FOR

People with academic backgrounds in any of a wide variety of sciences, including disciplines relating to biology, chemistry, food science, and engineering. There are opportunities in both academia and industry.



HOW MUCH DO WE NEED MORE EXPERTISE IN THIS AREA

There are hundreds if not thousands of possible roles in this space. Some more specific types of expertise are more urgently needed than others.



WHAT OPTIONS WOULD YOU HAVE IF YOU WERE TO LEAVE THIS PATH

There are opportunities for switching between roles relating to technical research for animal product alternatives, but few obvious other backup options that would help animals.



HOW TO PREPARE FOR THESE ROLES

Get a relevant bachelor's degree and probably also relevant graduate training. If needed, you can build experience through internships and volunteering, entry-level roles in industry, or in areas of academic research that overlap with animal product alternatives research.



INTRODUCTION

2013 saw the [first public tasting](#) of a cultivated meat hamburger — a burger grown from animal cells, without requiring the slaughter of an animal. Though the texture was described as “perfect” and the taste was “close to meat,” it was apparently “not that juicy” and the burger cost over \$300,000 to produce. But progress has been made rapidly. By February 2016, Memphis Meats [claimed](#) to have reduced the price of cultivated meat 18-fold.



Mark Post of Maastricht University and Mosa Meat unveils the cultivated meat hamburger for its public tasting

This profile discusses new animal product alternatives, such as cultivated meat (that is, products grown from animal cells without requiring the slaughter of any animals, variously referred to as “cultured meat,” “clean meat,” “cell-based meat,” “in-vitro meat,” “cellular agriculture” and so on) and new plant-based foods that accurately mimic animal products. We focus on technical research roles relating to these foods, including everything from food science to molecular biology to mechanical engineering to computational science.

We will share some insights with you from the experiences of people working on these foods (via 6 [interviews](#)), plus the findings of our research into companies in the space. You can read more about our methodology [here](#).

HOW DOES THIS WORK HELP ANIMALS?

IF YOU'RE INTERESTED IN HELPING ANIMALS EFFECTIVELY THROUGH YOUR CAREER, YOU SHOULD PRIORITISE WORK THAT HAS HIGH POTENTIAL FOR IMPACT.

At any one point, many [billions of animals](#) are trapped in factory farmed conditions, experiencing terrible lives. Advocates have been pushing for decades to help them through welfare reforms or by encouraging people to change their diets; progress has been made, but meat production is [still growing](#).

Imagine if we could give people alternative foods that were so good and so well-integrated into their existing habits that there was no reason for them to eat conventional animal products? This would save animals, since people would now be buying and producing other types of food. This is the goal of creating new and better cultivated meat, highly meat-like plant-based foods, and other alternatives to animal products. Removing conventional animal products from diets would probably push attitudes towards animals in a positive direction as well.

These roles also pay better than nonprofit roles, so you might be able to do technical research while earning enough money to donate large amounts to effective animal advocacy nonprofits.



