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Improving veal calf housing



Traditionally, veal production has involved housing calves individually, which is not popular with consumers. The veal industry is beginning to group house calves but have many unanswered questions. We teamed with Strauss Veal Feeds Inc., to determine the impact on production, health, and behavior of housing calves in groups with the same space allocation, calves were housed in groups of 2, 4, or 8 calves with the same area per calf for 5 months. Calves housed in larger groups

(4 or 8 calves per pen) showed more contact with other calves, more walking, more standing, and more disturbance and displacement from the feed trough and less manipulation of objects, less self-licking, and less lying when compared to calves housed in small groups (2 calves per pen). During feeding, group size had no effect on any behavioral pattern except for duration of contact with other calves. Calves in different group sizes were similar for hip height change and heart girth change over the duration of the experiment. Coughing was greater for calves in groups of 8 during the first 2 months, but they had fewer incidence of nasal discharge during the last month. Overall, production, health, and behavior differences were transient and not negatively affected by the changes in group sizes. Veal calves can be grouped at least up to groups of 8 without prolonged negative impacts on production or well-being of the calves when given excellent housing and management attention.

It's Complicated: By-products of Ethanol Production Use in Swine Diets and *Salmonella*

As an alternative to counteract the increased feed costs, dried distillers grains with solubles (DDGS) have been increasingly included in pig diets. Much research has been conducted recently to evaluate growth performance and carcass characteristics associated with feeding DDGS to pigs. However, little is known about the potential effect of DDGS on the susceptibility to infection or colonization with pathogens. Dr. Marcos Rostagno of the LBRU collaborated with Dr. Brian Richert of Purdue University to conduct two experiments using different concentrations of DDGS in swine diets. They found that the cumulative *Salmonella* fecal shedding frequency 5 weeks post-infection was less when pigs were fed diets containing 30% DDGS. However, they also found that cumulative *Salmonella* fecal shedding was greater as diets increased containment of DDGS from 0%, 20% and up to 40%; indicating that feeding DDGS may increase risk of spreading *Salmonella* in the herd

or abattoir when recently fed. They found no difference between treatments regarding the average *Salmonella* fecal shedding level. Also, no difference between treatments was found on the frequency or levels of *Salmonella* in intestinal samples collected at 3 or 5 weeks post-challenge. In conclusion, dietary inclusion of corn DDGS does not alter the susceptibility to or colonization with *Salmonella* of grow-finishing pigs; however it causes pigs to shed more *Salmonella* in the short term after initiation on the diet.



Reducing aggression in chickens starts with the egg

Cannibalism and injurious pecking are major welfare concerns in the egg production industry. Currently, hens are often beak trimmed (removing $\frac{1}{2}$ to $\frac{1}{2}$ of the upper and lower mandibles using a hot blade) to prevent or reduce injury and mortality from these injurious behaviors. However, the beak trimming procedure may introduce a separate welfare issue, causing pain to the trimmed birds.

Our research team designed a study aimed at reducing the birds' motivation to initiate injurious pecking. Serotonin is a primary neurotransmitter involved in regulating pecking behaviors. It is present in the egg during the earliest stages of development. The objective of our study was to investigate the long term effects of a single dose of serotonin or a pharmaceutical agent that stimulates a serotonin receptor

involved in aggression (5-HT1A receptor agonist) delivered to the egg immediately following lay. The eggs were then incubated and allowed to hatch.

The resulting chicks were raised to sexual maturity (18 weeks of age). Aggression and fearfulness were measured at 9 and 18 weeks of age.

Birds treated with excess serotonin in the egg were found to be less aggressive but have a greater fear response compared to untreated control birds. Birds treated with the pharmaceutical serotonin agonist in the egg showed no difference in behavioral response. Our data suggest that a prenatal increase in the concentrations of serotonin has long-term effects on the bird's behaviors including aggression and improves bird well-being.



