The Path to the Bloodless Butcher: *In Vitro* Meat and Its Moral Implications

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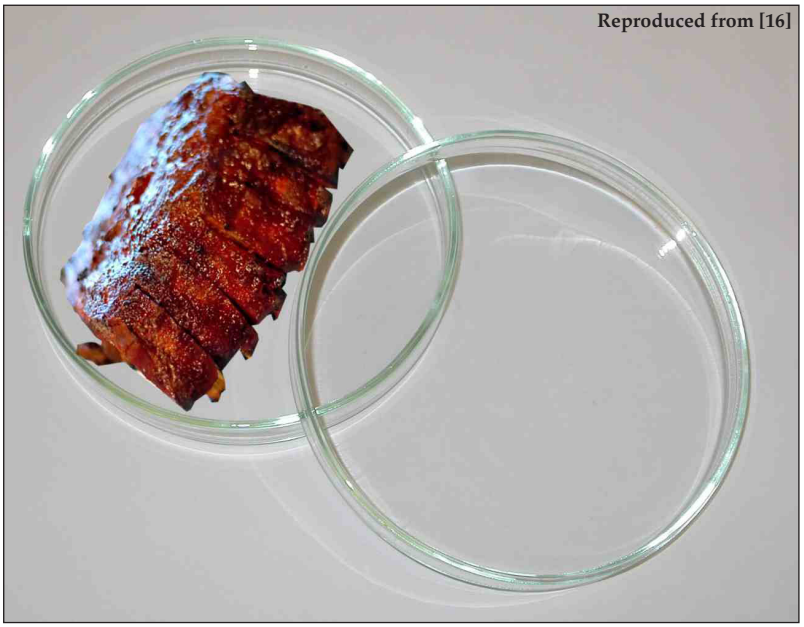
Within a decade, breakfast sausages could originate from a laboratory rather than a farm. In response to demands for safer meat sources following the mad cow disease scare of the 1990s, scientists developed the technology to produce *in vitro* meat. *In vitro* meat refers to animal muscle tissue that scientists grow in a controlled environment. In addition to providing consumers with an alternative food source, *in vitro* meat will generate debate regarding society's perception of ethical food choices. At the crossroads of moral acceptance of *in vitro* meat are two conflicting perspectives: the utilitarian view that people should welcome a food source that will reduce animal suffering and environmental harm and the deontological view that animals have the right to live free from human possession or interference. Despite these conflicting positions, society may ultimately accept *in vitro* meat as one of the most moral food choices, given that animal and human well-being should improve from its adoption.



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Producing laboratory meat is an extension of the established technology of muscle tissue culturing [1]. While there are many potential techniques for producing *in vitro* meat, the scaffold-based method is the most promising, given its experimental success in growing muscle cells [2]. The method produces meat that is suitable for ground products, such as hamburger, sausages, and chicken nuggets [3]. The technology required to replicate more structured meat offerings, such as steaks or pork chops, is still in its infancy. While research in this area is promising, the lack of blood circulation that can provide nutrients to the tissue currently limits meat growth [2].

The scaffold-based process begins with the extraction of livestock myoblasts, precursors to muscle cells, from a live animal by way of biopsy [3]. The cell-donating animal is not harmed in the process. Once the extracted cells divide over several days, they are placed in a vessel known as a bioreactor, along with a culture medium of fetal bovine serum and a scaffold system [2]. The myoblasts grow on the moving scaffold system, mature into muscle cells, and form a thin layer of meat over several weeks [4].

The primary obstacle to the commercial viability of *in vitro* meat production is the $30 per ounce cost of the fetal bovine serum in which the meat grows. This translates into over $1,000 for a pound of meat, compared to current ground beef prices in the $3 per pound range [4]. To overcome this cost impediment, researchers are experimenting with less expensive media, for example, extracts derived from amino acid-rich mushrooms [3]. In initial experimentation, meat growth has actually been greater with the mushroom extract medium than with fetal bovine serum [2]. If this mushroom culture medium proves viable, then competitively priced *in vitro* meat products could become a reality.

Although the development and sale of cultured meat is still years away, there are already divergent views concerning its moral efficacy, even within the animal rights movement. Dr. Peter Singer, a Princeton University bioethics professor and key influence in the animal rights movement, advocates the production of *in vitro* meat because it will reduce animal suffering related to factory farming [5]. However, not all animal rights activists share his view. In 2008, People For the Ethical Treatment of Animals (PETA) offered a million dollar reward to the first person who can design a commercially viable method of producing *in vitro* meat by 2012 [6]. The decision to offer the reward sparked debate among organization members, regarding whether PETA's aim should be to save animal lives or to uphold the general principle that animals do not exist for the purpose of human possession. In essence, this is a dispute between the utilitarian view that has centered on the pragmatic benefits that society could accrue through *in vitro* meat and the deontological view that treating animals as human possessions, even if livestock are subject to mere biopsies instead of slaughter, is morally wrong.

