Animal-Free Meat, Milk and Eggs

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Written by:

Mike McMorris and Chloe Neudorf
Livestock Research Innovation Corporation

Contributing editor:

Michael Von Massow

Food, Agricultural and Resource Economics at the
University of Guelph

What is it?

Two significant trends are bringing new competition into the market for Ontario livestock products. These trends are:

- **Plant-based proteins** have long provided an alternative to animal protein, but we are seeing the development of animal product analogs which mimic the taste and experience of traditional meat products. Plant-based milk alternatives are well established in the market and plant-based protein products are experiencing significant growth.
- **Cellular agriculture** involves the culturing of cells or fermentation to grow specific products or food ingredients without the requirement of an animal. Lab grown chicken nuggets are available for purchase in Singapore and “milk proteins” produced through fermentation are already being used in vegan frozen desserts in the United States. The technology allows for the production of traditional products without large scale animal use (cell cultures need to be harvested from animals for some products but others are produced through fermentation).

Consumers may be attracted to these products for several reasons including animal welfare, environmental impact, health, and/or novelty. It remains unclear what the future of these products is. For cellular agriculture, the technology is still emerging.

Why it matters to the Ontario livestock industry:

While the true long-term potential for plant based and cellular agriculture products remains unclear, the Ontario livestock industry is facing new competition. It is clear, however, that these competitors are rising and will continue to grow. The rate of growth and end point in terms of share will depend on consumer acceptance, new product development, and the ability to scale up production of some new products. It is critically important that the individual sectors within the livestock industry understand the strengths and weaknesses of these new competitors. It is also critical that the livestock industry understand its own strengths and weaknesses and to work to continue to provide cost effective, healthy, and safe products while minimizing its environmental footprint.

What do we know?

Livestock production like most human activity does have an impact on the environment. When not eaten in moderation and as part of a balanced diet, livestock products can also have a detrimental impact on human health. The livestock sector is often wrongly viewed as one entity whereas highly productive systems (e.g., Ontario) carry a much lower environmental impact per unit of production than low productivity systems found in many other countries. Ontario’s livestock producers have

decreased their impacts on the planet and will continue to do so. From a human health perspective, we enjoy some of the safest food in the world and from an animal welfare perspective, industry has made many improvements. The industry will continue these improvements into the future. It remains important to be able to tell the story of these improvements and to advocate for the benefits of the products we bring to the market.

Plant-Based Products

Two of the most innovative and successful plant-based meat companies, Beyond Meat and Impossible Foods, have large followings and make highly effective use of social media. Makers of the Impossible Burger shared that their carbon footprint is 89% smaller than its beef counterpart (Wonder, 2019). Along with this they, claim that land used is 96% less and water use 87% less when producing their animal-free plant-based burger (Wonder, 2019). While these statistics sound amazing, there is little substantiation in the marketing material. There has been substantial investment in plant-based companies. We have also seen companies that have traditionally been focused on livestock-based products expand into the plant-based space. Maple Leaf Foods bought Lightlife, a plant-based products company to complement their animal-based offerings. Cargill has also stepped into the plant-based market and now offers plant-based patties and ground products with a plan to expand offerings as they develop them. The milk market has seen a proliferation of new competitors including almond, oat, soy, and other beverages. These products continue to evolve and it is clear that they have an established place in the market.

The science of animal-free products has evolved. Some plant-based burgers now have an ingredient called heme. There are many types of additives that are used to improve the texture and appearance of animal-free products, heme is one of them. Heme is a natural molecule that causes the burger to appear to ‘bleed’ and helps give the appearance of raw meat as it looks like red blood cells (Ferreira, 2013). When imitating a livestock-derived product certain ingredients are needed to make the components bind together well and taste good. Ingredients such as starches, thickeners, emulsifiers etc. are used to create a favourable product. Additionally, there are ingredients like soy, wheat, pea, and fava bean proteins which are needed to provide protein so they can be used as substitutes for traditional livestock meat, milk, and eggs.

There is concern that some animal-free products are in fact highly processed foods which carry their own health concerns. Producing animal-free meat, milk and eggs is a long process which can include high-moisture extrusion and shear-cell technologies (Lamas, 2021). These specific technologies work to mimic the appearance and texture of meat. For some consumers, products that mimic the taste and feel of the products to which they are accustomed may make it easier to try and/or switch to these products.

Cellular agriculture remains in its infancy. Early products are on the market but there remain questions about the true potential of these products. A recent article in The Counter, suggests that lab-grown meat is too expensive to invest in and the hype over this new opportunity and technology is far bigger than the reality of it hitting the shelves (Fassler, 2021). The investment needed to bring this to scale is too high and technical issues regarding large scale production are limiting (Fassler, 2021). He suggests that it would be much more cost effective to focus on limiting food waste than producing animal-free products in a lab. On the other hand, there has been significant investment in the cellular agriculture space. Some estimates suggest that there has been over $7 billion USD of investment in cellular agriculture companies globally. Canadian investors are also active. The Canada Pension Plan Investment Board invested $50 million USD in Perfect Day, the US company fermenting dairy proteins who now have products in more than 5,000 stores across the US and Japan.