*“Award-winning
graduate researchers”*

Recent Awards



Feifei Yan picked up 2 awards at Purdue's Department of Animal Science Annual Graduate Student Luncheon. Firstly she was present-

ed with the Gerry W. Friars International Graduate Student Fellowship, awarded to international students studying quantitative genetics in poultry and secondly, she was awarded the W.R. Featherston Outstanding MS Award. Feifei moved to the LBRU and Purdue from Zhejiang University, China and has worked in Dr. Cheng's lab. Since completing her MS, she has stayed with us and is working on her PhD, still with Dr. Cheng, studying neuronal plasticity and perch access on well-being in laying hens.

Also successful at the Luncheon was **Gabriela Morello** who was presented with the W.R. Featherston Early Graduate

Career Award. Gabriela joined Dr. Marchant-Forde's lab in August 2011 and is in the 2nd year of her PhD studies.



Gabriela has completed a complex pilot project, with multiple components, investigating the effects of microclimate on piglet mortality and sow behavior and the results give tantalizing evidence that all farrowing crates within a room are not created equal and that the subtle differences in environment, such as temperature, humidity, airflow, sound and light intensity can impact piglet mortality and important behaviors of the sow that contribute to crushing mortality.

Gabi was also one of only 30 graduate fellows chosen

from universities across the U.S. at the 2012 Borlaug Summer Institute on Global Food Security, here at Purdue. The 2-week program aimed at developing a holistic understanding of the conceptual challenges around global food security. She also picked up 2 Conference Attendance awards in 2013 from the International Society for Applied Ethology and from Humane Society International, which enabled her to travel to the 47th Congress of ISAE in Brazil and present her work.

Laurie Mack collected a MidWest ASAS Young Scholar Award at the MidWest section meeting in Iowa in March 2013, where she gave an invited presentation on her PhD research entitled “Social stress and space allowance in gestational group housing influences sow and piglet welfare”.

Grants awarded



- **Cheng, H.W.**, Hester, P.Y., Gates, R.S., Makagon, M.M., Wigle, W., and Olynk Widmar, N.J. USDA-AFRI. \$499,814. Thermal perches as cooling devices for reducing heat stress in caged hens.
- Green, A.R., Gates, R.S., **Cheng, H.W.**, and Johnson, Y. USDA-AFRI. \$699,896. Decision support for environmental management of cage and cage-alternative layer housing systems for thermal comfort and air quality.
- Hester, P.Y., Garner, J.P., Rubin, D.A., Jefferson-Moore, K.Y., **Cheng, H.W.**, and Wakenell, P.S. USDA-AFRI. \$545,092. Osteoporosis in white leghorns: The effect of mechanical loading during the life cycle of the laying hens.
- **Lay Jr, D.C.**, **Marchant-Forde, J.N.** and Richert B.T. National Pork Board. \$147,273. Designer diets to decrease aggression and increase welfare.
- **Marchant-Forde, J.N.** University of Helsinki. \$20,900. Ending tail docking and tail biting in the EU – Hazard characterization and exposure assessment of a major pig welfare problem. Part of a \$3.5 million EU-funded project involving collaboration with 10 institutes in 8 countries.
- Rault, J-L, **Lay Jr., D.C.**, Johnson, C. and Sutherland, M. National Pork Board. \$43,387. Nitrous oxide for piglet euthanasia: validation by electroencephalography.
- **Rostagno, M.H.** and Richert, B.T. National Pork Board. \$45,000. Does the inclusion of distillers dried grains with soluble (DDGS) in the diet of grow-finish pigs affect their susceptibility to and colonization with *Salmonella enterica*?

Arrivals LBRU Welcomes.....

Dr. Avi Sapkota started as a post-doctoral scientist with the LBRU in May, 2013 to modify diets in pregnant sows to reduce aggression while mixing. Avi completed Bachelors in Veterinary Science and Animal Husbandry (BVSc and AH) in 2008 from his home country Nepal. In 2009, he started his PhD under Dr. John McGlone in the Laboratory of Animal Behavior, Physiology and Welfare, in the Department of Animal Science at Texas Tech University. He completed his PhD in 2012 on determining the bedding and boarding requirements for finishing pigs during commercial transportation and environmental management of pigs.

