



Cultured Meat: The Future of Pet Food

by Shannon Falconer, PhD,
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**Because,
Animals.**

*Love all
animals*



About the author



Shannon Falconer is the CEO and co-founder of Because, Animals, a biotech start-up creating nutritious, sustainable, cultured meat pet food. Shannon holds a Masters degree in Biochemistry, a PhD in Chemical Biology, and worked as a post-doctoral research fellow at Stanford University prior to co-founding Because Animals in 2016. Shannon has spent decades volunteering in the animal rescue community and is a fur mom to two amazing rescue dogs, Gaia and Nori – both failed fosters!

Summary

Meat is the central ingredient in commercial pet food. Cats evolved eating it and, in the wild, meat is the only single source of complete nutrition for both cats and dogs. However, the demand for meat – by not only humans but also cats and dogs – has come with some devastating consequences, including climate change, animal cruelty and risks to public health.

When it comes to feeding cats and dogs, Because, Animals recognizes the nutritional value of meat. For this reason, Because, Animals is not creating a meat alternative – we are creating meat that is produced in an alternative way. Specifically, Because, Animals is creating cultured meat for pets.

Cultured meat is 100% bioidentical to traditional meat. It has the same nutritional value and composition as animal-based meat. Cultured meat is made by growing animal cells inside of a bioreactor instead of inside an animal.

Cultured meat allows people to continue to feed cats and dogs the meat they love without any of the negative impacts associated with traditional meat. No animals raised inhumanely for slaughter. No greenhouse gas emissions. No wasteful use of natural resources. No antibiotics or growth hormones. And, no risk to pet or human public health in terms of bacterial contamination and zoonotic diseases.

Cultured meat allows people to continue to feed cats and dogs the meat they love without any of the negative impacts associated with traditional meat.

The way meat is currently produced comes with some devastating consequences.



Climate change.

Animal agriculture is responsible for 18% of the world's greenhouse gas emissions, which is more than all modes of transportation combined.¹



Threat to public health.

Pandemics. The main trigger for all pandemics in human history has been the jump of an infectious agent from a farmed or wild animal to a human.³



The problem with meat



Land degradation and use.

Close to a third of the world's soil has already been degraded due to livestock. In the United States, 41% of the country's land (nearly 800 million acres) is taken up by the feed, grazing and confinement of livestock.²



Animal abuse.

The animal agriculture industry is responsible for countless instances of unconscionable animal cruelty.⁵



Antibiotic-resistant pathogens.

Approximately 80% of all antibiotics manufactured in the United States are sold to the animal agriculture industry, making animal farming the largest driver of the development of antibiotic resistant pathogens.⁴

Making these matters worse, meat consumption is growing at a rapid rate. By 2050 we'll need 1.5 planets to meet demand! An alternative is imperative. Removing animals from the supply chain and eliminating the world's reliance on the animal agriculture industry is the ideal way to feed our pets a healthy diet.

Cultured meat will allow us to remove animals from the supply chain, eliminate the world's reliance on the animal agriculture industry and provide pets with their ideal diet.

¹ Food and Agriculture Organization of the United States. Livestock's long shadow. Rome, 2006. ² [bloomberg.com/graphics/2018-us-land-use](https://www.bloomberg.com/graphics/2018-us-land-use). Accessed May 14, 2021. ³ [theguardian.com/environment/ng-interactive/2020/sep/15/covid-farm-animals-and-pandemics-diseases-that-changed-the-world](https://www.theguardian.com/environment/ng-interactive/2020/sep/15/covid-farm-animals-and-pandemics-diseases-that-changed-the-world). Accessed May 14, 2021. ⁴ Martin et al. Antibiotics Overuse in Animal Agriculture: A Call to Action for Health Care Providers. Am J Public Health. 105(12), 2015. ⁵ Imhoff et al. The CAFO Reader: The tragedy of industrial animal factories. 2010.

Meat: the original diet for cats and the modern dog's ancestor

Meat is the central ingredient in pet food. Cats evolved eating it, as did wolves – the modern dog's ancestor. Although cats and dogs are both able to obtain all of the nutrients they need from meat, each species possesses key metabolic differences that greatly impact their nutritional requirements.

How so? Let's take a look at these differences in more detail.

As obligate carnivores, cats evolved as predatory animals, with their food sources being mice, rats, rabbits, lizards and insects.⁶ In the wild, the only way for felines to obtain all of the nutrients they need is to consume another animal.