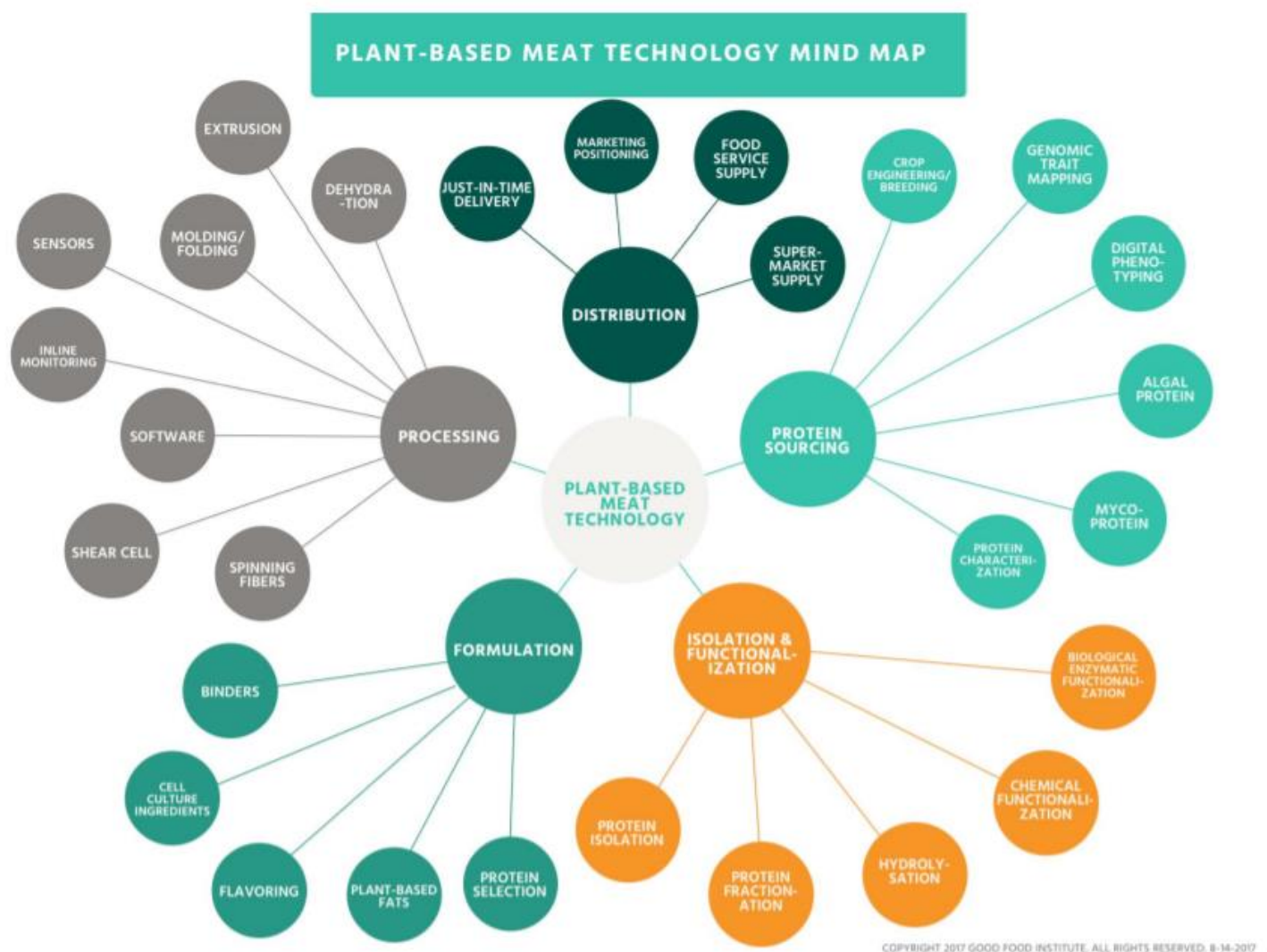
Ian the chicken sitting comfortably while staff at [Just](#) eat chicken nuggets made from cells harvested from one of Ian's feathers ([video here](#)).

The Good Food Institute (GFI) [wrote](#) in 2019 that, to commercialize *cultivated* meat, “four critical technology areas require further innovation: cell-line development, cell culture media, bioreactors and bioprocessing, and scaffold biomaterials.” So technical work on any of these technology areas could help to bring these products to market.

GFI [is also optimistic](#) that a shift in focus towards “large-scale production” will bring down the price of *plant-based* meat. Plant-based food companies seem to [agree](#) that there’s still a lot of work to be done.

A lot of this work relates to scaling up the technologies that have been developed so far, but there are other opportunities for technical research that can help animals. For example, in plant-based foods, there are opportunities for trialling out plant-based proteins in new contexts. And in cultivated meat, there are opportunities to test the findings from work on some animal cell types with other animal cell types.

The range of opportunities is summarised nicely by GFI’s mind maps on [plant-based meat](#), [cultivated meat](#), and [fermented foods](#). Here’s the first of those three, as an example:



WHICH TECHNICAL RESEARCH WORK HELPS ANIMALS THE MOST?

Cultivated meat might not become cost-competitive with conventional animal products [for a while](#), which might make you more optimistic about plant-based foods rather than cultivated meat. But if cultivated meat works out well, it could be much more effective at replacing conventional animal products. Work in both these fields, as well as in the [fermentation](#) field of animal product alternatives, seems promising.

