Egg Industry Center
ADVANCE
Advancing a thriving industry through research and outreach

Research Summary
January 2018
Issue 1

2017 EGG INDUSTRY CENTER RESEARCH SUMMARY

Project Name	Page	Animal Welfare	Bird Health	Egg Processing & Products	Egg Quality & Safety	Environment	Genetics	Housing Systems	Production
		Topic Areas Addressed							
Air & Environmental Sampling for AI	1	X	X			X		X	X
Role of Litter Beetles, Water, Feed & Rodents in AI	1	X	X						X
Understanding New HPAI Virus Persistance	1	X	X			X			X
Evaluation of Alternative Evironmental Sampling for AI	2	X	X			X			X
Evaluation of Feedstuffs for AI	2	X	X						X
Identifying Genetic Basis for Resistance to AI	2		X				X		
Evaluation of Electrostatic Air Filtration Systems	3	X	X			X		X	X
Modeling of Ventilation Shutdown to Stop AI	3	X	X						X
Role of Terrestrial Wild Birds, Rodents, & Insects in AI	3		X						X
Causes of Keel Bone Abnormalities	4	X	X					X	X
Evaluating Effects of LED vs. CFL Lighting	4	X			X			X	X
The Effects of Egg Yolk on Piglets	4			X					
Evaluating Behavioral Responses to Ultraviolet Light	5							X	X
Mitigation of Ammonia and PM Generation in Cage-Free	5	X	X			X		X	X
Relationship between HPAI & Weather Patterns	5	X	X						
Heat Treatment of Egg Flats to Ensure Biosecurity	6		X	X					
Quantifying Individual Hen's Feeding and Nesting Behaviors	6	X						X	X
Analysis of Sequence Data from HPAI Survivors	7		X				X		
Cage-Free Housing Ventilation Options	7	X	X			X		X	X
Feasible Methods to Extract Immune-Enhancing Yolk IgY	7		X	X					
Hen Gut and Lung Microbiomes in Different Housing	8	X	X					X	X
Improving Transition between Rear and Lay Environments	8	X						X	X

Completed Research

The Role of Litter Beetles, Water, Feed and Rodents in Avian Influenza Virus Transmission

Objective:
Determine if dry poultry feed, darkling beetles, poultry drinking waterers and laboratory mice could harbor AIV-RNA for a five-day period under laboratory conditions.

Takeaway:
AIV-RNA, but not viable virus, was found in dry poultry feed. Poultry drinking water systems were negative at 24 hours after flushing with distilled water or chlorinated city water. Therefore, neither dry poultry feed nor drinking waterers appear to be a significant source for transmission of LPAIV. In contrast, AIV-RNA and live virus was found in beetles up to five days after inoculation and could be a viable source for the transmission of LPAIV. Mice were susceptible to LPAIV but did not spread the virus to other mice via respiratory or digestive system routes; however, mice could play a role indirectly by mechanical transfer of contaminated organic matter on their feet or fur. (PI: Joseph Giambrone, Auburn University)

Air and Environmental Sampling of Infected Poultry Barns (Layer & Turkey) to Determine Dust as a Possible Carrier of AI Virus

Objective:
Test the hypothesis that HPAI virus exhausted from infected barns can be carried by dust particles. Infected particles, then airborne, could transmit to adjacent negative barns over certain distances, thereby posing a risk of additional infection and outbreak.

Takeaway:
The study showed that dust in affected poultry barns can indeed carry the virus. This finding verifies the need to minimize dust and stop transmission as quickly as possible once a flock is inflected. The final results indicate that additional research is needed to find a means by which virus-laden air can be treated or filtered for barn ventilation. (Egg Industry Center)

Disinfectant Effectiveness
Gallardo, UC - Davis

Understanding New HPAI Viruses Affecting the U.S. Poultry Industry and their Persistence

Objective:
Measure and compare the persistence of HPAI and LPAI over time and to assess the effectiveness of most disinfectants used against them.

Takeaway:
Bedding material and feces obtained from different commerical turkey, broiler and egg layer production units showed that live HPAI (H5N8) virus particles persisted 96 hours in layer feces and 48 hours in broiler and turkey bedding. In contrast, LPAI (H6N2) virus particles persisted only 12 hours. The effectiveness of footbath disinfectants showed that quaternary ammonia and quaternary ammonia + glutaraldehide based footbaths were not able to eliminate HPAI or LPAI live viral particles on boots, while a chlorine based granulated disinfectant was able to destroy the virus at contact. This result illustrates that footbaths are only one piece of a biosecurity program and cannot be exclusively relied upon for the prevention of pathogens in commercial flocks. (PI: Rodrigo Gallardo, University of California – Davis)

Evaluation of Alternative Environmental Sample Matrices for Avian Influenza Virus Surveillance and Stability in Commercial Poultry Facilities

Objective:
Evaluate different environmental sampling locations, sample matrices, collection materials and their utilization for simple and accurate detection of AIV as part of routine surveillance.