For the carnivorous cat, the following are among those key nutrients that are only or mostly found in meat:

- ⇒ Taurine
- ⇒ Arachidonic acid
- ⇒ Vitamin A (retinol)
- ⇒ Vitamin B3 (niacin)



Cats require specific nutrients rather than specific ingredients in order to survive and thrive.

In all cases, cats lack the enzymatic ability to synthesize these essential nutrients, leaving meat as their only source.

However, it's important to understand that – like all animals – cats require specific nutrients rather than specific ingredients in order to survive and thrive. While meat is the only source of complete nutrition for cats living in the wild, it is not the only source of complete nutrition for cats being fed a commercial diet. Indeed, recent research suggests that cats fed plant-based diets properly supplemented with animal-free, synthetic essential nutrients are just as healthy as cats fed meat-based diets.⁷

However, unlike cats, dogs diverged from their carnivorous ancestor more than 13,000 years ago. During this time, dogs co-existed alongside humans, eating the table scraps of their omnivorous human companions, and evolving metabolic traits that allowed them to survive on not only meat but also plant matter. Over a period of 10,000 years, dogs went from requiring meat to being capable of obtaining all of the nutrients they need from either a meat- or a plant-based diet.⁸

⁶ MacDonald and Rogers. Nutrition of the domestic cat, a mammalian carnivore. *Ann. Rev. Nutr.* 4, 1984. ⁷ Dodd et al. A cross-sectional study of owner-reported health in Canadian and American cats fed meat- and plant-based diets. *BMC Veterinary Research.* 17(53), 2021. ⁸ Bosch et al. Dietary nutrient profiles of wild wolves: insights for optimal dog nutrition? *British Journal of Nutrition.* 113, 2014.

Meat: the original diet for cats and the modern dog's ancestor

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Dogs are unique from cats in many ways, but in terms of nutritional requirements, it's their metabolism – and their body's ability to synthesize certain key nutrients from precursor molecules found in plants – that sets them apart. For example, in the case of vitamin A, dogs are able to synthesize this vitamin from a precursor molecule called carotene – a compound that is found in abundance in many vegetables, and gives carrots their orange color.

In contrast, cats lack the ability to convert carotene to vitamin A and therefore need to obtain this nutrient from their diet. Metabolically speaking, dogs are much more similar to humans than they are to cats.

Although today's domestic dogs do not need meat, many pet parents feel more comfortable feeding their canine a diet that includes at least some meat, as it's an ingredient that their wolf ancestors thrived on. Regardless of whether dogs need meat (they don't), most dogs still love the taste and will choose the flesh of a rabbit over a head of cabbage any day. The majority of pet parents choose to feed their cats and dogs meat, creating a huge demand and market for meat-based pet food.

Like most experts, when it comes to feeding our pets, Because, Animals recognizes both the nutritional value and sensory satisfaction that meat brings. For this reason we're not making a meat alternative – we're making 100% meat by an alternative means.

The problem with meat in pet food

Adding to its contribution to climate change, land degradation, threats to public health, egregious animal cruelty, meat comes with another set of problems specific to pet food:

Pet health

- ❖ Every year, multiple times a year, the FDA issues recalls on pet food typically due to bacterial contamination.⁹
- ❖ The extreme heat and pressure used in pet food production leads to a loss of many key nutrients such that even meat-based cat food is supplemented with synthetic nutrients, including taurine.
- ❖ Beef and poultry protein – among the main sources of protein used in pet food – are also among the leading food allergens in cats and dogs.¹⁰

- ❖ Pet food contamination by the euthanizing agent, pentobarbital, has been detected.¹¹
- ❖ The presence of antibiotic residues in pet food¹² has led to adverse health reactions in dogs.¹³
- ❖ Human-grade, raw meat diets put pets at risk of infection by pathogenic bacteria,¹⁴ as evidenced by a recent report showing that 100% of the meat tested positive for fecal bacteria.¹⁵

