Enhance Protection and Safety of the Nation's Agriculture and Food Supply

Reduce the incidence of food-borne illnesses and contaminants through science-based knowledge and education

KA 712, New technologies and programs to enhance safety and security of dairy products, CRIS #0201092

PROGRESS: 2005/01 TO 2005/12
Several milk processing plants from the list of plants licensed by the Commonwealth of PA were reviewed for size, location, and population in the surrounding central PA area. Information about various dairies was obtained from PSU Dairy and Animal Science faculty and from Cooperative Extension agents in county offices. Other state and local informants suggested by the PSU sources were contacted for more information. Ultimately four plants that represented a range of production, delivery and distribution characteristics were chosen for case studies. One has the farm operation, processing, and retail co-located and has been run as a family business for three generations. Two plants get their milk from mostly family farms in the surrounding 2 or 3 counties, many of which have supplied milk for 20 or more years to these plants. The fourth uses milk that is collected and delivered by a multi-state company. For each processing plant, potential participants filling the roles described in the network chart were identified, beginning with plant personnel. In most cases, the help of plant personnel in reaching out to dairy farmers was requested and received. A total of 45 potential candidates were identified. We devised and tested a phone interview script and the Office of Research Protections approved this plus an informed consent form in September 05. To date six of the 45 potential candidates were eliminated when they recommended a more suitable candidate. As of December 19, 2005, 26 interviews have been completed. Increasing growth temperature (from 4 to 15, 25, 35 or 43C) significantly increased the resistance of L. monocytogenes to high pressure processing at 400 MPa. For example, a 5-log reduction occurred within several minutes when cells were grown at 4C, but took 30 min when cells are grown at 43C. Growth phase also significantly effected pressure resistance at 400 MPa. Exponential phase cells grown at 43C were significantly more pressure sensitive than early- or late-stationary phase cells. Tailing was seen in cells grown at 35 and 43C. Injury was seen regardless of growth phase or growth temperature. E. coli and Pseudomonas strains were suspended in phosphate buffer and exposed to 500 MHz of ultrasound for up to 2 min. Approximately 0.1-0.4 log reductions occurred at this level. Experiments are being conducted to optimize reduction in numbers. Nanotechnology based approaches to extend the shelf-life of enzymes were investigated. Novel protocols to functionalize iron nanoparticles to enzymes, specifically cholesterol oxidase, glucose oxidase, and alkaline phosphatase were developed. Enzyme linked nanoparticles were found to be more stable under varying conditions of pH and temperature, possibly because of the preservation of the structures. Experiments are in progress to assess enzyme stability under varying high pressure and ultrasound treatment conditions.

IMPACT: 2005/01 TO 2005/12
This research will help us understand why a small fraction of the public still prefers to consume raw milk due to perceived health and quality attributes, even though this remains a high risk practice that often results in foodborne illness. This research may help us design non-thermal processes, such as high pressure processing and ultrasound that would greatly reduce the risk of consuming raw milk and cheeses made from raw milk. We anticipate that this project will result in the application of HPP for eliminating L. monocytogenes from raw milk and raw milk cheeses through understanding the mechanisms of inactivation and the subsequent modeling of inactivation through combined heat and high pressure processing. This research may also result in the use of novel nonmicrobial markers as indicators of adequate pasteurization of milk by HPP and ultrasound. Optimizing MVLST subtyping for Listeria monocytogenes and development of a MLST scheme for subtyping Listeria spp. will help food processors identify and eliminate routes of Listeria contamination in dairy plants.

Develop and deliver science-based information and technologies to reduce the number and severity of agricultural pest and disease outbreaks, (Plant protection)

KAs 204, 211, Breeding vegetables for pest and stress tolerance, CRIS #0060591

PROGRESS: 2005/01 TO 2005/12
In 2005, our primary emphasis in cucurbits and Capsicum was the generation of breeding lines with broad disease resistance and improved product quality and adaptation to diverse environments. In squash, our major focus is resistance to cucumber mosaic virus (CMV), zucchini yellow mosaic virus, watermelon mosaic virus and papaya ringspot virus in C. moschata and C. pepo. All virus resistant breeding material is being converted to powdery mildew (PM) resistance. Types where multiple virus resistance is a major objective include C. pepo (green and grey zucchini, Eskandarany, caserta, early prolific straightneck, yellow crookneck, costata romanesco, ebony acorn, bush ebony, early bush ebony, Delicata and derivatives, jack o'lanterns, patty pan, spaghetti squash) and C. moschata (Butternut varieties and novel types for immature consumption). In melon, we work on these four viruses and PM combined with excellent quality in an array of types including Cucumis melo Honeydew, Eastern cantaloupes, Western shippers, Ananas, Galia, Charantais. In addition to virus resistance and PM, our disease resistance breeding work in melon focuses on Fusarium, and gummy stem blight. We have an intensive breeding program to combine five different genes for GSB resistance using visual selection and molecular markers into melon types grown in the Eastern US and Middle East. In cucumber, C. sativus, we work on a dozen diseases, excellent quality and yield in the following types, North American slicers, white, blonde and green pickles, Beit Alpha types and Asian cucumbers. We have a collaboration with Dr. Jin-Feng Chen, Nanjing University, PRC who has created a synthetic species, C. hytivus, that shows considerable promise for broadening the genetic base for breeding in cucumber and furthermore, may offer the possibility of working at elevated ploidy levels. We have several open-pollinated varieties in wide use, and a number of lines in commercial use as hybrid parents. In Capsicum, we are breeding C. annuum (bell, Anaheim, and jalapeno) for resistance to CMV, tobacco mosaic virus, tobacco etch virus, pepper mottle virus, potato virus Y, green peach aphid and European corn borer. We have released allele-specific markers for the pvr1 locus, widely used by industry. We have also completed genetic mapping studies of several important disease resistance and quality traits, and have released a large public genetic map of pepper based on SSR markers. We have also mapped resistance to CMV and released CMV-tolerant breeding lines in jalapeno and bell backgrounds. Because of our work in the cucurbits and in Capsicum, many varieties are now in catalogs and are attributed to Cornell. With the availability of this germplasm to the public, we see reduced pesticide applications, and improved yields for growers and quality for consumers. Finally, we have launched a participatory breeding activity, the Public Seed Initiative, under the umbrella of the Organic Seed Partnership which we lead, to ensure the delivery of these benefits to growers who use organic production methods and serve local markets.

