made from unpasteurized milk, to eliminate the foodborne pathogens. From 1948 to 1988, there were 6 confirmed foodborne disease outbreaks in the U.S. transmitted with domestically produced hard cheeses as the food vehicle. Various research reports have raised concerns about the public health protection provided by the current 60-day aging period in the manufacture of hard cheeses made with unpasteurized milk. The objective of this study was to investigate the adequacy of the 60-day minimum aging to eliminate the foodborne pathogens and evaluate milk thermalization as a process to improve the safety of hard cheeses made from unpasteurized milk. Hard cheese was made from unpasteurized milk inoculated with a five-strain cocktail of acid-tolerant *E. coli* O157:H7. Samples of unpasteurized milk, curd and whey were collected during the cheese manufacturing process. After pressing, the blocks of hard cheese were packaged into plastic bags, and sealed with a vacuum-packaging machine, and aged at 7 °C. After 1 week, the cheese blocks were cut into smaller uniform-sized pieces, and vacuum sealed in clear plastic pouches for ease of sampling at the various aging intervals. Samples were plated and enumerated for *E. coli* O157:H7. Populations of *E. coli* O157:H7 increased during the cheese making operations. Population of *E. coli* O157:H7 in cheese aged for 60 and 120 days at 7 °C, decreased less than 1 log and 2 logs, respectively. Experiments were conducted at 64.4 °C for 16 seconds on milk inoculated with *E. coli* O157:H7 at 10 ^{5} CFU/ml. Supply milk and thermalized milk were taken at 0, 45 and 90 minutes to determine the levels of *E. coli* O157H7. Thermalization runs resulted in a 5-D *E. coli* O157:H7 reduction.

Key Words: Thermalization, *Escherichia coli* O157:H7, Raw Milk Cheese

188 An integrated approach to the safety of raw milk cheeses. P. S. Kindstedt*, *University of Vermont, Burlington.*

In the ongoing quest to reduce the risk of foodborne illness associated with cheese, the goal should be to achieve the appropriate level of safety using approaches that are both effective and practical, and that avoid placing unnecessary burdens and restrictions on cheesemakers and cheese consumers. Among the possible approaches that could be implemented to enhance cheese safety, mandatory pasteurization of all milk for cheesemaking stands out as being exceptionally burdensome and restrictive to producers and consumers of raw milk cheeses. Expanding mandatory pasteurization to include all cheeses should not be pursued if the appropriate level of safety already exists under current regulations or can be achieved through other practical and effective but less burdensome and restrictive approaches. Recent research strongly suggests that some raw milk cheeses, such as the highly cooked hard Italian and Emmental-types, present very low microbiological risks when made and aged properly. A strong argument can be made that these raw milk cheeses achieve the appropriate level of safety as a consequence of the high heat treatment that they receive during manufacture, their chemical composition and their long ripening times. Therefore, the safety emphasis for these cheeses should be on insuring that cheesemakers are adequately trained in cheese technology, hygiene and safety and held to appropriately high standards, rather than on mandatory pasteurization. For other raw milk cheeses that pose greater microbiological risks and which are deemed to fall short of the appropriate level of safety under current regulations, at least two different approaches should be evaluated and compared for overall merit: 1.) mandatory pasteurization; 2.) a combination of other safety approaches such as mandatory technical and safety training for cheesemakers (e.g. via a cheesemakers certification or licensing requirement), mandatory implementation of an approved risk-reduction (e.g. HACCP-like) program, and mandatory finished product testing for pathogens. The latter approaches have been used for raw milk cheesemaking in some European countries with apparent success.

Key Words: Cheese, Safety, Pasteurization

Extension Education: Applied Reproductive Management Symposium: Beef and Dairy Cattle Topics

189 Using melengestrol acetate (MGA)-based protocols to synchronize estrus prior to fixed-time artificial insemination in postpartum beef cows. D. J. Patterson*, F. N. Kojima, and M. F. Smith, *University of Missouri, Columbia.*