Takeaway:
This research showed that using environmental samples provides a convenient and continual method of animal and facility monitoring without invasive sampling of live hens. While further testing is needed to verify efficacy to detect the early stage of an outbreak of HPAI, these results show this is a distinct possibility. (PI: Phillip Gauger, Iowa State University)

Evaluation of Feedstuffs for the Presence of Avian Influenza Virus Collected from Feed Mills and Poultry Farms and their Role in Spreading AIV

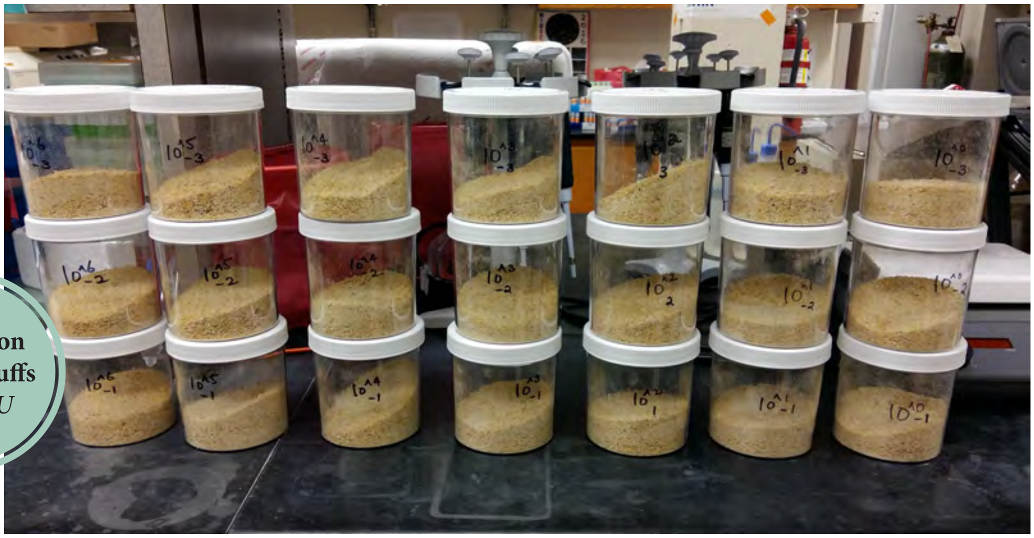
Objective:
Identify if feedstuffs, such as corn, could be contaminated with Avian Influenza Virus (AIV) and serve as a potential carrier and source of exposure in commercial chicken or turkey operations; and assess how long AIV is viable in spiked feed under controlled situations.

Takeaway:
The risk of infection through feed is low. However, managing and engaging in biosecurity is still essential for minimizing and eliminating potential pathways of contamination (such as egg shells used as ingredients in feed). (PI: Yuko Sato, Iowa State University)

Identifying Genetic Basis for Resistance to Avian Influenza in Commercial Egg Layer Chickens

Objective:
Through a case-control Genome-Wide Association Study, identify genomic regions that differ between survivors vs. their age and genetic-matched controls, determine whether the same genetic regions affect survival to HPAI in three genetic varieties of commercial laying hens, and whether the same genetic regions affect survival to H7N3 and H5N2 strains of HPAI.

Takeaway:
Analysis of the DNA from HPAI survivors showed that there is a genetic influence on survival, with 20% of bird survival being due to genetics. However, there is neither a single gene nor a small number of genes involved with the resistance, which complicates the process of selecting for improved resistance. (PI: Anna Wolc, Iowa State University)



Evaluation of Feedstuffs
Sato, ISU

Additional information can be found at *www.eggindustrycenter.org/research* under EIC Grant Program or EIC Research.

The Role of Terrestrial Wild Birds, Rodents, and Insects in Spreading Avian Influenza Virus to Commercial Layer Operations

Objective:
Determine whether small terrestrial wild birds (e.g., sparrows, starlings, and finches), rodents, and/or insects can transmit avian influenza viruses, including H5N2, between traditional wildlife reservoirs (i.e., waterfowls/shorebirds) and commercial layer operations, or among such farms.