Avi aims to extend his area of research to answer how lives of farm animals can be made better by modifying existing facilities and adopt-

ing new technologies to improve welfare of animals and also maximize profit to the industry.

Dr. Ediane Silva has taken up a role as a post-doctoral scientist with the LBRU. Originally from Brazil, Ediane holds DVM, MS and PhD degrees from the Federal University of Goias, Brazil. She moved to the US in 2008 and has held post-doc positions at the University of Texas Medical Branch and Colorado State University, working on bovine tuberculosis and the development of vaccines for *Burkholderia pseudomallei*. With her veterinary virology and microbiology expertise, Ediane will be focusing on our stress/pathogen biology research, but will contribute broadly across our projects.



Current Personnel

Dr. Don C. Lay, Jr. - Research Leader
 Dr. Heng-wei Cheng - Research Biologist
 Dr. Susan D. Eicher - Research Physiologist
 Dr. Jeremy N. Marchant-Forde - Research Animal Scientist
 Dr. Rachel L. Dennis - Post-doctoral scientist
 Dr. Avi Sapkota - Post-doctoral scientist
 Dr. Ediane Silva - Post-doctoral scientist
 Gary Nowling - Biological Science Technician

Rita Lockridge - Biological Science Technician
 Jiaying Hu - Graduate Researcher
 Gabriela Morello - Graduate Researcher
 Rebecca Strong - Graduate Researcher
 Feifei Yan - Graduate Researcher
 Usama Mahmoud - Visiting Scholar
 Rebecca Atkinson-Haley - Program Support Assistant

Flooring for dairy cows

Some housing can result in long-term chronic pain. Acute pain on immunity has been explored, but chronic pain influence on immune responses is poorly understood. Therefore the objective of this collaborative research with Dr. Mike Schutz of Purdue, was to determine chronic effects on immune responses and production of flooring in free-stall



housing for dairy cows. Rubber was compared with concrete flooring during the first and second lactations. Important production measures, such as milk fat and protein, were less for cows on concrete. The number of hoof therapies required was greater for those housed on con-

crete and cows housed on concrete had worse locomotion in the second lactation. Cows housed on concrete had greater white blood cell counts, particularly in the second lactation, indicating an on-going inflammation. Additionally, greater expression of inflammatory cell mediators (cytokines) confirms the presence of a chronic inflammation. These data support the use of rubber flooring for cow health and comfort, potentially reducing chronic inflammation that affects many aspects of production and health.

Perches for laying hens



Working with Dr. Scotti Hester at Purdue, we investigated a major skeletal problem of conventionally-caged hens; namely increased susceptibility to osteoporosis

mainly due to lack of exercise. Osteoporosis is characterized by a progressive decrease in mineralized structural bone. Whereas considerable attention has been given to enriching laying cages, the objective of the current study was to determine if metal perches during all or part of the life cycle of White Leghorns affected hen musculoskeletal health, especially at the end of lay. Treatments during the pullet phase (hatch to 17 weeks) entailed cages with and without perches. Four treatments were used during the laying phase (17 to 71 weeks of age). Treatment 1 chickens never had access to perches at any point during their life cycle,

typical of egg industry practices in the United States for conventional cages. Treatment 2 chickens had access to perches only during the egg laying phase which was from 17 to 71 weeks of age. Treatment 3 chickens had access to perches only during the pullet phase (0 to 17 weeks of age). Treatment 4 chickens had perch access throughout their entire life cycle (0 to 71 weeks of age). Musculoskeletal health was assessed by measuring bone mineralization, muscle weights, bone fracture incidence, and keel bone deviations. Results showed that muscle deposition of 71-week-old hens was increased by providing perches during the pullet phase. In addition, hens' bone mineralization was increased by accessing perches during the laying phase. However, the increase in bone mineralization of the keel bone as a result of perch access was not great enough to prevent a higher incidence of keel bone fractures at the end of lay. Perch re-design could be a solution to minimize keel fractures and deviations for improving caged hen well-being.

