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Factors influencing the expansion of Meatless Meat

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This is the third in a series of six articles from the author's master's thesis about plant-based meat. Previous articles in this series are: farmdoc daily, July 22, 2021 and July 29, 2021.

Introduction

As the meatless meat industry seeks to expand its market, a number of factors will influence its success. This article discusses two main factors: consumer acceptability – whether consumers are willing to eat and substitute meatless meat – and economic feasibility – whether companies can drive down production costs in order to price their products competitively with animal meat. Current research indicates that consumers are more willing to substitute plant-based meat than lab-grown meat, but the majority of U.S. consumers are not yet willing to substitute for meatless meat. A major hurdle that both plant-based and lab-grown industries face is achieving price parity with meat.

Consumer Acceptability

In order for the meatless meat industry to achieve its stated goal of supplanting the meat market, consumers must accept the products as substitutes for meat. Researchers started surveying consumers on this question approximately five years ago, and initial findings suggest that approximately 25-30%[1] of customers are willing to do so.

Studies about the acceptability of meatless meat ask two types of questions: 1) would consumers be willing to regularly eat meatless meat products, and 2) what is consumers' willingness to pay for these

[1] This figure is an approximate mean of the findings from consumer preference surveys. It also implies an expanded market for meat products, since alternative meats will also cause new consumers who were not purchasing meat to begin to purchase meat alternative products (Lusk, 2020). The state of the research does not yet point to a specific breakdown of what proportion of the alternative meat market will be cross overs from animal meat, and what proportion will be completely new consumers.

products.[1] The majority of the studies concern North American and European consumers. Because meatless meat products are not yet widely available on the market, the studies have relied on hypothetical choice scenarios related to purchasing meat.

For lab-grown meat, the current research estimates consumer willingness to substitute to be anywhere between 5% and 32%. Three studies surveyed U.S. consumers on this question. One study reported that 32.6% would be willing to regularly eat lab-grown meat, and 31.5% would be willing to substitute it for animal meat (Wilks & Phillips, 2017). A second study, which incorporated consumers' willingness to pay along with consumers' willingness to substitute, found that 17.2% of consumers would substitute lab-grown meat for regular meat if it cost the same and was the only meat alternative on the market. That number would go down to 10.6% if plant-based meat was available, and further down to 7.9% if both substitutes cost a dollar more than meat (Slade, 2018). A similar study which incorporated marketing messages found that only 5% of consumers would opt for lab-grown meat when given the choice between beef, plant-based beef, lab-grown beef, or no purchase (Van Loo et al., 2019).

The substitutability rate is higher for plant-based meat, though research findings still range widely. An online survey found that nearly 33% of U.S. consumers reported that they would be extremely likely to purchase plant-based meat, and another 41.8% were slightly or moderately likely, if it was widely available on the market (Bryant et al., 2019). A different survey found that 24.7% of U.S. consumers would substitute plant-based meat for beef if it was the only meat alternative on the market and cost the same price as beef (Slade, 2018). This share would drop to 20.5% if lab-grown meat was also offered at the same price on the market, and would further drop to 14% if both alternatives were $1 more than animal meat (2018). In the study about marketing messages, 23% of people opted for plant-based meats, and various marketing messages did not change this proportion of the market (Van Loo et al., 2019).

This initial research suggests that a significant population in the U.S. and Europe would switch to meatless meat if it was widely available on the market and priced competitively with animal meat. For plant-based meat, 20-33% of consumers would use it as a meat substitute if it was priced competitively with meat. For lab-grown meat, research suggests that 5-17% of consumers would make the switch. Since these two products would be competitive with each other, the estimate for total meatless meat market share is somewhere between 25% and 30%. Still, these initial studies suggest that the majority of U.S. consumers are not willing to substitute these products for animal meat, even if they did cost the same. Notably, during the early months of the pandemic when grocery stores across the U.S. faced meat shortages, sales of plant-based meat did not go up, despite the increased incentive to substitute (Lusk, 2020).

It is important to remember that these figures do not reflect consumer sentiment as influenced by commercial marketing. A couple of the studies considered subjects' behavior changes after exposure to certain marketing messages, but they do not simulate the influence of repeated exposure to attractive advertisements. Still, these studies offer initial insights about consumers' reactions to marketing messages. The survey referenced previously exposed American online shoppers to four different types of information about the products: the product descriptions (beef, plant-based meat made from pea protein, plant-based meat made from "animal-like" protein, or lab-grown meat), brand names ("Certified Angus Beef," "Beyond Meat," "Impossible Burger," and "Memphis Meats"), claims about products' environmental impact, and details of the technology used to create the products. The study found that exposure to brand names compelled 8% of consumers to switch from their original choice of meatless meat to beef. The messages regarding environmental impact and technology compelled a small percentage of people who originally opted not to purchase any product to purchase a meatless meat product.

Research studies also provide insights about the reasons for consumers' aversion to meatless meat products. A 2019 study (Bryant et al., 2019) focused on which marketing messages improve consumers' perceptions of lab-grown meat, which lags behind plant-based meat in hypothetical consumer acceptability. Consumers were presented with four different messages about meat: "Clean meat is natural," "Conventional meat is unnatural," "Naturalness is not important," or a fourth about lab-grown

[1] It is important to note that another genre of studies focuses on consumers' sensory acceptability of meatless meat products. The studies surveyed in this article assume that meatless meat products taste the same as meat.

meat's benefits without mention of natural qualities. The researchers found that only the message "conventional meat is unnatural" improved consumers' perceptions of lab-grown meat and their willingness to pay more for lab-grown meat over regular meat. The researchers also went so far as to say that marketing attempts to change consumers' opinions about the "naturalness" of lab-grown meat would be futile, based on their findings. Two other studies, by the Institute for Environmental Decisions (Siegrist et al., 2018) and Ghent University (Verbeke et al., 2015), support these findings, suggesting that the main roadblock to greater acceptability of lab-grown meat is that consumers perceived lab-grown meat as unnatural and therefore disgusting (Siegrist et al., 2018).