From a utilitarian perspective, *in vitro* meat production would address the principal ethical objections to meat consumption. These objections relate to the view that society should minimize animal suffering and environmental damage that result from meat production in order to maximize the well-being of all sentient creatures. Opponents of meat consumption contend that large-scale industrial farming practices fail to do this. In 2008, the Pew Commission on Industrial Farm Animal Production identified numerous problems with factory farming that cause harm to animals and the environment: intensive animal confinement, the use of chemical inputs, energy and water demands, animal waste, and antibiotic resistance due to the use of antimicrobial drugs [7]. The Commission concluded that current factory farm processes "fall short of current

ethical and societal standards" for animal treatment due to overcrowding and confinement [7]. These are ethical concerns that *in vitro* meat production would alleviate.

The precise impact that *in vitro* meat processes would have on the environment is uncertain. One study has estimated that laboratory meat production would require substantially less land and produce far less greenhouse gas emissions per pound of meat than traditional farming [8]. It would also use less energy than existing beef, lamb, and pork production facilities, and slightly more energy that conventionally produced poultry [8]. However, these findings are based on many assumptions regarding the bioreactor and culture medium used, sterilization and cultivation methods, muscle cell density within the bioreactor, and the scale of production. Therefore, because no one has produced *in vitro* meat on a large scale, these generalized assumptions may not be accurate. However, it is clear that *in vitro* meat processes would produce much less animal waste than all forms of traditional farming. In addition, animal suffering would be greatly reduced, particularly with the use of the scaffold-based system, which would only require livestock biopsies. *In vitro* meat would likely require antibiotics to ensure sterility in the process. However, because the meat would be produced in a closed system rather than an open farm environment, the leakage of antibiotics from the bioreactor, as well as any bioreactor contamination that could cause environmental harm, would more likely be contained within a laboratory [9]. In totality, this evidence suggests that *in vitro* meat offers a morally superior choice to conventional meat consumption that would reduce animal suffering and environmental impact.

> **"*In vitro* meat offers a morally superior choice to conventional meat consumption that would reduce animal suffering"**

If society uses animal suffering and environmental harm as the basis for judging the morality of food consumption patterns, then eating *in vitro* meat may be on par, or even ethically superior, to a vegetarian or vegan diet. With *in vitro* meat production, animal suffering would be virtually eliminated, as the process would only require a minimal number of animal biopsies to provide the necessary cells for meat growth [10]. In comparison, crop harvesting for vegan diets consisting of vegetables, fruits, and grains results in the deaths of about two animals for every million calories of food produced [11]. Compared to conventional meat, these food sources cause virtually no harm to animals.

While no studies have directly compared the environmental impact of *in vitro* meat with vegan diets, statistics from the comparison of these consumption alternatives to conventional meat production suggest that the ecological footprint from producing *in vitro* meat may be smaller. Beef production is estimated to result in approximately 2.7 times the energy use, 48 times the greenhouse gas emissions, and 250 times the land use of *in vitro* production for the same quantity of meat [8]. When compared to growing food for vegan consumption, beef production results in about 2.5 times the energy use, 7 times the greenhouse gas emissions, and 3 times the land use efficiency [12-14]. Crop production also relies on the use of large quantities of fossil fuels, pesticides, fertilizers, and water, while *in vitro* meat production does not.

From a deontological perspective, even if *in vitro* meat reduces animal suffering and environmental harm, the ends do not justify society's possession of livestock when alternative sources of food are available. In the words of Dr. Tom Regan, an animal rights philosopher and a proponent of deontology, animals are "subjects of a life" with inherent value that should not be subject to unwarranted interference from humans [15]. The problem with this view is that it ignores the consequences of existing dietary alternatives. If animal well-being would improve with the introduction of *in vitro* meat due to a reduction in suffering and less harm to their environment, it is difficult to reject this food source simply because animal biopsies are potentially invasive. If a moral approach is based upon concern for animals, ignoring their overall welfare is counterintuitive.

If the well-being of animals and of our planet are our primary moral concerns in choosing what society eats, then the commercial introduction of *in vitro* meat will impact our view of the ethical diet. Although society often views morality as a static code that governs our lives, scientific advances, such as *in vitro* meat technology, undoubtedly change the utilitarian moral landscape by altering the consequences of our decisions. In the future, perhaps further progress in food technology or agricultural processes will again alter our concept of ethical food choices and lead us further down the path to the bloodless butcher. ■

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