Beef producers are often restricted in their operations from implementing production-enhancing technologies, including estrus synchronization and AI, due to a lack of time and labor. The inability to predict time of estrus for individual cows in a herd often makes AI impractical to use because of the labor required for detection of estrus. The development of methods to inseminate beef cows at a fixed time with high fertility should result in a dramatic increase in the adoption of AI in beef herds. Although hormonal treatment of cows to group estrous periods has been a commercial reality for over 30 yr, producers have been slow to adopt this management practice. Perhaps this is because of past failures, which resulted when females that were placed on estrus synchronization treatments failed to resume normal estrous cycles following calving, and the reality that early estrus synchronization protocols failed to synchronize follicular waves, resulting in more days in the synchronized period. These factors collectively precluded the application of fixed-time AI with acceptable pregnancy rates. We proposed the general hypothesis that progestin treatment prior to the GnRH-PG estrus synchronization protocol would successfully: 1) induce ovulation in anestrous postpartum beef cows; 2) reduce the incidence of a short luteal phase among anestrous cows induced to ovulate; 3) increase estrous response, synchronized conception and pregnancy rates; and 4) increase the likelihood of successful fixed-time AI. This review considers recently developed methods to control estrous cycles of postpartum beef cows with MGA. New methods of synchronizing estrus in beef cows with the MGA Select or 7-11 Synch protocols prior to fixed-time AI present the opportunity to enhance results from AI and eliminate the need to detect estrus entirely. These new protocols provide an opportunity for the beef cattle industry to expand the application of this important reproductive technology by making the implementation of an AI program feasible.

Key Words: Beef Cow, Estrus Synchronization, Progestin

PSA Air Emissions & Poultry Production

190 Air emissions in poultry production: Current challenges and future directions. R. Angel*[1], W. Powers[2], and T. J. Applegate[3], [1]*University of Maryland, College Park,* [2]*Iowa State University, Ames,* [3]*Purdue University, West Lafayette, IN.*

In the last few years, regulatory focus has been on nutrient management from animal feeding operations (AFOs) with recent emphasis on air emissions. Concerns are with air-borne emissions of nitrogenous compounds as well as with small particulate matter (PM 2.5). Of specific interest to the Environmental Protection Agency and specific states include ammonia, hydrogen sulfide, nitrogen oxides, sulfur oxides, nitrous oxide, and volatile organic compounds but the main challenges are establishing current emission levels and determining best methodologies for measuring these accurately. Currently methodologies to measure air emissions under field and research conditions exists and are being further developed but extensive challenges exist as to both accuracy and precision of the different analytical methods. Current best estimates are based on a mass balance modeling approach (Air Emissions From Animal Feeding Operations, NRC 2003) but due to lack of current biologically generated data to use in the models, nutrient excretion and emission levels appear to be overestimated by these models. Extensive work is being done on dietary strategies to reduce nitrogenous excretions from poultry but the impact of these on air emissions is not always defined. Litter management strategies that reduce volatilization of nitrogenous and other compounds have shown promise and are being further developed. Flock, house, and whole farm management strategies are also being successfully implemented and further developed. The magnitude of the potential impact on air emissions of each of these strategies is still in question. There is no question, though, as to the need for the use of whole farm systems that implement different strategies at all

management levels if large decreases in air emissions from AFOs are to be achieved.

Key Words: Air Emissions, Poultry, Mass Balance

191 Air emissions from layer houses.

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Measurements of air emissions from confined animal buildings are perhaps more challenging for laying hens than any other species. Modern laying houses typically have the greatest volume, the greatest mean live mass density, the greatest number of exhaust fans, the highest ridge, the largest particles, and the highest concentrations of ammonia and particulate matter (PM). This paper describes a comprehensive air emission measurement program carried out for over six months at a 250,000-hen high-rise caged-hen building. Continuous measurements of gas and particulate matter (PM10, PM2.5) concentrations, building static pressure and airflow, inside and outside temperature and humidity, wind speed and direction, and barometric pressure were conducted. Extractive air sampling was used to provide continuous gas streams to two sets of gas analyzers and to fill sample bags for odor evaluations. Ammonia (NH3), hydrogen sulfide (H2S), carbon dioxide (CO2), and odor were measured using chemiluminescence, pulsed fluorescence, photoacoustic infrared detectors, and olfactometry, respectively. PM was measured in the exhaust air using three tapered element oscillating microbalances. Ventilation rates were assessed by monitoring fan operation and static pressure, and testing fans with a portable fan tester, and a certified fan testing lab. During 6 days in June, the average daily mean (±95% c.i.) concentrations and emissions were 39±8.0, 518±74, and 1887±563 $\mu g/m^3$ and 1.1±0.3, 16±3.4, and 63±15 g/d-AU for PM2.5, PM10, and total suspended particulates (TSP), respectively. PM emission was correlated to ventilation, ambient and exhaust temperatures, and relative humidity ($P<0.05$). Ventilation inlet and exhaust odor concentrations ranged from 43 to 74 and 216 to 451 European odor units (OU_E) per m^3 , and averaged 51 and 316 OU_E/m^3 , respectively. Mean H2S concentrations of ventilation inlet and exhaust air were 3.1 and 19.7 ppb, respectively. Mean H2S emission rate was 5.6 μg/s-AU. The overall mean odor emission rate was 65.6 OU_E /s-AU. Odor emissions were correlated to ventilation rate, and building temperatures. The average NH3 emission rate was about 200 g per day per 500 kg live mass.