In 2020, the Good Food Institute published a report to predict the dynamism of consumer acceptability in response to mass marketing. The report applied Diffusion of Innovation Theory to predict the rate at which reluctant consumers will switch to meatless meat. This theory categorizes a population into different groups based on their willingness to adopt an innovation, and states that the groups will adopt an innovation sequentially, on the condition that the innovation is "perceived to be of lower social or economic costs, that provide a good fit with values and current practices, and [is] of low complexity" (Encyclopedia Britannica, 2016). The report uses data from a 2019 study by Bryant et al. to predict that 18-33% of the population will be 'early adopters' of meatless meat products, with this segment's demographics disproportionately male, Millennial, Hispanic, urban, politically liberal, educated, and higher income in relation to the rest of the population (Szejda and Urbanovich, 2020). The report also asserts that the entire population will eventually adopt meatless meat, which could be an overconfident application of Diffusion of Innovation Theory. The Theory is contingent on certain aspects of the innovation, including cost and consumers' values, and there have been plenty of innovations which have not been adopted by the entire population.

Economic Feasibility

The meatless meat industry's ability to price its products competitively with animal meat is the second key to its success. The high rate of estimated consumer acceptability depends on the price parity with animal meat, and achieving price parity depends on the industry's ability to scale up production. Currently plant-based meat prices are approximately $1 above hamburgers when sold at restaurants,[1] and up to three times the price of animal meat when sold in grocery stores.[2] However, in response to animal-meat shortages during the COVID-19 pandemic, both Beyond Meat and Impossible Meat lowered their prices (McClain, 2020) (Watson, 2020). Lab-grown meat is not yet available on the market so the retail price is not yet set. The research to grow the first hamburger cost 250,000€ (Mosa Meat, 2020), and with the current technology it costs more than $15,000 to grow a kilogram of meat in a lab (Specht, 2020). Business press estimates of the initial market price for lab-grown meat – projected to hit the market in 2021-2022 – range from $10 to $50 per pound (Lucas, 2019) (Axworthy, 2019) (Purdy, 2019).

The market capture permitted by consumer acceptability hinges on the industry's ability to develop production technologies which produce sundry cuts of meat at competitive prices. According to the Good Food Institute, the industry has just "scratched the surface" of optimizing its production process, with the ultimate goal being a more efficient conversion of raw material calories to consumable calories (Allen, 2018). A popular technique involves a high moisture twin-screw extrusion process, which creates new covalent bonds among the plant proteins, forming fibers akin to meat (Wild et al., 2014). These fibers are then used as the main ingredient in the product, with flavorings and further processing to create a final product. An advantage of plant-based meat is that it can have a longer shelf life than animal meat (Kyriakopoulou et al., 2019).

The cellular agriculture industry faces major technical hurdles to scaling and commercializing lab-grown meat products. Cuts of meat have been grown successfully in laboratory environments, but the

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[1] In downtown Chicago, a Whopper meal at Burger King goes for $8.09 while an Impossible Whopper meal $8.59. In Springfield, IL, they go for $7.29 and $8.29 respectively. At Hardee's in Springfield, the Beyond Burger goes for $7.34 while a regular burger of the same size goes for $6.57. (March 2020 prices)

[2] At a grocery store in Champaign, Illinois, Beyond Meat is offered at $5.99/8oz. Impossible Meat made its grocery store debut in California in August 2019, where it went for $8.99 per pound, which was three times that of a pound of beef.

technology has not yet been developed that would manufacture lab-grown meat on a large scale. The prototypes of the equipment that would be used for large-scale lab-grown meat come from the lab-grown therapeutics industry (Specht et al., 2018), which grows organs individually. To this end, the lab-grown meat industry needs to develop equipment for commercial production, such as a bioreactor for the controlled growth of large volumes of cells, and micro-scaffolding for the structure of different cuts of meat (Stephens et al., 2018). Bioengineering research also needs to enhance the industry's ability to control cell differentiation, as well as develop cost-effective formulas for cell growth media. According to a production analysis conducted by the Good Food Institute, the cell growth medium accounts for 55% to 95% of the marginal production costs (Specht, 2020). It is also important to note that different types of media are needed to grow different types of animal cells, and that the same type of medium may not work for the entire growing process of a piece of meat (Bhat et al., 2014).

Start-ups and research institutes are mobilized to tackle each of these challenges. The Good Food Institute has produced models for cell media production which would reduce the cost from $400 per liter, the market price, to $0.24 - $40.94 per liter (Specht, 2020) if produced in-house.[1] A group of researchers at Northwestern University recently developed a formula for a stem cell medium which can be produced at 97% less cost than the market varieties (Kuo, 2019). The world's first industrial factory of lab-grown meat is scheduled to start operation in the Netherlands in 2020, a joint venture between Mosa Meats, Nutreco, and Low Capital Carbon (Mosa Meat, 2020). Based on the high level of investment and the projections of start-up companies and research institutes, it is highly likely that lab-grown meat will become available in the U.S. in the next decade. The USDA and the FDA are poised to oversee its production in the U.S., planning to split regulation between its two production phases. The question remains whether the industry can reduce the costs of production by scaling and innovating, because there is no evidence that it has overcome the technical barriers to doing so yet.

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[1] These models assume 20,000L of this medium to grow 3,500 kg of meat (Specht 2020).

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