Takeaway:
After swab and blood sampling of 554 small birds and rodents, not a single positive was found for AIV. Therefore, the researchers concluded that it is unlikely that small wild birds and rodents are a major factor in the transmission and spread of AIV. (PI: Kyoung-Jin Yoon, Iowa State University)

Modeling of Ventilation Shutdown (VSD) to Help Stop Virus Transmission

Objective:
Model the thermal environment and supplemental heat needs for proper depopulation using VSD. The goal was to provide information that could act as a guideline for the industry should this need arise in a future HPAI outbreak.

Takeaway:
The study found that a critical component for successful VSD is the proper distribution and ample supply of supplemental heat. The research team developed and partially verified a computer model that simulates the indoor environment upon VSD and the supplemental heat capacity required to reach and maintain the target environment for different housing styles, production stages of the birds, and a range of weather conditions. This information has been adopted and used by the USDA and egg producers. When available, field data are being collected and used to continue to validate and refine the VSD model. (Egg Industry Center)

Evaluation of an Electrostatic Air Filtration System in a High-Rise Layer House

Objective:
Evaluate a potential economically feasible and effective method to reduce risk of airborne disease transmission in a commercial layer facility.

Takeaway:
An electrostatic air filtration system (consisting of a low-grade air filter and an electrostatic particle ionization or EPI system) was installed and tested. According to one year of field measurements, removal efficiency of the EPI system was up to 80% in summer and 60% in winter. Depending on the time of year, this air filtration system resulted in a Particulate Matter (PM)2.5 and PM10 reduction ranging from 30-66% and 36- 68%, respectively. Removal efficiency became unstable when solely relying on the filter (with EPI turned off) for PM removal. Filter replacement was needed after approximately 16 weeks of use during the spring/summer. The timing of filter replacement could be determined by analyzing changes in static pressure or by image assessment of filter appearance. (Egg Industry Center)

> Removal efficiency [of EPI system] was up to eighty percent in the summer and sixty percent in the winter.
>
> Evaluation of an Electrostatic Air Filtration System in a High-Rise Layer House

Causes of Keel Bone Abnormalities in Laying Hens Housed in Enriched Colony Systems

Objective:
Evaluate the causes of keel bone damage (fractures and deviations) in laying hens housed in enriched colonies.

Takeaway:
A majority of keel bone damage in enriched colony systems originates from collisions with perches. More research needs to be done to determine the best way to design systems to minimize this damage. (Maja Makagon, University of California - Davis)

Evaluating Effects of LED vs. CFL Lighting on Behaviors and Production Performance of Pullets and Laying Hens

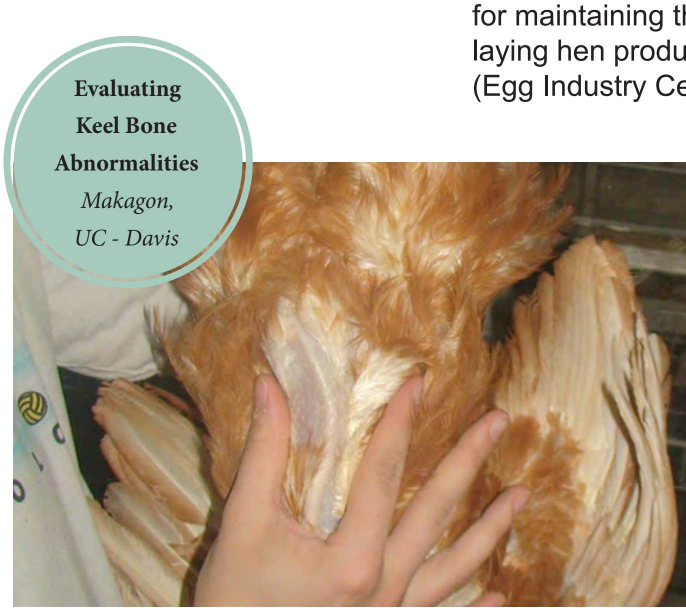
Objective:
Assess pullet locomotion behavior, hen production and egg quality, and lighting preference under commercial light-emitting-diode (LED) lighting and typical compact fluorescent (CFL) lighting.

Takeaway:
When given free choice, pullets and layers showed preference to the CFL lighting in terms of time spent, regardless of the prior lighting experience. However, no diference in feed intake was detected between the two light sources. LED and CFL light sources had no effect on timing of sexual maturity, egg production performance, egg quality, or yolk cholesterol of hens during the laying period of 17 to 41 weeks of age. This study demonstrated that the poultry-specific LED lights may provide a viable alternative to the traditional fluorescent lights for maintaining the Hy-Line W-36 laying hen production performance. (Egg Industry Center)

The Effects of Egg Yolk on Piglet Growth, Health, and Gut Microbial Populations

Objective:
Examine the effects of egg yolk on nursery pig growth performance, gut microbial communities, and immune system.