If you're very flexible, you might want to look for opportunities to focus on fish, seafood, meat from chickens, or eggs, which [cause](#) a lot of animal suffering but don't have as many good alternatives. But there are opportunities to help animals by working on other product types, too.

It's [helpful](#) for animals if research related to animal product alternatives is open-access, via academic institutions, rather than kept solely for use by individual companies. It also means that even if there's some sort of [investment winter](#) following industry failures, the field won't be damaged too much. On the other hand, there is a risk that academic work will simply duplicate some of the work that companies have already completed or focus on less urgent research questions.

We're excited about work in all these areas, so [career strategy](#) considerations like [personal fit](#) (discussed below) are important in deciding where you should focus.



Impossible Foods and Beyond Meat are often compared to one another. Both make highly meat-like plant-based burgers, among other products, and both have been gaining lots of attention and investment.



IS IT RIGHT FOR YOU?

THE INFORMATION IN THIS SECTION IS INTENDED TO HELP YOU ASSESS WHETHER YOU WILL HAVE GOOD PERSONAL FIT WITH PPL ROLES. YOUR “[PERSONAL FIT](#)” WITH A ROLE OR CAREER PATH IS HOW WELL-SUITED YOU ARE TO IT AND YOUR CHANCES OF REALLY EXCELLING AT IT. WE THINK THIS IS ONE OF THE MOST IMPORTANT FACTORS IN [IMPACT-FOCUSED CAREER STRATEGY](#).

WHAT DO TECHNICAL RESEARCHERS DO?

We asked our [interviewees](#) about what the work is like in this area and took a look at job postings.

Basic research tasks include:

- Preparation and maintenance of the bioreactors, cell cultures, food samples, or whatever equipment and products that you work with,
- Ordering and monitoring equipment,
- Carrying out tasks to run the experiments,
- Monitoring and recording of results,
- Data analysis,
- Planning future experiments.

But your day-to-day might look quite different, depending on your specific role and the research field that you’re working in.

It also depends on your level of seniority. Senior scientists might need to figure out what sorts of experiments and equipment are needed, and manage others to achieve this. More junior scientists, engineers, researchers, technicians, and PhD students will focus more on



Birgit Dekkers has a foot in both academia and the for-profit world, as a researcher at Wageningen University and co-founder of Rival Foods.

execution and implementation of research. These roles may include administrative tasks, too.

There are also some parts of the job that differ between academia and startups. Startups can be more fast-paced and flexible. Academic work might be more varied, including side projects, teaching, writing grant applications, publishing journal articles, and networking at conferences.



WHAT MAKES GREAT TECHNICAL RESEARCHERS?

Our [interviewees](#) believed that great technical researchers:

- Have relevant technical experience,
- Are motivated and passionate about the mission,
- Are willing to work hard,
- Are good communicators,
- Think outside the box and have a problem-solving mindset,
- Are detail-oriented.

Skills that might become more important as you become more senior include:

- The ability to ask good research questions and design experiments to test them,
- An overview understanding of how technology develops,
- [Management and leadership](#) capability.



Zhong-qing Jiang, Co-Founder and Chief Scientist at Gold & Green Foods Ltd, a plant-based meat company, has a PhD in cereal technology from Helsinki University.

ARE THERE ANY OTHER REASONS YOU MIGHT OR MIGHT NOT BE A GOOD FIT?

- Research on animal product alternatives is very mission-driven, seeking to have a positive impact; excitement about this is common among researchers in the field and the work could be more rewarding than roles in other scientific fields.
- Many researchers enjoy the collaborative aspects of the work.
- Some research tasks can be very repetitive.
- Some roles might involve quite long hours.
- Securing permanent employment in *academia* is [very competitive](#).
- There's not a lot of overlap between the technical knowledge required in cultivated meat and plant-based foods (see the “academic training” section below). So you might have much better personal fit with one area over the other.
- The animal product alternatives industries, especially for cultivated meat, are relatively small, new, and dynamic. This may be exciting. But it also makes it difficult to predict the future needs of the industry, which makes this a riskier career path than some others that help animals. Seeking to slowly develop highly specialised technical expertise (e.g. through a PhD) could backfire if the needs of the industry change.



