of eggs were selected for grading samples based on USDA random sample selection process. Physical quality of intact shell eggs was significantly improved using cryogenic cooling. The difference in the percentage of AA, A, and B eggs began to differentiating after approximately 5 weeks of storage. Eggs cooled cryogenically maintained a higher AA quality throughout the storage period. A random sample of eggs was also selected to evaluate the shell surface and interior content microbial level. The microbial counts of the content of the cryogenically cooled eggs were significantly higher ($p<0.0001$) compared to traditionally cooled eggs in trial one. It was determined that the cooler sanitation was lacking during the first trial. A cleaning and sanitation protocol was developed for the cooler then the trial was repeated. Internal microbial loads between the two treatments were not significantly different in trial two, after the improvements were made. External microbial counts were higher for cryogenically cooled eggs ($P<0.002$) in both trials. The increased internal microbial level of cryogenic cooled eggs in trial 1 was due to the lack of cleaning and sanitizing of the cryogenic cooler. The physical quality of the eggs was better in the cryogenically cooled group, with no difference in apparent microbial quality. These trials led to improvements in the design of the equipment, which have been made in the commercial unit. These improvements will facilitate cleaning the equipment, reduce the shell surface microbial load, and improve the physical quality of the eggs.

Key Words: Cryogenic cooling, Shell eggs, Microbial load

229 Comparison of quality and functionality of traditionally and cryogenically cooled shell eggs. K.C. McAvoy*[1], P.A. Curtis[1], K.M. Keener[1], K.E. Anderson[2], and D.E. Conner[3], [1]*Department of Food Science, North Carolina State University,* [2]*Department of Poultry Science, North Carolina State University,* [3]*Department of Poultry Science, Auburn Universtiy.*

Previous studies have found that cryogenic cooling of shell eggs results in, a lower Salmonella enteritidis level, a higher quality egg, and a longer shelf-life than traditional cooling. This research was designed to compare quality and functionality of traditionally cooled eggs to cryogenically cooled eggs from a commercial egg processing plant. Three replicate runs of each of the two treatments were processed to give a total of six treatment reps. Data for cooling curves was obtained by inserting temperature probes attached to data recorders into an egg from each treatment rep. Two hours after processing the cryogenically cooled eggs had reached 11.6°C while the traditionally cooled eggs were at 28°C. Eggs from both treatments were held in refrigerated storage (4°C) during the fifteen-week testing period. Functionality and quality tests conducted include: Haugh units, displacement and specific gravity measurements of angel food and sponge cakes, emulsion stability of mayonnaise, shell and vitelline membrane strength, pH, whipping height and overrun. Haugh unit values were measured every week; all other functional and quality tests were conducted tri-weekly. Data was analyzed using the General Linear Model (GLM) of SAS (1996). Means were separated using the least square method. Cryogenic cooling of shell eggs with carbon dioxide increased the percentage of AA quality eggs compared to traditional cooling. The traditionally cooled eggs dropped from Grade AA to Grade A approximately one week prior to those from the cryogenic treatment. The average Haugh unit values for the fifteen-week testing period were 69.8 and 67.6 for the cryogenically and traditionally cooled eggs, respectively. There were no statistical differences in functionality measurements between the two treatments. Cryogenic cooling of shell eggs with carbon dioxide gas is a viable option for improving safety and quality of shell eggs. This enhanced safety and quality should have significant economic benefit to egg producers.

Key Words: Cryogenic Cooling, Shell Eggs, Functionality

Biotechnology, Animal Products, and the Food Industry

230 Is DNA or protein from feed detected in livestock products? Kevin Glenn*, *Chair, ABSTC Subcommittee on DNA Detection.*

With the advent of highly sensitive analytical technology such as polymerase chain reaction (PCR), the need for documentation regarding the potential for the detection of DNA and protein from biotech crops in meat, milk, and eggs (MME) is critical. This is not a concern over the safety of the transgenic DNA or protein in MME since the introduced proteins undergo rigorous review prior to approval, and the UN FAO and WHO, the U.S. FDA and the U.S. EPA have all stated that DNA in food, including transgenic DNA in biotech crops, is a safe, natural component of food. However, it is well recognized that significant logistical problems would be incurred for meat, poultry, egg, and milk processors if labeling and segregation of products from animals fed biotech crops could occur using new detection methods. The scientific studies that have attempted to detect transgenic DNA or protein in MME derived from animals fed biotech crops will be reviewed. To date, the scientific evidence clearly shows that the transgenic DNA and proteins cannot be detected in MME products and that these products are equivalent in every way to products from animals fed conventional feeds. In addition, new data will presented from studies in which DNA and protein were extracted from chicken breast samples from animals fed YieldGard® or conventional corn. PCR followed by Southern blot hybridization was used to analyze the DNA for the presence of specific fragments from the Bt cry1Ab gene and the gene encoding the corn protein ADP glucose pyrophosphorylase (sh-2). None of the extracted DNA samples was positive for cry1Ab or sh-2. The extracted DNA was shown to be of high quality and amendable to PCR amplification of the chicken ovalbumin gene. In addition, data from a new competitive immunoassay sensitive to both intact and partially digested Cry1Ab protein will be presented, showing that this transgenic protein or immunoreactive fragments of the protein cannot be detected in the breast samples from chickens fed YieldGard® grain.