Departures....



Goodbye!

Dr. Marcos Rostagno departed in Fall 2013 after 9 years as a Research Animal Scientist in our unit, with expertise in veterinary microbiology. During his time in the unit, Marcos greatly enhanced our work on the relationships between stress and pre-harvest food safety, collaborating within LBRU, nationally and internationally. He has moved on to be

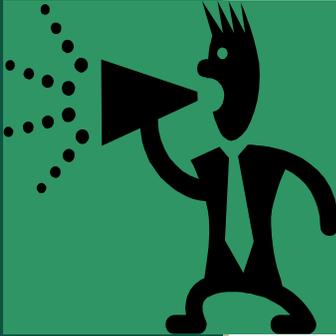
Senior Global Technical Consultant with Elanco Animal Health based in nearby Indianapolis, but will continue to collaborate with LBRU.

Kim McMunn left in the summer of 2013 to begin her DVM studies here at Purdue University and, concurrently, her MPH through the University of Minnesota. Kim had been with the

LBRU since 2001, working as an Animal Scientist, supporting Dr. Lay primarily. However, her broad knowledge and skillset were used across the Unit.

After 2 years as a Biological Technician, **Emily Var-go** joined Covance in December 2013, as a Study Technician working on developmental and reproductive toxicology.

Invites & Media Coverage



- Cheng, H.W.**, Hester, P.Y. et al. (2013) Perch access in laying hen cages studied. Consultant-written article in Feedstuffs. Feb. 4, 2013. Available at: http://mydigimag.rrd.com/article/Perch_Access_in_Laying_Hen_Cages_Studied/1303045/145167/article.html
- Eicher, S.D.** (2014) Invited Editor of Special Issue of Veterinary Immunology and Immunopathology. April 2014.
- Lay Jr., D.C.** (2012) Laying hen welfare. Talk presented to stakeholders at the Annual Meeting of the American Egg Board. Columbus, OH, March 2012.
- Lay Jr., D.C.** (2012) Research methods in animal welfare. Talk given to students and faculty at Eastern New Mexico University (a Hispanic-Serving Institution), Portales, NM, April 2012
- Lay Jr., D.C.** (2012) Invited to discuss animal welfare with Costco, at their International Product and Safety Conference, Seattle, WA, Nov. 2012.
- Lay Jr., D.C.** (2014) Animal Care and Well-Being. What is best for the Animal. Talk presented to attendees at the Minnesota Veterinary Medical Association conference. Minneapolis, MN, Feb. 2014.
- Lay Jr., D.C.** (2014) The science of animal welfare. Talk presented to attendees at Joint ASAS/ADSA Midwest Meeting, Des Moines, IA, March 2014.
- Lay Jr., D.C.** (2014) Pain, mechanisms and management. Talk presented to attendees at the National Institute for Animal Agriculture Annual Conference, Omaha NE April 2014
- Marchant-Forde, J.N.** (2012) Current research program at USDA-ARS, LBRU. Talk presented to researchers at Nanjing Agricultural University, China. Dec. 2012.
- Marchant-Forde, J.N.** (2012) Housing sows in groups: the ethology of sow aggression. Talk presented to researchers at Nanjing Agricultural University, China. Dec. 2012.
- Marchant-Forde, J.N.** (2012) Ethology of sow aggression. Talk presented to attendees at 2012 Allen D. Leman Swine Conference, University of Minnesota, St. Paul, MN. Sept. 2012.
- Marchant-Forde, J.N.** (2013) Mixing sows: the search for social stability with minimal aggression. Talk presented to researchers at University of Helsinki, Finland. Nov. 2013.
- Marchant-Forde, J.N.** (2013) Cognitive abilities of pigs. Live radio interview given on the Colin McEnroe Show "Paying Homage to Pigs" on WNPR Radio. Dec. 19, 2013. Available at: <http://wnpr.org/post/paying-homage-pigs>
- Rostagno, M.H.** (2013) Pre-harvest risk factors for *Salmonella* in pork production. Talk presented to stakeholders at 2013 Boehringer Ingelheim North Carolina Swine Health Seminar, Sept. 2013.
- Rostagno, M.H.** (2013) Food/Pork safety analysis. Talk presented to stakeholders at 2013 World Pork Expo, Des Moines, IA, June 2013.