⁹ [fda.gov/animal-veterinary/safety-health/recalls-withdrawals](https://www.fda.gov/animal-veterinary/safety-health/recalls-withdrawals). Accessed May 14, 2021. ¹⁰ Mueller et al. Critically appraised topic on adverse food reactions of companion animals (2): common food allergen sources in dogs and cats. BMC Veterinary Research. 12(9), 2016. ¹¹ [fda.gov/animal-veterinary/outbreaks-and-advisories/fda-alerts-pet-owners-about-potential-pentobarbital-contamination-canned-dog-food-manufactured-jm](https://www.fda.gov/animal-veterinary/outbreaks-and-advisories/fda-alerts-pet-owners-about-potential-pentobarbital-contamination-canned-dog-food-manufactured-jm). Accessed May 14, 2021. ¹² [eurekalert.org/pub_releases/2020-04/esoc-srr041720.php](https://www.eurekalert.org/pub_releases/2020-04/esoc-srr041720.php). Accessed May 14, 2021. ¹³ Di Cerbo et al. Adverse food reactions in dogs due to antibiotic residues in pet food: a preliminary study. Vet Ital. 54(2). 2018. ¹⁴ Murphy et al. Occurrence of antimicrobial resistant bacteria in healthy dogs and cats presented to private veterinary hospitals in southern Ontario: A preliminary study. 50(10). 2009. ¹⁵ [consumerreports.org/cro/food/how-safe-is-your-ground-beef](https://www.consumerreports.org/cro/food/how-safe-is-your-ground-beef). Accessed May 14, 2021.

The problem with meat in pet food

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Sustainability

❖ More than a quarter of the environmental effects of the animal agriculture industry are directly attributable to the foods that Americans feed their cats and dogs.¹⁶

❖ Growing pet populations worldwide place added demand and stress on meat production.¹⁷

Rendered animal ingredients

The vast majority of pet food is made from something called rendered ingredients.¹⁹ For the most part, rendered ingredients consist of:

❖ Animal offal (viscera, heads, bone, blood, and other byproducts) from slaughterhouses

❖ “Fallen animals”, which are livestock that die before making it to slaughter, typically due to disease, dehydration or suffocation during transit.

Human-grade meat

Many premium and ultra-premium brands of pet food use human-grade meat in their products. Some companies even produce pet food using only meat from “humanely raised” and/or “free-range” animals. Although such meat may indeed have come from animals treated humanely before slaughter, this style of meat production is also far more environmentally devastating. Although human-grade, free-range pet food may be better for the animal from which it came, those higher animal welfare standards come at a higher cost to the planet.¹⁸

In the United States and Canada alone, more than 25 million tons of rendered animal material is processed every year, with the majority of those rendered ingredients being sold to the pet food industry.¹⁹

Although it is argued by some that rendering is an environmentally sustainable practice, another perspective is that the practice of rendering is only sustainable in the sense that it sustains the animal agriculture industry – which many experts have argued is the most unsustainable practice on our planet.²⁰

Cultured meat is bioidentical to traditional meat. It is 100% meat.

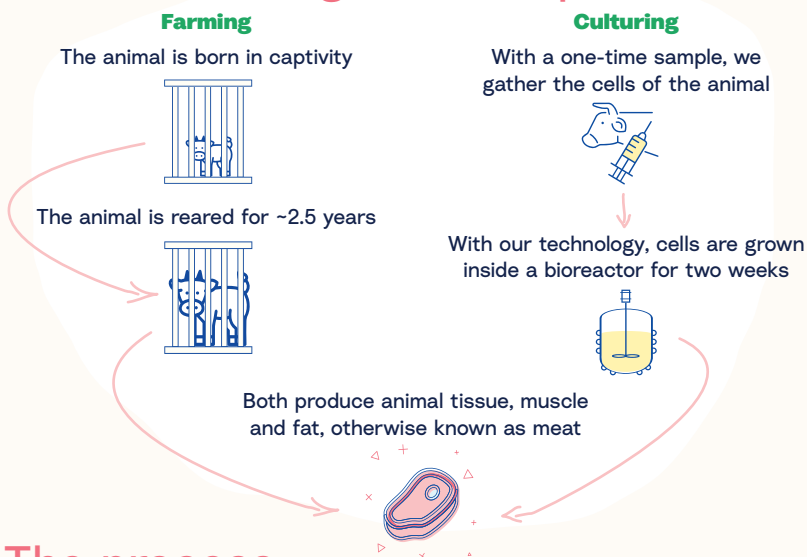
The difference is in how that meat is produced: namely, **a) raising and slaughtering an animal** (current production method) versus, **b) taking a sample of cells from an animal and then growing those cells inside a bioreactor through a process very similar to beer and probiotic production** (cultured meat production method).

