In Vitro Meat: A Vehicle for the Ethical Rescaling of the Factory Farming Industry and *in Vivo* Testing or an Intractable Enterprise?

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The factory farming industry is the invisible proprietor of the modern entitlement: one predicated on and distinguished by unsustainable excess. According to the U.S. Department of Agriculture, in 2007 over 10 billion terrestrial food animals were slaughtered in the U.S., accounting for nearly 25% of the world's total of non-aquatic animals killed for food. Additionally, we are becoming increasingly addicted to meat, with American consumption having grown from 234 pounds per person in 1980 to 273 pounds in 2007 (Pluhar, 2009). This unrequited excess comes with several grave consequences: the desensitizing and excessively brutal slaughter of millions of food animals, the development of antibiotic-resistant pathogen strains in immune-compromised animals, and the environmental repercussions of raising livestock, including pollution from their excrement and massive emissions of methane that contribute to global warming.

Emerging in the wake of the necrotic factory farming industry is a new biotechnological enterprise, *in vitro* meat, which enables the production of meat from cells taken from food animals via biopsy that are cultured using advanced tissue engineering techniques. The promise of *in vitro* meat lies in the fact that it circumvents many of the issues of sustainability seen with factory-farmed meat while simultaneously winning the favor of animal rights groups, notably People for the Ethical Treatment of Animals (PETA), for its humane production of meat. However, several obstacles may prove to be insurmountable for the near-future commercialization of *in vitro* meat. The legacy of consumer wariness for foods produced through biotechnological intervention, as encapsulated by the prolific debate over genetically modified foods, coupled with the fetishization of the process of slaughter as a component of meat quality compounds the issue of meat production. Nevertheless, as will be discussed, if *in vitro* meat proves to be successful it may have tremendous promise that translates to several areas of contention for animal rights activism.

To gain insight into why the Western consumer is so dependent on and inured to factory-farmed meat, it is first necessary to understand how

consumer sympathy for animal life is displaced by the presentation of commercial meat products. Meat is commoditized in such a way that "we cannot even tell by looking which part of the animal the tissue comes from" because it is presented to consumers in a way that "avoids triggering horror or sympathy by being sterile and distancing" (Hopkins 2008, p. 580). We are so safely insulated from the production of the meat we consume that few would find it odd that "people can spend nearly as much money on their pets as their own children, oppose animal cruelty, and yet casually eat meat slaughtered from animals" (p. 580).

This dissonance arguably has a deep psychological effect on the consumer as well as meat practitioners, the latter a more explicit manifestation on which slaughterhouse expert Temple Grandin states that "it is not unusual for...employees to become sadistic, literally brutalized by what they must do hourly and daily" (Pluhar, 2009, p. 456). Complicity with the factory farming system assumes anthropocentric ethics that legitimize the most unnecessarily cruel and intensive food animal production techniques, ranging from feeding cattle the blood, brains, and spinal cords of other cattle for cost efficiency to force-feeding of birds to produce *foie gras*. No matter what psychological distance is placed between the consumer and the product, eating meat developed this way can be likened to "eating misery" as Alice Walker writes in her essay concerning animals rights, "Am I Blue?" (Walker, 1988).

At the foreground of animal rights groups against factory farming, PETA champions this cause in a representative campaign against McDonald's, pithily named the "McCruelty" campaign. A brief video on the home page of the campaign's online site depicts the slaughterhouse methods used by McDonald's suppliers. Lurid images of hundreds of chickens hanging upside down in shackles as they have their throats cut while conscious, suffer broken limbs, and are scalded to death in defeathering tanks are juxtaposed with a soft rock song with such lyrics as "free me" and "I didn't ask to be broken or taken here." This juxtaposition attempts the simultaneous effect of horrifying the viewer while appealing to their sympathy, as if to shake him or her from somnambulism with a visceral response to the obscenely cruel imagery. PETA goes on to argue that conversion to less brutal methods would only be a nominal cost to McDonald's, and yet McDonald's refuses to require these considerations from its American and Canadian suppliers.