HOW CAN YOU ASSESS YOUR PERSONAL FIT?

- Look honestly at your previous success in related work that uses the skills described above and the academic disciplines described below. Introspection on your preferences and personality could also be helpful.
- Read relevant technical academic papers, and perhaps write up your thoughts, synthesis, and analysis in a public blog or academic review article.
- Talk to researchers; ask them about your uncertainties and ask them to candidly assess your chances at excelling in similar work. We recommend using your personal connections and [GFI's database of academic labs](#) as starting points. GFI can [help connect](#) you to individuals in the space, as can national organisations like [Cellular Agriculture UK](#), [Cellular Agriculture Canada](#), [Agriculture Cellulaire France](#). You can join relevant directories that help connect individuals, such as GFI's [Talent Database](#), [GFI India's Talent Database](#), GFI's [student database](#), the [effective animal advocacy community directory](#), and the [Effective Altruism Hub](#). See also 80,000 Hours' recommended "[email scripts for cold-emailing](#)."
- Seek out opportunities to volunteer in an [academic lab](#) doing relevant work; these opportunities might not always be advertised. You could also look for internships or other lab opportunities at [companies](#) working on animal product alternatives.
- If you already work in a job doing some kind of lab research, is it possible to seek out opportunities more directly relevant to the sorts of work you would be doing if you worked on animal product alternatives?
- It might be possible to get a role at a relevant company in between your undergraduate and graduate degrees.



[Cellular Agriculture Society's](#) "vision for meat production in 2040" as part of their "[Project CME](#)"

WHAT DOES TECHNICAL RESEARCH FOR ANIMAL PRODUCT ALTERNATIVES LOOK LIKE IN PRACTICE?

A BETTER UNDERSTANDING OF THE LANDSCAPE OF THE ANIMAL ADVOCACY MOVEMENT MIGHT HELP YOU UNDERSTAND SOME PRACTICAL CONSIDERATIONS OF WHETHER YOU ARE WELL-SUITED TO WORK IN THIS AREA.



It's also important for understanding how your strengths compare to other members of the animal advocacy movement who might plausibly do similar roles. This determines your [comparative advantage](#) — the job or path that is highest-impact for you, taking into account the possibility of coordination with others in the animal advocacy movement. This is something we can talk through with you if you apply for a [one-to-one careers advice call](#) with us.

HOW MUCH DOES THE MOVEMENT NEED MORE EXPERTISE IN THIS AREA?

The success of animal product alternatives will presumably depend on continued excellent technical research. Our [spot-check](#) found that these roles make up a large proportion of the current roles at companies producing animal product alternatives:

Area of expertise the role seems to focus on	% of roles at cultivated meat companies	% of roles at plant-based food companies
Technical product-focused research	53%	16%
Engineering, manufacturing, and processing	15%	3%

This represents hundreds of jobs. And there are additional relevant research roles in academia and in companies that only partly focus on animal product alternatives.

Within technical research on cultivated meat, several interviewees highlighted engineering skills as being especially needed at the moment. There was also evidence in our [spot-check](#) that cultivated meat companies struggle to hire or retain people in these roles. We don't have evidence to believe this is also the case for plant-based food companies though. As the cultivated meat industry is relatively young and is growing rapidly, these needs may also change, so you probably shouldn't seek to retrain to engineering from other relevant technical skillsets if this will take a long time or if you don't have good personal fit with those sorts of roles.

There is substantial investment in private companies, meaning that there are lots of technical research jobs available at [companies working on animal product alternatives](#). Funding for academic research is available from a variety of places (see the "useful resources" below), but there is still not enough. Academic research for cultivated meat still relies substantially on GFI and New Harvest.



Petra Hanga is a Lecturer in Biological Engineering at Aston University in the UK. She works on scaling up the production of cultivated meat.

WHICH COUNTRIES ARE TECHNICAL RESEARCH ROLES BASED IN?