Time will tell what impact animal free products will have in the food marketplace. Currently, alternative proteins account for about 2% of the meat, milk, and egg market (Wonder, 2019). One estimate is that, globally, alternate proteins have potential to secure over 10% of the meat and dairy markets (Wonder, 2019). The true potential remains uncertain but there are those that believe that these products are poised for significant growth. Some analysis suggests that cellular agriculture will represent $95 billion USD in global revenues by 2030. There is reason to pay attention to these products in the coming years.

Diversifying the protein market has some beneficial environmental benefits. It can build resiliency to climate change and can help with food insecurity. It can also diversify the market and give consumers with different priorities products that fit their needs.

Deb Stark a Canadian Agri-Food Policy Institute board member encourages the agriculture industry to watch and be conscious of the changing food system as cellular agriculture and lab-grown meat, milk and egg products enter the food industry (2021).

What can livestock farmers do?

Livestock farmers must understand their own production impacts and work to continuously improve. They need to address consumer concerns regarding human and planet health as well as animal welfare. Farmers should understand their competition and, when possible, be able to provide factual information about both animal and animal-free production and products.

Consumers will drive the adoption of new food products. It remains critical for livestock producers to understand the current and emerging priorities of consumers and adapt to meet those demands.

History of Animal-free products

- Plant-based protein options have been around for a very long time outside of the western world. Seitan (wheat based), tofu (soy-based) and tempeh (also soybean-based) food has been popular in Eastern cuisine for a very long time (Wonder, 2019).
- In 1889 Dr. John Harvey Kellogg is believed to have created the earliest imitation meat in North America (Wonder, 2019). A member of the Seventh-Day Adventist Church, Kellogg believed, as did many in the church, that animal-based foods create animalistic urges within humans. Kellogg set out to create a product called Protose which was made from peanut butter, mashed beans, water, corn starch, onion, sage and salt (Watson, 2021). This bland protein alternative was created to encourage a diet focused on bland foods to distract from sin.
- An exposé of the meat packing industry was released in 1906 by Upton Sinclair who revealed how sausage was being made with risk of contamination (Wonder, 2019). Unintentionally Sinclair's exposé expanded the vegetarian movement to those outside the Seventh-Day Adventist Church which later introduced more variety of plant-based meat replacements. (Watson, 2021).
- The Adventists, in pursuit of a less sinful diet, founded Loma Linda Foods in 1931 (Wonder, 2019). Loma Linda Foods was first to produce commercially available soy and wheat-based meats for American consumers.
- In 1932, Winston Churchill predicted, in an article titled "Fifty Years Hence", "*We shall escape the absurdity of growing a whole chicken in order to eat a breast or a wing, by growing these parts separately under a suitable medium*.".
- Diet for a Small Planet was published in 1971 and was a bestselling book written by Francis Moore Lappé (Haberman, 2020). This was a pivotal piece of literature showcasing the environmental impact of meat production and naming the Livestock Industry to be a contributor to global food scarcity. Including the founder of Tofurky, a plant-based meat company.
- Responding to Diet for a Small Planet, Seth Tibbot created animal-free alternatives (Haberman, 2020), the most famous of which being the Tofurky.
- In 1981 The 'Gardenburger' was created and placed on the menu by a restaurant owner in Oregon (Wonder, 2019). The Gardenburger was made from vegetable and rice pilaf. The quintessential American food on almost every menu was now available plant-based.
- In 2002 Burger King created the BK Veggie Burger with Morningstar Farms, a subsidiary of Kellogg Company (Haberman, 2020). The burger did very well with many customers mistaking it for a regular beef burger.

- Beyond Meat first launched in 2009 and Impossible Foods two years later out of Silicon Valley (Wonder, 2019). These companies are very well known in the media and plant-based market, both competing to create good tasting meat alternatives.
- In 2013 the first meatless mock-up for a lab-grown burger was developed from cow muscle cells, blood, and antibiotics by Dutch Scientists (Haberman, 2020).
- In 2020, cultured chicken was introduced to the menu of a restaurant in Singapore.

Market Change

- Consumers continue to develop more interest in food production. This drives changes in demand.
- There is greater dispersion between consumers. This doesn't mean that individual consumers want more choice but that different consumers want different things. Industries that understand these changes and respond to them will be successful. 'One size fits all' will not work and niche production will be essential for success.
- Livestock is the market leader and will be for a long time. Competitors will be looking to take away share of plate. Reinforcing the strengths and benefits of traditional livestock products and adapting to provide products that are of interest to consumers will be key to maximizing long term share.

Research Gaps

- The feasibility of fermentation and cell culture at commercial scale
- Understanding, commercializing, and adoption of tools and technologies to continue to reduce livestock's current impact on the environment
- Health impacts of highly processed plant-based products
- Consumer attitudes relative to cellular agriculture and things like gene-editing in livestock
- Continuous monitoring of consumer preferences and priorities and implementation of plans to meet those going forward.

Innovation Gaps

- Niche products to meet specific consumer segments
- Potential for blended products to meet consumer demand and maintain share

For more information

1. Michael Von Massow, Professor, School of Food, Agricultural and Resource Economics, University of Guelph

   See Michael's blog and podcast which hosts conversations and perspectives on issues of interest in the food system: *https://www.foodfocusguelph.ca/*

2. LRIC at info@livestockresearch.ca or 519-766-5464.

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