



Cultured Meat: What's the Beef?

Craig Gifford, Extension Beef Cattle Specialist

Introduction

In the past few years, cultured meat has received a lot of attention. Indeed, several prominent food companies have invested in start-up businesses that produce cultured meat-like products. However, the concept is not new. Winston Churchill in 1931 postulated: “*We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium*” (Churchill, 1931). Since that time, scientists have searched for ways to make laboratory grown meat feasible. The world’s first cultured meat hamburger was made in 2013 and costs thousands of dollars (Post, 2014). The self-proclaimed benefits of cultured meat are that it has the potential to be more environmentally friendly and more humane than traditional animal-based products. The environmental impacts and animal welfare considerations of meat production is beyond the scope of the current newsletter, but both topics warrant debate. Nonetheless, cultured meat products are certain to gain more attention and perhaps prominence in the coming years.

Myosatellite Cells

Before discussing the cells that are used to generate cultured meat products, it is important to understand the generic term “stem cells”. Embryonic stem cells are cells that can give rise to essentially any other type of cell in the body. Adult stem cells, which are also present in young animals, are typically used by the animal to replace damaged tissue or generate new blood cells. As such, they are more specific and can only generate the type of tissue they derive from, muscle for example. During embryonic development, an animal will develop all of their skeletal muscle cells prior to birth. After birth, the animal generally will not grow additional muscle cells unless suffering a muscle injury. In the event that muscle repair is required, myosatellite cells are the primary adult stem cell in muscle and can be used to generate new muscle fibers. According to the websites of several companies growing cultured meat products, myosatellite cells are the primary cell type that is used to grow laboratory-based meat products. The first step in generating laboratory grown meat is to collect a biopsy from the muscle of the animal and use enzymes to dissociate the myosatellite cells from the rest of the muscle tissue. Once the myosatellite cells are isolated, they can be grown for cultured meat products.

Growing Cells for Cultured Meat

Myosatellite culture has gained interest from both cultured meat companies as well as scientists who are attempting to grow muscle tissue for medical applications. As such, advancements in culture techniques are occurring rapidly (Syverud et al., 2015). Once the myosatellite cells are purified, they are transferred to large vats or bioreactors where they are provided appropriate nutrients via a liquid culture media for cell growth and proliferation. Once enough cells are grown, they are “differentiated” into myotubes and ultimately form a crude muscle fiber. According to Mosa Meat’s website (mosameat.com), one small biopsy from a cow will provide enough myosatellite cells to grow 80,000 quarter pound hamburgers. However, from a tissue engineering perspective, developing a muscle tissue that is similar to that observed in an animal is more complex. Syverud et al. (2015) note that myogenic potential (ability to form muscle cells) rapidly decreases after approximately 2 weeks in culture. Though the cultured myosatellite cells can replicate up to 50 times (Gaster et al., 2001), it appears that the ability to differentiate those cells into something that resembles muscle begins to decline. The loss of myogenic ability, is potentially limiting for development of products other than those mimicking ground meat products. Additionally, animal muscles are composed of many other cell types that provide the structure and nutrient delivery for muscle growth and maintenance. Replicating blood supply, support cells, fat cells, etc. poses a challenge to developing products beyond those that mimic ground meat (Kadim et al., 2015).

The culture media is also a key consideration in feasibility and acceptability of cultured meat products. Myosatellite cells are very metabolically active and require extensive nutritional support. The composition of media for culturing myosatellite cells has traditionally contained fetal bovine serum (Danoviz and Yablonka-Reuveni, 2012). Fetal bovine serum is harvested from fetal calves during slaughter of pregnant cows and is rich in nutrients, hormones, and growth factors required to support cell growth in culture. Several companies are striving to eliminate fetal bovine serum from their culture media, and some claim to have done so (mosameats.com). It should be noted that, unless treated, fetal bovine serum contains estrogen, and estrogen is a key compound used in growth-promoting implants for cattle. If fetal bovine serum is used to culture the myosatellite cells as suggested by Danoviz and Yablonka-Reuveni (2012), then the amount of estrogen in the culture medium would actually exceed the amount of estrogen in the blood from implanted steers (Smith et al., 2018). Though the serum-free media that cultured meat companies use are proprietary, it is very likely that they include additional growth factors or other hormones in the media to support cell growth in the absence of fetal bovine serum. In preparation for this newsletter, requests for information regarding exogenous hormones in the culture media were unanswered.

Regulatory Issues

There are 2 main discussions surrounding regulation of cultured meat products: 1) Can they be called meat? 2) Who regulates them? Neither of these considerations are trivial to the future of cultured products. The term “beef” for cultured meat products is being challenged by industry groups like the National Cattlemen’s Beef Association who maintain that the *“term beef should only be applicable to products derived from actual livestock raised by farmers and ranchers”* (beefusa.org). For regulation of the product, there is not a clear jurisdiction and could fall under the FDA’s Center for Food Science and Applied Nutrition (CFSAN) or the USDA’s Food and Safety Inspection Service (FSIS). The regulatory jurisdiction may depend on what the product is labeled as. If labeled as meat or meat

product, then it seems more likely to fall under USDA guidelines. Currently, USDA FSIS process involves USDA inspection of every carcass, continuous inspection of meat products through the system, and a subsequent “USDA Inspected and Passed” label. The FDA system is less labor intensive and likely cheaper to implement because the USDA process involves USDA Inspectors at many of the steps in the processing system.

Future Considerations

It isn't clear at the moment how the culture conditions will be monitored and the safety of those products will be evaluated. New products to promote growth and efficiency of livestock must undergo years of intensive experimentation with federal oversight to receive approval for use in food animals. Aside from time, the process requires millions of dollars of input from the company developing the product. There are also growing markets for all-natural, hormone-free, organic, etc. It begs the question that if cultured meat products are administered hormones or growth factors in the culture media, can the cultured products be considered all-natural? Additionally, will every current ingredient in the culture media and every minor change to the media be subject to the same scrutiny as current and future growth promoting technologies for livestock? Will cell culture media have the same regulatory limitations with respect to compounds that can be used in the media, as compounds that are limited for use in food animals? The rise of cultured meat products has clearly entered a new area in food production, safety, and regulation with no clear answers to numerous questions.

References

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UPCOMING EVENTS

5–States Beef Symposium and BQA Training

Thursday, November 15

Clayton, NM

Cattlemen's College

Wednesday, December 5 – Sandia Resort & Casino

Bernalillo, NM

Southwest Beef Symposium

January 16 – 17, Tucumcari Convention Center

Tucumcari, NM

Happy & Safe Halloween – October 31st



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