In our [spot-check](#) of roles at companies producing animal product alternatives, companies were identified in 29 different countries. A lot of roles are based in the US:

Country	Companies making animal product alternatives in general	Cultivated meat companies specifically
United States	53%	42%
Belgium	10%	2%
United Kingdom	7%	5%
Sweden	7%	0%
Netherlands	5%	14%
Canada	4%	3%
Chile	2%	0%
Israel	2%	15%

Of the staff working for companies based in the US, 74% worked for companies based in California.

[GFI's database of academic labs](#) working on animal product alternatives includes 24 labs in the United States, 7 in Israel, 6 in Canada, 4 in the Netherlands, 3 in China, 3 in the United Kingdom, and one in each of Australia, Belgium, Brazil, Estonia, Finland, Germany, Japan, Norway, Portugal, Serbia, Singapore, and Switzerland.

WHAT OPTIONS WOULD YOU HAVE IF YOU WERE TO LEAVE THIS PATH?

Much of the career capital built up through technical research for cultivated meat might be useful in related scientific disciplines like tissue engineering for regenerative medicine. Food scientist expertise, specialised to plant-based foods, might be less useful outside of this area.

Of course, there are opportunities for changes within the overall category of technical research for animal product alternatives. There's a lot of overlap in the required skills in academia and startups, but it seems easier to transition from academia to industry than the other way round. You could certainly apply for roles at nonprofits like the Good Food Institute and New Harvest if you have developed technical research experience. And relevant academic, startup, or nonprofit backgrounds could all provide useful preparation if you decided to start your own company developing animal product alternatives.

There aren't many other great backup options that would help animals. You might apply your expertise to [lobbying roles](#) focused on animal product alternatives. If you can use your experience to find well-paid work in other sectors, then you might be able to switch your focus towards donating lots of money to effective animal advocacy nonprofits. Technical research roles seem unlikely to be the best preparation for either of these routes though.

INTERESTED IN TECHNICAL RESEARCH ROLES TO HELP ANIMALS?

If you need to do some career planning, 80,000 Hours' ["Tips on making career plans"](#) will likely be helpful.

If you're considering whether you'd like to focus on developing technical research expertise for animal product alternatives, or bringing your existing expertise to support the animal-free food movement, we might be able to help you talk through your options. You can apply for a one-to-one careers advice call with us [here](#).

HOW TO PREPARE FOR TECHNICAL RESEARCH ROLES FOR ANIMAL PRODUCT ALTERNATIVES

SO FAR, THIS PROFILE HAS FOCUSED ON INFORMATION TO HELP YOU DECIDE WHETHER SEEKING TO DEVELOP TECHNICAL RESEARCH EXPERTISE FOR DEVELOPING ANIMAL PRODUCT ALTERNATIVES WOULD BE A HIGH-IMPACT USE OF YOUR TIME. THE INFORMATION BELOW IS MORE FOCUSED ON HELPING YOU DECIDE WHAT YOU COULD DO NEXT IF YOU DECIDE THAT YOU DO WANT TO FOCUS ON THIS.



WHAT ARE THE ENTRY REQUIREMENTS?

Our [spot-check](#) found that the majority of advertised opportunities in “technical product-focused research” and “engineering, manufacturing, and processing” roles in for-profit companies explicitly required a bachelor’s (undergraduate) degree. Most of those roles also explicitly required some sort of biology, chemistry, or life sciences focus in your educational qualifications, though this wasn’t always the case for engineering roles (e.g. pure mechanical engineering might be fine). So, priority number one, is: get a relevant degree.

The question of whether you should seek a relevant master’s degree or PhD in addition to your bachelor’s has a less obvious answer. About half of relevant job postings in our [spot-check](#) asked explicitly for this; this was less frequently a requirement for engineering than product-focused roles and for plant-based than cultivated roles.

Several technical research roles asked for PhDs *or* master's degrees — but if asking for a master's, they often also asked for additional years of industry experience. Pursuing a PhD seems like a safer bet if you hope to enter this field, but if you've already got a master's, there may be other entry routes. And if you're hoping to test your fit in the space before applying for graduate programmes, then seeking out relevant full-time work that only requires a bachelor's degree could be a good option for a few years. Of course, you'll need a PhD if you want to work in academic settings rather than for-profit settings.