Moms-to-be, exercise pays off!

In 2008 one-third of all deaths in America were due to cardiovascular disease. This disease was thought to be predominantly associated with the aging population. However, recent reports about atherosclerotic lesions in adolescents, children and infants challenge this perception and provide evidence that the intrauterine environment may alter susceptibility to cardiovascular disease. Maternal over- or under-nutrition during pregnancy can influence the offspring's feed consumption, behavior and metabolism. However, knowledge regarding potentially positive maternal health behaviors during pregnancy is currently limited. Exercise is a well-known intervention for prevention and treatment of cardiovascular disease in children and adults, and exercise in mothers during pregnancy may convey protective effects on the developing fetus that has long-lasting effects after birth. Therefore, the aim of this collaborative study between ARS and Purdue's Departments of Health & Kinesiology and Animal Sciences was to test the hypothesis that



maternal exercise during pregnancy would improve function of femoral arteries of pigs at 3 (pre-pubertal), 5 (pubertal), and 9 months (post-pubertal) of age. We hypothesized that altered feed consumption, spontaneous activity, liver gene expression, and blood lipid profile would contribute to the improved vascular health of the offspring from

exercise trained mothers. We compared offspring from sedentary sows with offspring from sows that were trained during gestation to run on a treadmill. We found that exercise did not affect feed consumption, activity, liver gene expression, or blood lipid profile. However, alterations in vascular function were observed at 3, 5 and 9 months of age. Therefore, maternal exercise during pregnancy may provide a stimulus sufficient enough in strength to induce artery specific programming in offspring and have long-term impacts on cardiovascular health.

Feed withdrawal and transportation

Market pigs infected with *Salmonella* pose significant food safety risk by carrying the pathogen into abattoirs. This work determined if two common pre-slaughter stressors, feed withdrawal or transporting of the pigs, affected the levels of *Salmonella* in market-weight pigs and determined effects of management components. Feed withdrawal (FW) alone or followed by transportation (FWT) increased *Salmonella* concentrations in the intestinal contents of the pigs. However, only FWT increased *Salmonella* in cecal contents, where pathogens are initially controlled. Fecal shedding was not affected by treatments. Concentrations of the stress hormone cortisol were

greater for FWT and only transport compared to controls. In contrast, white blood cell counts and lymphocyte percentages were reduced by FWT.

Spleen cell expression of inflammatory messengers were greater for the FW than control pigs. Feed withdrawal alone or in conjunction with transport appeared to have more detrimental effects for the market weight pig.



Visitors



Essam Abdelfattah from Benha University, Egypt, spent 24 months with the LBRU as a Visiting Scholar,



working to finish his PhD looking at the effects of housing system on the behavior, immunity and performance of dairy calves. The goal of this work is to improve calf welfare by providing answers for the best practices in group housing for veal and dairy calves in N. America.

Eduardo Santurtun, a Mexican veterinarian studying for his PhD in Australia, spent time in winter 2013 as a Visiting Scholar to learn heart rate variability analysis techniques, to apply to his research on sheep transport at the University of Queensland.

Usama Mahmoud is currently with the LBRU as a Visiting scholar working on stress in poultry. Usama is a lecturer at Assiut University in Egypt, completing his PhD.