Key Words: Polymerase Chain Reaction, Transgenic DNA, YieldGard®

231 Preventing food allergy - The impact of biotechnology. James D. Astwood*, *Monsanto Company, St. Louis, MO.*

People who suffer from food allergies manage their condition by avoidance strategies such as diet eliminations and careful examination of ingredient labels. Unexpected exposures and resulting adverse reactions to food allergens represent the main challenge in food atopy. Unlike hay fever and respiratory allergies, immunotherapy has achieved only limited success because of the potency of food allergens - i.e., immunotherapy with food allergens can often trigger serious side effects, including anaphylaxis. Biotechnology has had a positive influence on the science of food allergy by facilitating the discovery and characterization of allergens using recombinant DNA methods. Today, it is generally accepted that most major allergens have been identified and described. Subsequently, biotechnology has enabled the development of diagnostics based on recombinant allergens and more recently has been used to engineer potentially safer immunotherapeutic versions of food allergens - the creation of de-allergenized variants. This will allow safer immunotherapies since the de-allergenized variants of food allergens should produce fewer, if any, side effects. In addition, DNA vaccines based on these variants are being tested presently, with a view of providing long-lasting immunotherapeutic options for food allergy patients. Biotechnology is also providing prophylactic options through the development of hypoallergenic foods which have either been engineered to contain fewer endogenous allergens, or have been modified by the presence of proteins like theoredoxin, to render endogenous food allergens less potent and less allergenic. Hypoallergenic foods could reduce the incidence of new food allergies on a global basis.

Key Words: Biotechnology , Allergy, Food

232 The risks of going non-biotech. Thomas P. Redick*, *Law Offices of Thomas P. Redick, Del Mar, CA.*

Many companies see product lines that are free from modern biotechnology (non-biotech) as necessary to satisfy consumers who may want "non-GMO" foods, including meat, eggs and milk from animals fed non-GMO feed. Before making this leap, however, companies should analyze

potential liability risks of non-GMO products. Product liability risks include potential increases in carcinogenic mycotoxins, such as aflatoxin, which may concentrate in milk or meat (unlike the rDNA in digested GMO ("biotech") feeds). The comparative product liability risks of rDNA ("biotech") and non-biotech choices may actually dictate the use of biotech. Moreover, environmental liability risks may be reduced by biotech feeds (e.g., low-phytate soybean meal to reduce phosphorus in animal waste); the EPA could require such feeds as the "best available control technology". Companies may find that rDNA plant breeding, on a case by case basis, minimizes the environmental impacts of the traditionally bred crops and their associated inputs. Finally, assuming equal safety profiles for biotech and non-biotech feed, a company that goes "non-biotech" risks consumer fraud liability. An affirmative "non-biotech" representation should follow an agreed standard acceptable to all stakeholders. Without careful legal and scientific management of the process behind "non-biotech" representations, companies face fraud suits over unwanted "biotech" content. Until regulators endorse a process for non-biotech certification, dropping the "tolerances" for DNA content in food or feed (i.e., a process standard comparable to USDA's new Organic Rule), the risks of going non-biotech may often outweigh the benefits. Consumers know about biotech content from intensive media campaigns, so biotech content without a non-biotech claim is not a fraud risk. Since some consumers will ignore reduced mycotoxins and improved environmental performance in favor of non-biotech sources of food, regulations should ensure peaceful co-existence between organic farming and commercial agriculture, but ensure continuing innovation that reduces product liability risks, environmental impacts, and consumer fraud.

Key Words: Food biotechnology, Food safety, GMO

233 Economic and practical considerations of using non-biotech grain in U.S. livestock and poultry feed. Scott Richman*, *Sparks Companies, Inc., Memphis, TN.*

Given concerns about the continuing acceptance of agricultural biotechnology among U.S. consumers, some companies may consider offering for sale meat and poultry produced from animals which were fed only non-biotech grains and protein meals. This avenue may be considered as a way to protect a company's market share in the event that U.S. consumer attitudes toward biotechnology turn negative, or it may be seen as an opportunity for a company to serve a niche market of consumers who prefer "natural" foods and are willing to pay a premium. Yet,there are practical considerations which constrain the ability of livestock and poultry firms to offer meat and poultry certified as coming from animals fed only non-biotech corn and SBM. At the farm level, biotech varieties of corn and soybeans have been adopted widely across the U.S. At the grain elevator, corn mills and soybean crushing facilities, grain from different sources is commingled. Many animal feeding operations would face challenges unless they switched entirely to non-biotech feeds. There would be difficulty in keeping the resulting meat separate from commodity meat in packing and processing plants. The objectives of this talk are to describe the constraints which exist in the current supply chain, to indicate the steps which must be taken if those constraints are to be overcome, and to estimate the costs involved with undertaking such an effort.