Key Words: Ammonia, Particulate Matter, Odor

192 Ammonia emissions from broiler houses.

A.J. Pescatore*, K.D. Casey, and R.S. Gates, *University of Kentucky, Lexington.*

Ammonia levels in poultry houses are a concern due to the impact on bird performance including poor feed efficiency, blindness and respiratory problems. Recently, there has been increased interest in ammonia as it relates to emissions. EPA through its safe harbor program and third party lawsuits under CERCLA and EPCRA regulations has increased the concern of the poultry industry. Ammonia emissions are a function of the level of ammonia in the exhaust air and the ventilation rate. Accurate measurements of both ammonia concentration and rate of ventilation is essential for determining ammonia emissions. A study was conducted over five consecutive flocks to determine ammonia emissions from four commercial broiler houses with built up litter. Ammonia levels in exhaust air were determined by using Portable Measuring Units (PMU) equipped with two Drager PAC III electrochemical gas monitors. A Fans Assessment Numeration System (FANS) was used to determine exhaust fan capacity. Placement densities were either 10.75 or 13.44 birds per square meter depending on final body weight. The results of this study indicated that there is seasonal variation in the pattern of ammonia levels in the exhaust air from broiler houses. The fall and winter flocks had increasing ammonia levels in the exhaust air with increasing bird age. While the two summer flocks demonstrated a decreasing ammonia level with regard to bird age. The one spring flock was highly variable. Ammonia levels for the five flocks ranged from 1 to 40 ppm. During all five flocks, ammonia emissions which are a function of ammonia level and ventilation rate increased linearly with bird age. Average maximum ammonia emissions (g/bird/day) were .93, 1.01, 1.45, 1.73, and 1.27 for the five consecutive flocks. The lowest level for ammonia emissions occurred early in the flock and ranged from .01 to .45 g/bird/day. Results from this study indicate that the rate of ventilation as opposed to ammonia level had a greater effect on ammonia emissions.

Key Words: Ammonia Emissions, Broiler, Ammonia Levels

193 Dietary strategies to lower nitrogen load in poultry.

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The poultry industry has made tremendous strides over the past 50 years to meet the demands of the retail and foodservice industries for increasing supplies of inexpensive and safe meat and eggs. The pressure to lower cost and increase supply has led to higher efficiencies which have only been possible through larger more integrated facilities. In certain areas these facilities with higher concentrations of livestock has resulted in some environmental concerns which include ammonia and odors. The poultry industry is now being challenged to reduce emissions by some of the same groups that have driven the industry into expansion and consolidation. The move toward mandating lower nitrogen emissions in the United States is inevitable. To meet these limits the poultry industry will need to either reduce the number of birds placed or implement feeding practices that minimize the feeding of excess nitrogen (crude protein). The first step in reducing ammonia emissions is to more accurately define the amino acid needs of a bird. With more accurate requirements we are able to design feeds with reduced levels of excess protein in the feed. The second step in reducing ammonia is to develop procedures that allow for more frequent feed changes. Current practices of changing broiler feeds every 14 to 20 days results initially in underfeeding followed by overfeeding of nutrients. Changing diets more frequently will reduce nitrogen emissions by improving efficiencies and reduced feeding of excess nutrients.
Tools available to nutritionist in their pursuit of reduced nitrogen emissions include commercially available crystalline amino acids. Making full use of them to more accurately balance feeds can significantly reduce excess crude protein. Unfortunately, there is still a common belief that lowering of the crude protein level of feeds negatively affects performance. The research presented in this paper strives to demonstrate to the poultry industry in the US that by embracing these technologies we can move toward lower crude protein, more efficient feed formulation and achieve the same level of performance with lower nitrogen emission at a lower cost of meat and eggs