Amanda Figueiredo Amaral, a veterinary undergraduate student from University Federal of Lavras (UFLA) - Brazil, spent 2013 as a Visiting Scholar at the Purdue University working with researchers at the LBRU, especially with swine, in the areas of microbiology, nutrition, wellness and stress physiology.

Guilherme Milanez Preis, a veterinary student from Santa Catarina State University, Brazil, spent 9 months in 2012-13 as a Visiting Scholar, supported by the CNPq program "Science Without Borders", obtaining knowledge on applied microbiology with emphasis in microbial ecology of the gastrointestinal tract of swine and poultry, and pre-harvest food safety.

Antonio Diego Brandao Melo, developed the academic training required for his DVM degree at Santa Cruz State University, Brazil, spending one year (2012-2013) as a Visiting Scholar working with production animals, advancing his knowledge on applied microbiology with emphasis in microbial ecology of the gastrointestinal tract of swine and poultry, to apply to his future researches projects in Brazil

Lucas Januzzi Lara a veterinary undergraduate at UFLA, Brazil, spent 2013 as a Visiting Scholar to learn microbiology and molecular biology analysis techniques and animal welfare and behavior concepts.

Hebert Silveira, a student of animal production for his PhD at UFLA, Brazil, spent 7 months of 2013 as a Visiting



Scholar to learn the gene expression techniques following an ex-vivo model in swine, to apply to his research on Animal Science

department at the University of Lavras. While with us, he helped in our research program involving gut health of swine, doing analyses of histology and microbiology.

Cristiano Bortoluzzi, a veterinarian and masters student of University of Sao Paulo, Brazil, spent 3 months in summer 2013 as a Visiting Scholar, to learn microbiology and gene expression techniques, to apply



in his research on poultry nutrition at the University of Sao Paulo.

Lucio Vilela Carneiro Girao, an animal scientist studying for his PhD in Sao Paulo State University, Brazil, spent one semester in 2012 as a Visiting Scholar to work with microbial ecology of the digestive tract of pigs and intestinal health.

Gustavo Schaefer spent 5 months in Summer 2012 as a Visiting Scholar to learn The Antimicrobial Effects of Essential Oils to apply to his completion of veterinary degree coursework at FAI University from Brazil

Dr. Cheng coordinates the Summer Research for Mainland Chinese and Taiwanese Students Program and has hosted 9 students in 2012, and 10 students in 2013. The students work with faculty in Purdue Dept. of Animal Sciences and LBRU scientists.