IMPACT: 2005/01 TO 2005/12
We currently have 43 commercial licenses in force confirming that the products of these breeding programs have broad impact. Licensees include all the largest seed companies and a number of smaller, more regionally focused companies that offer seed produced organically, untreated and treated. We have thousands of material transfer agreements on file, and distribute germplasm globally. We have recruited over 30 companies into our Vegetable Breeding Institute, a consortium of companies interested in vegetable seed production around the world that support our research, breeding and training activities at Cornell. We have also released a number of molecular markers that are widely used in commercial genotyping operations at seed companies and contract genotyping businesses around the world.

Develop and deliver science-based information and technologies to reduce the number and severity of agricultural pest and disease outbreaks, (Animal protection)

KA 311, Emerging infectious diseases poultry, CRIS #0175567

PROGRESS: 2005/01 TO 2005/12
Objective 1: Identify and characterize infectious agents - A novel adenovirus-like virus has been identified as the etiology of transmissible viral proventriculitis (TVP) in broiler chickens Collaborations with researchers at the University of Georgia and Emory University have evaluated various methods of M. gallisepticum strain identification. These studies are allowing exploration of the molecular variability of MG isolates from House finches and other songbirds, and the development of new and improved methods of MG strain identification of isolates from commercial poultry. Mycoplasma gallisepticum isolated from house finch populations in eastern North America have been evaluated. M. gallisepticum isolates are more polymorphic than previously recognized. AFLP analysis of MG strains demonstrated that this technique is a useful tool for molecular epidemiological studies of outbreaks. Objective 2: Develop and assess diagnostic - Cytology has been shown to be a rapid, inexpensive, and accurate method for diagnosing coccidia infections in turkeys. New laboratory diagnostic techniques were developed for M. gallisepticum detection and identification. Objective 3: Determine pathogenesis - To better understand the pathogenesis of avian bordetellosis and to devise better ways of controlling bordetellosis in

commercial turkeys we have constructed a variety of B. avium mutants. A study of mortality in broiler breeder hens indicated that mortality resulted from non-infectious diseases; especially vent picking, mate aggression, musculoskeletal disorders, calcium tetany, and renal disease. A pilot field study in broiler breeder hens has been initiated to determine the etiology and pathogenesis of 'calcium tetany'. The pathogenicity of a North Carolina field strain MG (RAPD type B) was compared with the S6 reference strain in chickens and turkeys. The pathogenesis of M. gallisepticum in free-ranging House finches is being studied by a multidisciplinary team of scientists from NCSU, Princeton, Cornell and University of Wisconsin. Ovarian cancer in chickens is being studied as a model for human disease. Objective 4: Identify risk factors - Domestic house flies (Musca domestica) were shown to be unlikely vectors of NDV. A USDA grant on 'Biosecurity and Diversity of Foodborne Pathogen Populations on Poultry Farms' - was completed in 2005. A 'list serve' and Web site were developed to facilitate communications among stake-holders and the public

IMPACT: 2005/01 TO 2005/12
The demonstration that AdLV (R11/3) is the etiological agent responsible for producing transmissible viral proventriculitis provides the impetus for further study leading to development of specific control procedures. Methods to control B. avium infection in poultry are unlikely to emerge without a basic understanding of the avian and bacterial factors required for disease production. With the present genetic tools and genomic information available to us, we are now in a position to extend our examination of bordetellosis pathogenesis to a level of sophistication and practical application unprecedented for any bacterial disease in an agriculturally important animal. An educational extension program on biosecurity was created for use in the United States and foreign countries. A Spanish version is currently being produced. Our cross-sectional studies and field investigations of Salmonella and Campylobacter in chickens and turkeys have allowed us to identify important risk factors associated with these agents. Studies on the pathogenesis and epidemiology of Mycoplasma gallisepticum in House Finch (Carpodacus mexicanus) indicate that this is a highly tractable model system for experimentally studying microbial diseases