Takeaway:
Both egg yolk and plasma are adequate options for nursery pig diets with egg yolk showing a slight increase in average daily gain at 42-52 days of age. Therefore, the decision of which protein source to use in a nursery pig diet would depend on the cost of the protein at the time of feeding and shifts in the egg market would need to be considered. (PI: Phillip Miller, University of Nebraska - Lincoln)



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Research In Progress

Assessment of the Relationship between HPAI Outbreaks and Weather Patterns through Meterological Modeling

Objective:
Assess the likelihood and risk of HAPI spread through airborne transmission during the 2015 outbreak using a meteological modeling technique.

Preliminary Takeaway:
The preliminary results of this on-going study indicate a potential exists for air originating from the inflected facilities to have played a role in the disease spread. This reinforces the need to promptly stop the emission of the virus-laden air from the positive facilities and to explore ways of stopping the virus-laden air from entering the negative barns. (Egg Industry Center)

Evaluating Behavioral Responses of Poultry to Ultraviolet Light (UV) via Preference Test

Objective:
Investigate the behavioral and health responses of young chicks to selected UV lights.

Preliminary Takeaway:
No preliminary results were available at the time of publication. (Egg Industry Center)

Mitigation of Ammonia & Dust
Egg Industry Center

Mitigation of Ammonia and PM Generation in Litter-Floored Cage-Free Hen Housing Systems

Objective:
Identify the optimal combination of acidic electrolized water (AEW) pH and spray dosage to reduce both Particulate Matter (PM) and ammonia (NH_3) in a commercial cage-free housing system.

Preliminary Takeaway:
The preliminary results of the lab-scale study indicate PM can be reduced by 60-70% through the use of AEW. However, because spraying liquid on litter can enhance NH_3 emissions, it is important to apply a low pH liquid to the litter. When assessing this research for wide-scale industry application, the potential corrosive effect of low pH liquid application on the housing equipment needed to be addressed. Therefore, a commercial poultry litter additive was tested together with a neutral electrolyzed water spray for a simultaneous reduction of both NH_3 and PM. Results from this portion of the study indicated that if the litter additive was applied at the higher end of the recommended rate, litter NH_3 emissions could be reduced by up to 79%. A field verification study within a commerical cage-free layer house is on-going at this time. (Egg Industry Center)

Quantifying Individual Hen's Feeding and Nesting Behaviors in Group Housing and the Impact of Resource Allocation on these Responses

Objective:
Use radio-frequency identification (RFID) to track individual bird behavior which enables informed enhancement of next generation design and management techniques for enriched colony housing (ECH) systems for hens.

Preliminary Takeaway:
Preliminary results show that laying hens in the ECH system spent an average of 56 minutes inside the nest box either laying eggs or exploring the area. This amounted to approximately 17 visits per day. While a majority (93%) of the eggs are laid in the nest box, 4% of the eggs were laid in the scratch area and 3% were laid in the perch area. Maximum occupancy was forced to occur 5-6 hours after the lights were turned on. Hens spent 310 minutes at the feeder. There was no difference between 4.7 and 3.7 inch feeder space for all the feeding behaviors including feed intake. Less feeder space (3.3 and 2.6 inches) did affect the time that birds spet feeding, but this did not impact measured production performance parameters such as hen-day egg prodcution, or feed and water intake.(Egg Industry Center)

Heat Treatment of Egg Flats to Ensure Biosecurity

Objective:
Investigate an increased biosecurity protocol involving heat-treating of egg transport flats to a certain threshold temperature (e.g., 130-140°F or 54 - 60°C) for a certain period of time (e.g., 8 hr) to ensure any pathogens on the flats would be destroyed. This experiment determines how fast heat can penetrate into wrapped stacks of egg flats and the most effective design of a heating system so it can be installed on a farm.

Preliminary Takeaway:
A number of lab trials have been conducted to test the impacts of flat-stack configurations, initial temperature of the stack, and heating capacity and air distribution on temperature within the stack. The lab-test results have been extended to a commercial operation, where further verification and adjustment of the heating strategies are continuing. (Egg Industry Center)

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>
> Quantifying Individual Hen's Feeding and Nesting Behaviors in Group Housing

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Recently Funded Research

Cage-Free Housing Ventilation Options to Reduce Disease Spread, Improve Air Quality, and Enhance Bird Welfare

Objective:
Provide refinements on upward-flow ventilation design that showed promise in a previously published study. The goal is to create more uniform conditions and substantially decrease disease spread that can occur with current downward-flow ventilation designs.