¹⁶ Okin GS. Environmental impacts of food consumption by dogs and cats. 2017. ¹⁷ Alexander et al. The global environmental pawprint of pet food. Global Environmental Change. 2020. ¹⁸ [theguardian.com/2015/dec/22/festive-christmas-meal-long-haul-flight-meats-damaging-planet](https://www.theguardian.com/2015/dec/22/festive-christmas-meal-long-haul-flight-meats-damaging-planet). Accessed May 14, 2021. ¹⁹ Meeker and Meisinger. Rendered ingredients significantly influence sustainability, quality, and safety of pet food. 2015. ²⁰ [ipcc.ch/srcccl-report-download-page](https://www.ipcc.ch/srcccl-report-download-page). Accessed May 14, 2021.

The solution: cultured meat

What is meat? All meat is simply a collection of animal cells. Meat in the traditional sense is produced when these cells grow inside a body. But, when given the right nutrients, these cells can also grow inside a specialized container called a bioreactor. The end result in both scenarios is 100% meat.

Culturing cells, simplified



Growth medium

A key aspect to successfully culturing animal cells outside of an animal is ensuring that those cells are being fed all of the essential nutrients they need to grow and divide.

Creating cultured meat is a new application of a relatively old technology. For more than half a century, scientists have been growing animal cells without the animal, mostly for the purposes of better understanding biology in order to treat disease. And over these many decades of cell culture research, scientists have relied on a pivotal tool to move them forward: fetal bovine serum (FBS).

FBS is collected from the fetuses of unborn calves at the time of slaughter of pregnant cows.²¹ It found application in cell culture as an incredibly nutrient-rich blend of vitamins, trace elements, hormones and growth factors.

However, there are a number of problems associated with the use of FBS, including ethical concerns, unstable supply issues, high cost, and batch-to-batch variation that makes scientific replication difficult.

As such, it is imperative that any producer of cultured meat find a replacement for FBS that is animal-free, readily available, affordable, and replicable in order to achieve nutritional consistency between batches of cultured meat.

The process

In a one-time scenario, a small sample of animal cells are collected from an animal, normally from a single biopsy. This is done as humanely as possible, and can be considered the equivalent of an ear piercing in a human being.

From that sample the necessary cells are isolated and fed a nutritious blend of nutrients, such as vitamins and minerals, all inside a bioreactor, which is warm and allows for gas exchange.

As those cells consume nutrients, they continue to grow and divide, ultimately producing more cells to yield a larger and larger biomass.

At harvest time, the cells are collected from the bioreactor and blended with other nutritious ingredients to form nutritionally complete foods for cats and dogs.

²¹ Jochems et al. The use of fetal bovine serum: Ethical or scientific problem. *Altern Lab Anim.* 30. 2002.

**What
cultured
meat
is not**

Because, Animals has formulated a proprietary growth medium that is free of FBS and any other animal ingredients for use in the commercial production of cultured meat pet food. This proprietary medium addresses the scientific, ethical, and supply challenges of FBS, and reduces the cost of production – a key step towards commercialization of the technology.

Cultured meat is not a meat alternative. A meat alternative implies that the product in question – for example, a burger – is made with ingredients that do not come from an animal. For the most part, meat alternatives are plant-based ingredients that impart a texture, taste, look, smell and/or nutritional quality that resembles the meat-based product being replaced.

For example, soy is often used as a meat alternative since, similarly to meat, it has an excellent amino acid profile with protein that is highly bioavailable. Other plant-based ingredients used as meat alternatives include legumes, macroalgae and protein isolates that come from vegetables, such as peas and potatoes.

In addition to plant-based ingredients, microorganisms provide another class of ingredients that can serve as meat alternatives. These include yeast – either whole yeast or yeast extract – and fungus, such as species of *Aspergillus*. These ingredients are often used as they are both highly nutritious as well as impart a savory taste that provides satisfaction in the absence of meat.

Because, Animal's proprietary growth medium addresses scientific, ethical and supply challenges while reducing the cost of production.

Microorganisms can also serve as a technology platform to produce animal protein isolate without the animal. One example of where this technology is currently applied is in making cheese. Rennet – which are a class of enzymes found in the stomachs of some animals – is responsible for curdling milk and ultimately producing cheese. Traditionally, this process involved extracting these enzymes from animal stomachs following slaughter. However, with the advent of cloning technology, such enzymes can be recombinantly expressed using microorganisms such as yeast.²²

Although not yet commercially available, a number of companies are currently in the process of creating more foods – including pet food – made with animal protein produced from yeast rather than the animal.

²² [fao.org/3/y5819e/y5819e04.htm](https://www.fao.org/3/y5819e/y5819e04.htm). Accessed May 14, 2021.