Key Words: Nitrogen, Low Protein, Amino Acids

194 Management strategies to reduce air emissions: emphasis ammonia.

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Air emissions generated by poultry production are numerous and can include odors, dust, endotoxins, and nitrogenous compounds. Ammonia (NH_3) emissions have the potential to contaminate surface waters, while, nitric oxide and nitrous oxide lead to the formation of nitric acid, a principle component of acid rain. These emissions in and around poultry production facilities can be a health and performance issue for birds and their caretakers, and an environmental concern on both a local and global scale. Dietary strategies can aid in the reduction of many airborne emissions including NH_3. Management techniques to quell, capture or eliminate these air contaminants are numerous but vary in their cost, effectiveness and practicality. Many strategies that control dust also control the release of odorous compounds, microorganisms and NH_3 that can adhere to dust particles. Techniques for dust control include cleaning and vacuuming, fogging with water and oil, ionization, electrostatic filtration, air scrubbing techniques, and vegetative shelterbelts. Impermeable covers for manure reduce emission rates by reducing radiation and wind velocity. Biofilters trap and treat exhaust air from mechanical ventilation systems combining filtration (woodchips, or straw) with biological conversion in compost to capture emissions. Litter and manure amendments include those that inhibit microbial growth and conversion of nitrogenous compounds to NH_3; clays that absorb moisture, odors and NH_3; and acidifying agents such as ferrous sulfate, ferric chloride, and aluminum sulfate that convert NH_3 to $NH_4{}^+$. Rapid drying techniques for litter and manure can significantly reduce NH_3 volatilization. These include slotted floor systems for turkeys, ventilated floors for broilers and new cage systems for layers each reducing litter and

manure moisture and NH_3 losses compared to conventional systems. Although many strategies are available to address NH_3 and other air emissions, ultimately regulations and costs will be determining factors guiding implementation.

Key Words: Ammonia, Air Emissions, Management

195 Emissions, regulations and impact in the EU and The Netherlands. H. Ellen*, *Applied Research of Animal Sciences Group of Wageningen, Lelystad, The Netherlands*.

Air pollution has been one of Europe's main political concerns since the late 1970's. The aim of EU-policy is to develop and implement appropriate instruments to improve air quality. The Sixth Environment Action Programme, "Environment 2010: Our future, Our Choice" regards the period from 2001 until 2010. One of the important issues of the EAP is the reduction of greenhouse gasses. This also supports the aims of the Kyoto-Protocol, because EU-countries have promised to decline their emissions with 8% in total in 2010 in comparison with 1990. In the EAP each country of the EU has an Emission Ceiling for gasses as SO_2, NO_x and NH_3. According to an EU-directive these emission ceilings have to be reached in 2010. In addition to the EU-rules, each country have to implement its own national programme for a progressive reduction of the national emissions. For poultry, the reduction of NH_3-emission is the most important issue in the EAP. Already there was EU-directive in 1996 concerning the integrated pollution prevention and control (IPPC). According to this directive no new poultry farm larger than 40,000 bird places may be operated without a permit. From 2007 all farms need a permission and have to use a so called BAT. These are techniques that aim to reduce emission of ammonia at acceptable costs. Large farms have to make a Environmental Impact Assessment when they apply for a new permit. For already many years in Holland poultry farms require a permit in which also the amount of ammonia and odour emission is registered. Lists of ammonia and odour emission factors for all the housing systems in the different poultry categories has been established. To fulfil the EU-directive 2001/81/EC, the Dutch government has set maximum values for the ammonia emission from farms. Together with the environment regulations, poultry farmers also have to deal with EU-directives on animal welfare. Most of the housing systems that give good welfare, have higher emissions of ammonia. These systems also consume more energy, which doesn't harmonise with the need to reduce the emission of CO_2.

Key Words: Ammonia Emission, Environment, Poultry

Food Safety in Animal Production

196 A USDA multi-agency project: Collaboration in animal health, food safety & epidemiology (CAHFSE). R. R. Kraeling*[1], E. J. Bush[2], D. A Dargatz[2], N. E. Wineland[2], S. Ladely[1], and P. J. Fedorka-Cray[1], [1]*ARS, USDA, Athens*, [2]*APHIS-VS, USDA, Fort Collins, CO*.

The emergence of antimicrobial resistant zoonotic bacteria continues to be a global concern. In response to growing surveillance needs, USDA-ARS, APHIS and FSIA collectively developed CAHFSE. CAHFSE will enhance our overall understanding of pathogens that pose a food-safety risk by tracking these organisms from farm to plant. Risk analysis, antimicrobial use information, resistance and animal health will also be assessed. The first commodity of CAHFSE is pork. Currently, blood and fecal samples are being collected quarterly on sentinel farms in four states. Herd health and management data are also being collected from these farms. To date, fecal samples from 48 site visits have been collected and cultured for Salmonella, Campylobacter and E. coli. Salmonella was recovered from 8.1% (146/1811) of the samples. Sixteen serotypes were identified, of which the predominant serotypes included; S. derby (31.5%), S. typhimurium var. copenhagen (26%), S. heidelberg (8.9%) and S. give (7.5%). Across all serotypes, resistance was most commonly observed for tetracycline (90.4%), streptomycin (63.5%), sulfamethoxazole (43.5%) and ampicillin (43.5%). Among generic E. coli, resistance to tetracycline (92.2%), sulfamethoxazole (27.2%), streptomycin (27.1%) and ampicillin (25.4%) was most common. All Campylobacter isolated to date were identified as C. coli. Resistance to tetracycline (73.6%), azithromycin (60.3%) and erythromycin (60.1%) were observed most often. Determination of risk factors related to prevalence and antimicrobial resistance of these organisms will lead to practical methods of mitigating food borne illness.