In addition to animal cruelty, the maintenance of farm animals has a deleterious effect on human health. At an international scale, everyone, even non meat-eaters, is put at risk by the pathogens released from stressed, immune-compromised, contaminant-filled livestock, which are administered routine non-therapeutic doses of antibiotics in their feed. This practice facilitates the development of highly-resistant strains of dangerous bacteria including Campylobacter, MRSA, Salmonella, *E. coli*, and Enterococcus. Consequently, in the United States alone, approximately 70 million are sickened annually by infected food, 5,000 of

them fatally (Pluhar, 2009). Furthermore, Jovian Parry (2009) argues that "risk theory posits that as control exerted by humans over the nonhuman world becomes ever more complete, the risks of catastrophe when that control slips become greater and greater" with reference to the outbreaks of bovine spongiform encephalopathy (BSE), or mad cow disease, in the UK (p. 243). The outbreak of BSE in the UK during the 1990s is thought to be largely attributable to the practice of feeding sheep offal infected with scrapie to cows in order to cut costs and fatten them rapidly. The consequences of this excessive control of efficiency include the mass burning of thousands cattle and, coupled with subsequent BSE crises in the U.S. and other countries, international food scares and a "turbulently declining reputation of meat" (p. 241).

In the wake of the plummeting legitimacy of factory farming, i*n vitro* meat may very well be a feasible vehicle for both the ethical and pragmatic demobilization of the factory farming industry. Hailed by animal activists and meat experts alike as "victimless meat," *in vitro* meat bypasses the moral ramifications of standard meat production, avoiding animal death entirely by typically removing cells from the donor animal via biopsy and cultivating cells in medium containing mushroom extract rather than animal blood serum (Hopkins, 2008, p. 583).

According to Jason Matheny, a researcher at Johns Hopkins and a co-founder of the nonprofit organization called New Harvest that supports the mass production of *in vitro* meat, the production of meat this way is more environmentally friendly than factory farming. He states that the supplantation of factory-farmed meat by *in vitro* meat would reduce the carbon footprint of meat products, largely referring to the bulk methane emissions from cattle. Also, *in vitro* meat is more energy efficient because, as Matheny points out, in meat produced the traditional way, 75 to 95 percent of what is fed to an animal is lost because of metabolism and inedible structures like skeleton or neurological tissue (Madrigal, 2008).

However, *in vitro* meats have had some difficulty in competing with the taste and appearance of slaughtered meat. Early versions of *in vitro* meat included yolk-like blobs of self-assembling muscle fibers and tissue monolayers that were harvested from a synthetic scaffold to make ground meats. However, the innovations to produce more appetizing future meat products are manifold. Tissue engineering experts attempt this by using scaffolds seeded with muscle cells that can firm up the resulting meat and even use edible scaffolds made from biomaterials like collagen that allow for 3-D tissue culture and complex structuring of meat (Hopkins, 2008). Additionally, *in vitro* meat can be engineered to be healthier than slaughtered meat because it is separate from a potentially compromised organism and can also have harmful saturated fats replaced by healthy fats, like omega-3 (Midgley, 2008). As projected by the first *In vitro* Meat Symposium in 2008 held in Aas, Norway, the first commercial *in vitro* meat products will be available in the next 5 to 10 years at prices competitive with European beef (~$5,200-$5,500 per ton or 3,300 to 3,500

euros), and this is made possible by large tissue culture bioreactor facilities (Madrigal, 2008).

In addition to such organized support for the commercialization of *in vitro* meat, PETA is a tremendous advocate for the enterprise and is offering a $1 million reward to the first group to develop an *in vitro* meat product for commercial use. However, the reception of *in vitro* meat spurred a "'near civil war'" among PETA offices between "purist animal rights campaigners [who] abhor absolutely the idea of eating meat, even if no animal died to produce it" and regard it as "a moral surrender" and members more inclined to compromise (Midgley 2008, p. 1). The latter group concedes that "since human beings seem unlikely to ever kick their meat-eating habit, [*in vitro* meat] may be the ideal—indeed *only*—compromise" (p. 1).