**What
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In the case of each of these it's important to understand that while they serve as a kind of meat replacement, none of these options is meat. It's simple to recognize how plant- and microorganism-based ingredients might replace some function of meat, but that they're not meat themselves. But whether or not an ingredient is actually meat becomes a little less clear when we're talking about an animal protein produced without the animal.

However, meat is much more than protein. Especially when it comes to our pets, protein is only one vital nutrient found in meat. Meat naturally contains not only protein, but also free amino acids such as taurine, essential fatty acids, and a number of vitamins and minerals.

Our cells are fed the same nutrients that cells growing inside of an animal receive - vitamins, minerals and amino acids. Whether those animal cells are growing inside or outside of the whole animal, the nutritional needs of those cells are the same. Among the biggest differences between cultured meat and animal-grown meat is the source of those nutrients: rather than nutrients coming from within the animal, the nutrients used in Because, Animals' cultured meat come from plant and microbial sources.






This proprietary medium addresses the scientific, ethical, and supply challenges of FBS, and reduces the cost of production – a key step towards commercialization of the technology.

Meat contains not only protein, but also free amino acids such as taurine, essential fatty acids and a number of vitamins and minerals.



Cultured meat versus meat alternatives

Unlike plant- and yeast-based meat alternatives, and unlike recombinantly-produced animal protein using microbes, cultured meat is meat. The process of culturing meat is the only way to produce meat without the animal.

	 Plant ingredients	 Fermentation products (think probiotics and nutritional yeast!)	 Insects	 Recombinant (cloned) animal protein	 Cultured meat
Final ingredient	Either whole plants (lentils, pumpkin, etc.) or isolated and concentrated plant protein (soy, pea and potato protein isolate)	Dried yeast, bacteria and other microbes grown via fermentation	Insects and insect larvae, including black soldier fly and cricket	Animal protein produced using bacteria or yeast. A current commercial example is vegetarian rennet found in cheese	Meat
Form	Dehydrated plant material or protein isolate in powder form	Dried powder, such as nutritional yeast	Insect meal	Purified protein isolate or whole yeast cells with animal protein still inside the cell. Both are in powder form	Meat. Can be included in either kibble or wet food
Nutritional profile	Plants contain a number of essential vitamins and minerals. Some protein isolates offer complete protein with all essential amino acids (such as soy) but most do not. Any plant ingredient alone is not nutritionally complete for cats or dogs	A variety of naturally-occurring microbial proteins that are often complete with all essential amino acids. The microbial cells also contain a range of other nutrients, including vitamins and minerals. This ingredient alone is not nutritionally complete for cats or dogs	Depending on the insect, this ingredient may or may not be nutritionally complete for cats and dogs	A single animal protein, likely complete with all essential amino acids. If the protein is isolated or separated from the yeast cells then protein will be the only nutrient remaining. This ingredient alone is not nutritionally complete for cats or dogs	Meat – including cultured meat – is nutritionally complete for cats and dogs
Will it need to be supplemented for pets?	Yes	Yes	Sometimes. Certain insects, such as black soldier fly, do not meet the taurine requirements of cats ²³	Yes	No
Genetically modified	Depends – check label!	Sometimes	Sometimes	Yes. It's impossible to make recombinant protein without GMO technology	Not Because, Animals' cultured meat!
Do dogs and cats like it?	Just like people, many dogs like certain fruit and vegetables and dislike others. Cats tend not to enjoy the taste of plant matter	Yes! These are common ingredients in pet food as they're both nutritious and delicious	Depends on the cat and dog. In the wild, the primary diet of the cat is mouse and small birds, though they will eat insects. Dogs also prefer fleshy animals	If the protein is still inside the yeast cell then cats and dogs should like it. A protein isolate alone will not have a very appealing taste	Yes, it's meat!
How is it made?	Traditional farming. Plant-based materials already represent a large part of modern-day pet food, though not always advertised	Through fermentation. Think about the process of beer making!	Insect farms. Special conditions are needed to make sure insects are safe for consumption – they can be prone to chemical, parasitic and microbial contamination	Through genetic engineering. A gene for an animal protein is cloned into a yeast, which then grows and produces the protein inside the cell	Growing animal cells inside a bioreactor instead of inside an animal. This is very similar to growing yeast cells (such as in beer making!). Because, Animals grows its meat without any genetic engineering (our products are non-GMO), antibiotics or other growth-promoting hormones typically used in animal agriculture

²³ McCusker et al. Amino acid content of selected plant, algae and insect species: a search for alternative protein sources for use in pet foods. Journal of Nutritional Science. 3, (2014).

