Food Security: Foodborne Pathogens in Preharvest and Postharvest Livestock Research

Background

Foodborne pathogens remain a constant threat to consumers and are responsible for an estimated 48 milion illnesses every year. Symptoms can range from mild and transient to fatal, with an estimated 3,000 deaths in the U.S. per year. Natural gut flora present in healthy animals can be a significant cause of human illness because of contamination during slaughter and processing. Products prepared by combining harvests from multiple animals are especially vulnerable since large batches may be contaminated from just a single source. Sources of contamination from imported products can be especially difficult to identify. In addition to health impacts, economic consequences can be substantial with potential closure of processing facilities and product recalls.

Description

The Biosecurity Research Institute, or BRI, at Kansas State University's Pat Roberts Hall has a highly unique capability for research on raw and further processed food, primarily meat products, in secure high containment. A dedicated food security and food processing area of over 2,500 square feet includes an industry-standard slaughter floor and is fully equipped with standard meat processing equipment. A unique, purpose-built carcass-scale electrostatic spray chamber designed for controlled product inoculation and efficient application of food-grade antimicrobials is also located in the area. To provide additional containment, some large equipment can be housed in transparent plastic biobubbles that not only control dissemination of aerosols, but also enable rapid decontamination procedures. These facility features and validated operational protocols enable research on highly infectious and potentially lethal pathogens that can be precisely introduced into the food production process at multiple points. This can include the preharvest infection of livestock with subsequent slaughter and processing, to contamination of postharvest products, such as ground meat products. Most processing equipment is movable enabling significant containment space to be used for large equipment needed to research other food commodities — e.g., produce and grain-based foods. Analysis of samples collected during processing is performed in dedicated laboratory space within the food wing. Contaminated carcasses and other animal waste are ultimately disposed of using a 5,000-pound capacity alkaline hydrolysis tissue digester, autoclaves and effluent disposal systems.

Ongoing U.S. Department of Agriculture-funded research includes large-scale studies on highly pathogenic Shiga toxin-expressing *Escherichia coli*. Previous projects have included Department of Defense-funded research to develop detection and identification technologies for organisms such as *Bacillus anthracis*, or anthrax, and *Yersinia pestis*, plague, that could be deliberately introduced into the food system, posing great risks to the public and our military.

The BRI is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. Uniquely, however, the BRI supports the systematic evaluation of pathogen responses in various food products: from live animal or food crop, through processing, to final consumer-ready products within one biocontainment facility. The BRI is the designated facility at K-State for work on organisms classified by the U.S Government as select agents, or SAs. One of the defining factors for SA designation is that these agents have the potential for weaponization. As such, they are of high priority and require highly specialized facilities and highly trained and approved personnel to ensure constant accountability, safety and security.

Relevance

The mission of the BRI is "Leading through research and education to protect agriculture and the public from biological threats." This mission is epitomized by the BRI's unique integration of interdisciplinary work on pathogens that contaminate food and infect livestock, people, and plants.

The primary purpose of research in the food wing is to improve the understanding of risks associated with the food system, and to develop diagnostics and manufacturing processes that can better detect, quantify and neutralize pathogenic food contaminants that threaten agriculture and public health.

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