The vast majority of roles at for-profit companies in our [spot-check](#) also asked explicitly for one or more years of relevant experience beyond those provided by your education, often in relevant *industries*, rather than academia.

Area of expertise the role seems to focus on	Cultivated meat companies, average years of experience required	Plant-based food companies, average years of experience required
Technical product-focused research	2.6	2.6
Engineering, manufacturing, and processing	3.5	4.6

Note that sometimes formal entry requirements are [not as "required"](#) as the job advert implies. Of course, beyond the formal entry requirements, you'll also want to ensure that you have good personal fit (see the relevant section above).



WHAT SORTS OF EXPERIENCE ARE MOST USEFUL FOR DEVELOPING TECHNICAL RESEARCH EXPERTISE?

Relevant technical research experience is very helpful, if not required. The more closely related your experience to the positions you're considering, the better. However, there is still a lot of overlap between technical research focused on animal product alternatives and other fields of research (such as those mentioned in the section on academic training below), so working in one of these fields seems a good temporary option for skill-building if you can't immediately land your ideal technical research role.

Another option is to work in entry-level roles in the industry, such as being a lab assistant or technician, that might not require as much relevant technical experience.

If you have sufficient expertise to secure a role at the Good Food Institute or New Harvest, then this may provide you with a great overview of the needs of the research field, which you can later apply to work in industry. On the other hand, you likely wouldn't be gaining technical research experience in these roles.

WHAT SORTS OF ACADEMIC TRAINING IS RELEVANT?

GFI's [student guide](#) lists the following academic pathways as relevant for particular types of technical research to improve plant-based foods technology:



Plant-based meat

Think about plants as raw materials. How can we grow better raw materials for plant-based meat?

Genetic engineering Mycology Plant science

How do we build a model that can predict what the right plants are?

Computational science Data science Genetic engineering Food science Plant biology

How can we take a plant and turn it into optimally functional ingredients for plant-based meat?

Food science Molecular biology Biochemistry Plant biology

Let's dig deeper into processing. How can we achieve an optimal texture and mouthfeel from our ingredients?

Chemical engineering Biochemistry Mechanical engineering Food science

And for cultivated meat:

Cultivated Meat

How can we establish immortal cell lines?

Genetic engineering Molecular biology Cell biology

How can we ensure that cells differentiate into the desired tissue types at scale?

Bioengineering Tissue engineering Molecular biology Cell biology Computational science

What are the different methods we can use to improve the structure of cultivated meat products?

Tissue engineering Materials engineering Meat science

How can we design sensors and facilities to ensure quality and efficiency for large-scale cultivated meat production?

Mechanical engineering Chemical engineering Electrical engineering Computational science Design

The guide also lists mycology, industrial biotechnology, and microbiology as relevant for working on the fermentation of microorganisms.

An alternative option is to just try to get really good at a less obviously relevant scientific field that you are especially well-suited to and then apply your expertise to technical research for animal product alternatives. This is much riskier because you may *never* succeed in applying your expertise to animal product alternatives.

When choosing your academic institution, applying to the most prestigious and highly ranked universities you have a realistic shot at securing a place in is probably a good strategy. But you'll also want to try to look for courses that have the best training and experiences of specific relevance to animal product alternatives. Be aware that graduate programmes in some institutions might not provide much hands-on experience in the lab or with relevant machinery.



Caption: Uma Valeti, CEO and Co-Founder of Memphis Meats has an academic background in Cardiovascular medicine.

USEFUL RESOURCES

- The [interview findings spreadsheet](#) for this profile.
- [One-to-one careers advice calls](#) with us.
- We have a much longer list of useful resources in the [detailed version](#) of this skills profile.

THANK YOU FOR YOUR INTEREST IN HELPING ANIMALS!

Thank you for reading this skills profile. We hope this has been helpful for shaping your future steps. We wish you the best of luck in your animal advocacy career planning.

If you've found this skills profile useful, you can support our work by [donating to Animal Advocacy Careers](#). Your contributions will support us to help animals!