Key Words: Economic, Biotechnology, Livestock

234 Effects on Global Trade: Setting International Food Standards via Codex Alimentarius. Mark Mansour*, *Attorney and Partner, Keller and Heckman LLP, Washington, DC.*

Although the Codex Alimentarius Commission has functioned as part of the U.N. Food and Agriculture Organization since 1962, its activities, until recently, were of little more than incidental interest to the international food and feed industries, especially U.S.-based multinationals. However, with the advent of the World Trade Organization (WTO) and the establishment of NAFTA and other regional trading blocs, Codex's deliberations became significantly more important to government and industry alike. As manufacturers realized that Codex, in the absence of any other mutually acceptable arbitral mechanism, would be enshrined in the WTO as the means by which disputes over trade in food products would be resolved, member countries also realized that the Commission would provide a solution to the growing gaps in their food regulatory structures. Lesser developed countries lacking both the expertise and the budgets to fully develop food regulatory structures adequate for both the protection of public health and streamlining the free flow of goods found such expertise through the 37 year long deliberative process, during which period they have institutionalized in their own regulatory regimes the experience gleaned from delegates representing the industrialized countries of North America and Europe. Despite the progress made in many countries toward developing coherent food legislation and regulatory structures, there remain significant gaps in the laws of many jurisdictions, particularly in Asia, the Middle East and Latin America, as well as persistent confusion about the legality of ingredients, additives and preservatives, and the propriety of various types of claims. In no functional area have these developments been as vital as in the area of biotechnology where, during the course of the next year, Codex is poised to make a series of decisions that will have a significant, and perhaps irreversible impact on the future of the global trade in food and feed products derived from biotechnology.

Key Words: Biotechnology, WTO, Food trade

Genetics of Disease Resistance

235 Transgenic approaches to prevent bovine mastitis. D. E. Kerr*[1], K. D. Wells[2], and R. J. Wall[2], [1]*University of Vermont, Burlington, VT,* [2]*USDA-ARS, Beltsville, MD.*

Transgenic animal technology is a strategy likely to play a major role in the prevention of animal disease. One approach is to enable the production of novel antibacterial proteins by the mammary gland as a means to enhance mastitis resistance. To this end, we have produced transgenic mice that have the ability to produce a bioactive variant of lysostaphin in milk. Lysostaphin, which is normally produced by *Staphylococcus simulans*, has potent staphylolytic activity. The lysostaphin-transgenic mice exhibit substantial resistance to staphylococcal mastitis. Fortification of milk as a strategy to enhance disease resistance has also resulted in reports of transgenic mice whose milk contains human lysozyme, bovine tracheal antimicrobial peptide, or a neutralizing antibody to a strain of murine hepatitis virus. We are currently evaluating additional antimicrobial proteins as candidates to be secreted by the mammary glands of transgenic animals. Our selection strategy is based on a number of parameters. First, there must be no indication of toxicity to eukaryotic cells. Second, the selected protein or peptide must be effective in milk in reducing the growth of mastitis pathogens. Milk components such as negatively charged casein micelles, and milk fat globule membranes can markedly reduce the activity of cationic antimicrobial peptides. Third, antibacterial activity must have limited or no enzymatic activity against milk proteins to ensure product quality. Fourth, the mammary epithelium must be able to produce the protein of interest in an active form. For many antibacterials this will likely require additional genes to enable post-translational processing and activation. Fifth, activity against bacteria normally used in the production of fermented dairy products must be considered. Lastly, the potential exists for the development of resistant microbial strains. This potential should be reduced by the simultaneous production of multiple antibacterial proteins. Transgenic mice producing lysostaphin in milk represent a proof of concept for the generation of mastitis resistant transgenic cows. Additional proteins will be needed to prevent coliform and streptococcal mastitis.

Key Words: Lysostaphin, Milk

236 Immunogenomics and the periparturient dairy cow: letting leukocytes tell us their own story about disease susceptibility. J.L. Burton*[1], [1]*Michigan State University.*

Despite rigorous management practices aimed at environmental cleanliness, good nutrition, and even vaccination, mastitis remains a problem in periparturient dairy cows. This is partly due to well-known leukocyte dysfunctions that occur during periparturition and jeopardize immune defenses against mastitis-causing organisms. To better understand and control mastitis susceptibility in periparturient cows we need detailed understanding of the genes that regulate and orchestrate leukocyte development, trafficking, and immune defense against the bacteria that infected mammary glands and cause mastitis. We have begun to use combinations of DDRT-PCR, cDNA dot blots, and cDNA microarrays