Expected Outcomes:
Create practical recommendations that can be used by building and equipment suppliers. This project will document the impact of refined/various ventilation configurations in cage-free housing on indoor air quality, uniformity, supplemental heat, and bird comfort. (PI: Eileen Fabian, Pennsylvania State University)

Analysis of Sequence Data of Survivors and Controls from Highly Pathogenic Avian Influenza Outbreaks

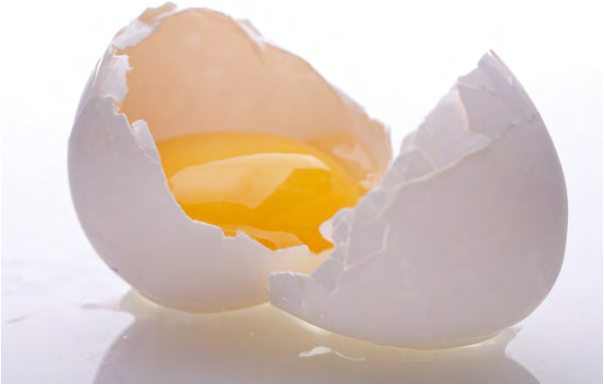
Objective:
Analyze sequence data of Avian Influenza survivors and controls to find genomic regions that differ between these two groups and therefore may encompass prime candidates for genes that infer resistance to HPAI.

Expected Outcomes:
Assist in recreating the favorable gene combinations that allow for selecting birds with improved resistance to HPAI in current breeding stocks; if genetic variants that convey resistance can be identified. (PI: Anna Wolc, Iowa State University)

Develop Feasible Methods to Extract Immune-Enhancing Yolk IgY and Produce Differentiated and Functional Yolk Products

Objective:
Make the scale-up separation of IgY and other yolk components feasible and determine the functionalities and applications of yolk co-products.

Expected Outcomes:
Add value to egg yolks and make IgY technology production-ready. Ideally, once the separation process is finalized, an additional phase of research can focus on the use of IgY as an option to manage overall hen health and possibly protect against infection of diseases like avian influenza. Yolk co-products will be used to provide additional value to egg processors as they diversify their offerings of the egg products and egg-based ingredients. (PI: Tong Wang, Iowa State University)



Comparison of Gut and Lung Microbiomes of Hens Raised in Conventional and Cage-Free Houses to Determine Disease Susceptibility

Objective:
Compare hens raised in conventional and cage-free houses at different stages of their maturity for their susceptibility to infections, using high-throughput sequencing of the gut and lung microbiota and in-vitro assays, and determine how housing conditions may affect chicken health.

Expected Outcomes:
Produce an in-depth characterization of hens' innate immune functions and their microbiota from cage and cage-free housing and provide information that may be used to decrease disease susceptibility in laying hens housed in cage-free systems. (PI: Melha Mellata, Iowa State University)

Improving the Transition between Rear and Lay Environments to Improve Welfare and Productivity of Aviary-Housed Laying Hens

Objective:
Investigate whether encouraging greater and earlier locomotion among vertical tiers during rearing by installing ramps can lead to specific changes in the short term bone density and strength. In the long term, the goal is to see if birds during the lay cycle have increased movement which will increase their access to feed and water and may reduce the frequence of keel bone damage. Reseachers will also investigate the benefit of overall structural similarities between rearing and laying environments to evaluate if hens adapt more quickly following population.

Expected Outcomes:
Results from this study are expected to provide industry stakeholders with data-driven, objective solutions for improving structural design of rearing and laying aviaries. A quicker adaptation to laying environments after transfer from rearing environments would result in reduced stress and that would improve general quality of life for laying hens in aviaries. The information gathered from this study will serve to inform the US egg industry about the viability of aviary systems and how that viability can be improved in terms of animal welfare and production.   (PI: Janice Siegford, Michigan State University)


Improving Rear and Lay Transition
Siegford, MSU

Photos courtesy of Big Dutchman

Additional information can be found at *www.eggindustrycenter.org/research* under EIC Grant Program or EIC Research.

Save the Date
April 16-18, 2018

10th Anniversary Celebration
Egg Forum & Golf Championship

Scottsdale, AZ

Photos courtesy of Scottsdale Convention & Visitors Bureau

TALKING STICK RESORT

Golf Tournament
Monday, April 16 @ 1 pm

Egg Issues Forum
Tuesday, April 17 @ 1 pm -
Wednesday, April 18 @ 1 pm

Registration opens January 2018
at www.eggindustrycenter.org