Key Words: Swine, Food Safety, Antimicrobial Susceptibility

197 Monitoring the safety of edible poultry tissues: Antibiotic residue concentrations can vary between different muscle tissues. I. Reyes-Herrera*[1], M. J. Schneider[2], K. Cole, P. J. Blore, and D. J. Donoghue, [1]*Department of Poultry Science, University of Arkansas, Fayetteville*, [2]*USDA/ARS/ERRC, Wyndmoor, PA*.

The use of veterinary antibiotics is an important tool for the treatment of disease in poultry. However, misuse of these antibiotics can create antimicrobial residues in edible animal tissues exceeding the FDA established safety tolerances. To ensure the safety of the U.S. food supply, the Federal Government monitors foods, including poultry, for illegal residues. For the veterinary antibiotic enrofloxacin (Baytril ®), the FDA, in the Code of Federal Regulations, has listed muscle as the tissue to be monitored in poultry, irrespective of the type of muscle tissue. This study was conducted to determine if either breast or thigh meat is a better indicator of the highest enrofloxacin concentrations. One hundred and sixty five, 5-wk old chickens were dosed with the FDA approved dose of enrofloxacin in water. The 4 treatment groups were: 25 ppm for 3 days, 25 ppm for 7 days, 50 ppm for 3 days and 50 ppm for 7 days. Five chickens from each treatment group were randomly selected and samples of breast and thigh muscle tissue were collected prior to dosing (controls, n=5), during the dosing (n=5/group/day) and for a 3-day withdrawal period (n=5/group/day). Each sample was prepared and assayed using an agar diffusion microbiological method (Schneider and Donoghue, Poultry Science, 2004). The results demonstrated that greater overall concentrations of enrofloxacin were present in breast versus thigh muscle tissues during the dosing period (443 ± 22 ppb vs. 386 ± 24 ppb. $P < 0.05$). These data indicate that, at least for enrofloxacin, not all muscle tissues incorporate antibiotics at the same concentrations. Therefore, the Federal Government should consider monitoring specific muscle tissues to ensure established safety tolerances are not being exceeded.

Key Words: Enrofloxacin Residues, Muscle Tissues, Chicken

198 Survival of *Salmonella* species following sodium hypochlorite treatment during commercial broiler processing. R. M. Lipscomb*, L. T. Walker, W. L. Hurlock, L. L. Williams, and M. Verghese, *Alabama A&M University, Normal*.

Technological advances and mass production in poultry processing present new challenges for providing a microbiologically safe product. Research has shown that Salmonella can survive acidic conditions. The objective of this study was to determine the effect of Acidified Sodium Hypochlorite (ASH) on survival of *Salmonella* species on commercially produced broiler carcasses. Broiler carcasses were sampled from four processing steps (rehang, reprocessing, prechill, and postchill) to determine the effect of ASH against Salmonella. Ten carcasses were sampled at each processing step. Carcasses were dipped (20 secs) in an ASH solution dip tank at prechill and rinsed (1 min) with 400ml Butterfield's Phosphate Dilution water (BPD). A 1:10 dilution was plated onto Brilliant Green and Bismuth Sulfite agars, incubated for 24 hours at 37C, and Salmonella counts were determined. Salmonella O Poly A and H Poly A antigens were determined by serotyping. *Salmonella* species were confirmed by PCR analysis. The experiment was replicated three times over three periods. The results showed that average Salmonella counts were 1.2888 log cfu/ml (rehang), 0.9403 log cfu/ml (reprocessing), 0.9779 log cfu/ml (prechill), and 0.2039 log cfu/ml (postchill). Means for 48 and 72 hours were not significantly different at p#88050.05. Of a total of 53 suspect Salmonella isolates (including all reps), 37 were positive for the Salmonella O Poly A antigen, and 50 samples were positive for the Salmonella H Poly A antigen. PCR analysis confirmed 32 samples to be *Salmonella* species.