There is little or no doubt that large-scale production of *in vitro* meat is a much more desirable and sustainable alternative to factory farming. However, it is questionable whether these commodities will be well-received by the average Western consumer, who has a legacy of distrusting biotechnological intervention in food production. In the particular case of meat, meat experts identify a thought complex held among culinary experts and the common consumer alike that the raising and slaughter of meat animals is a "natural" process that is inextricably coupled with the quality of the meat produced. This is meat fetishism, a once dormant complex that is rising to the surface of social consciousness in response to being extensively challenged in recent decades. Consequently, placid images of cleanly cut, sterilized supermarket meat are occasionally supplanted by such phenomena as "[c]elebrity chefs slaughter[ing] animals in front of live studio audiences," "journalists 'adopt[ing]' calves and follow[ing] their progress…before eating them," and "documentaries extol[ing] the spiritual benefits of raising and slaughtering one's own animals" in a demonstrative attempt to legitimize and preserve the culture of slaughter (Parry, 2009, p. 242).

Additionally, the prolific debate over genetically modified (GM) foods may aptly portend the reception of *in vitro* meat products. Of the varied anti-GM discourses, the anti-scientific faction is rich with slogans denouncing "'contaminated DNA,' 'genetic pollution,' and intrusion into our foods of 'alien genes' and 'foreign genes'" despite the fact that single, well-characterized genes are introduced in GM foods at a time in a precise and managed process (Gusterson, 2005, p. 114). Analogously, *in vitro* meat will face challenges of acceptance among consumers who view biotechnological intervention as an unnatural and therefore untrustworthy process.

An apparent circumvention of these beliefs can be seen in the popular representations of *in vitro* meat. The web is rife with imagery of *in vitro* meat, be it in science blogs or casual web articles, that portray this near-future commodity as a single well-structured, appetizing slab of meat isolated in a flask or beaker. This juxtaposition attempts to simultaneously

evoke a visceral response from the potential consumer base that is highly dependent on meat products while portraying the context that the meat is produced in as immaculate and of trustworthy design and origin. This imagery contrasts greatly with the unappetizing, yolk-like blobs or sheets of meat previously described, and such circumvention of conventional views of biotechnologically-produced foods may prove to make *in vitro* meat more appealing to consumers in the near future.

If *in vitro* meat proves to be a successful enterprise that facilitates the rescaling of the factory farming industry, the impact of its success could have a resounding effect on other areas of contention for animal rights. Particularly, it could impact current tissue culture practices in which model organisms are usually killed for the acquisition of primary cells and also change *in vivo* animal testing paradigms for biomedical applications. To appreciate the possible impact of *in vitro* meat on biomedical research, it is necessary to focus on what makes it unique in the legacy of tissue culture and explantation. Having its origins in the early 1900s, tissue culture far preceded animal rights activism (which largely emerged in the late 1960s). *In vitro* meat is thus arguably the first instance of an *in vitro* tissue culture application in which ethical considerations for animal rights are an integral basis for the development of the field. This is evidenced by the effort and attention paid by *in vitro* meat specialists to develop more efficient and sterile methods of biopsy and developing an animal blood serum-free medium in which to cultivate cells.

Given the success of *in vitro* meat, its techniques and protocols may thus have a feedback effect on tissue culture and animal testing. In the biomedical context, improved biopsy techniques may promote the isolation of primary cells from model organisms while avoiding the death of the organism when it is not inconvenient. Similarly, support and funding for *in vitro* meat development will have a transformative effect on tissue engineering, and thus tissue-engineered organs and organ systems from model organisms may become more accessible to researchers such that they supplant the need for *in vivo* testing in several instances. In these ways and with respect to the factory farming industry, the potential of the *in vitro* meat industry is enormous and can lead to the progress on other animal rights issues. Ultimately, *in vitro* meat may make an appreciable contribution to a more sustainable world and effectively combat the anthropocentrism that not only endangers other life on Earth but hinders human beings as well.

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