Recent Publications



- Abdelfattah, E.M., Schutz, M.M., Lay Jr., D.C., Marchant-Forde, J.N., and Eicher, S.D.** (2013) Effect of group size on behavior, health, production and welfare of veal calves. *Journal of Animal Science*, **91**: 5455-5465.
- Bahls, M., Sheldon, R.D., Taheripour, P., Clifford, K.A., Foust, K.B., Breslin, E.D., **Marchant-Forde, J.N.**, Cabot, R.A., Laughlin, M.H., Bidwell, C.A. and Newcomer, S.C. (2014) Mothers' exercise during pregnancy programs vasomotor function in adult offspring. *Experimental Physiology*, **99**: 205-219.
- Carvalho, E.R., Schmelz-Roberts, N.S., White, H.M., **Wilcox, C.S., Eicher, S.D.**, and Donkin, S.S. (2012) Feeding behaviors of transition dairy cows fed glycerol as a replacement for corn. *Journal of Dairy Science*, **95**: 7214-7224.
- Cheng, H.W.** (2012) Genetic variation in resistance to inflammation and infectious disease. In: *Inflammatory Diseases – Immunopathology, Clinical and Pharmacological Bases*, (ed. M. Khatami) Published by InTech, Croatia. Pp.333-350.
- DeBoer, S.P.**, Garner, J.P., **Lay Jr., D.C., Eicher, S.D.**, Lucas, J.R. and **Marchant-Forde, J.N.** (2013) Does the presence of a human effect the preference of enrichment items in young isolated pigs? *Applied Animal Behaviour Science*, **143**: 96-103.
- Dennis, R.L.**, and **Cheng, H.W.** (2012) Effects of selective serotonin antagonism on central neurotransmission. *Poultry Science*, **91**: 817-822.
- Dennis, R.L.**, and **Cheng, H.W.** (2012) Effects of different infrared beak treatment protocols on chicken welfare and physiology. *Poultry Science*, **91**: 1499-1505.
- Dennis, R.L.**, Fahey, A.G., and **Cheng, H.W.** (2013) Alterations to Embryonic Serotonin Change Aggression and Fearfulness. *Aggressive Behavior*, **39**: 91-98.
- Dennis, R.L.**, **Lay, D.C., Jr.**, and **Cheng, H.W.** (2013) Effects of early serotonin programming on behavior and central monoamine concentrations in an avian model. *Behavioral Brain Research*, **253**: 290-296.
- Eicher, S.D.**, **Lay, D.C., Jr.**, Arthington, J.D., and Schutz, M.M. (2013) Effects of rubber flooring during the first 2 lactations on production, locomotion, hoof health, immune functions, and stress. *Journal of Dairy Science*, **96**: 3639-3651.
- Eicher, S.D.**, Miller, L.C., and Sordillo, L.M. (2014) Dual purpose with dual benefit research models in veterinary and biomedical research. *Veterinary Immunology and Immunopathology*, <http://dx.doi.org/10.1016/j.vetimm.2014.02.006>
- Enneking, S.A.**, **Cheng, H.W.**, Jefferson-Moore, K.Y., Einstein, M.E., Rubin, D.A., and Hester, P.Y. (2012) Early access to perches in caged White Leghorn pullets. *Poultry Science*, **91**:2114-2120.
- Felver-Gant, J.N.**, **Mack, L.A.**, **Dennis, R.L.**, **Eicher, S.D.**, and **Cheng, H.W.** (2012) Genetic variations alter physiological responses following heat stress in 2 strains of laying hens. *Poultry Science*, **91**: 1542-1551.
- Hester, P.Y., **Enneking, S.A.**, Haley, B.K., **Cheng, H.W.**, Einstein, M.E., and Rubin, D. A. (2013) The effect of perch availability during pullet rearing and egg laying on musculoskeletal health of caged White Leghorn hens. *Poultry Science*, **92**:1972-1980.
- Hester, P.Y., **Enneking, S.A.**, Jefferson-Moore, K.Y., Einstein, M.E., **Cheng, H.W.**, and Rubin, D. A. (2013) The effect of perches in cages during pullet rearing and egg laying on hen performance, foot health, and plumage. *Poultry Science*, **92**: 310-320.
- Jiang, S., **Cheng, H.W.**, Hester, P.Y., and Hou, J.-F. (2013) Development of an enzyme-linked immunosorbent assay for detection of chicken osteocalcin and its use in evaluation of perch effects on bone remodeling in caged White Leghorns. *Poultry Science*, **92**: 1951-1961.
- Jiang, S., **Cheng, H.W.**, Cui, L.Y., Zhou, Z. L., and Hou, J. F. (2013) Changes of blood parameters associated with bone remodeling following experimentally induced fatty liver disorder in laying hens. *Poultry Science*, **92**:1443-1453.
- Kanaan, V.T., **Lay, D.C., Jr.**, Richert, B.T., and Pajor, E.A. (2012) Increasing the frequency of co-mingling piglets during the lactation period alters the development of social behavior before and after weaning. *Journal of Applied Animal Welfare Science*, **15**: 163-180.
- Lara, L.J. and **Rostagno, M.H.** (2013) Impact of heat stress on poultry production. *Animals*, **3**: 356-369
- Mack, L.A.**, **Felver-Gant, J.N.**, **Dennis, R.L.**, and **Cheng, H.W.** (2013) Genetic variations alter production and behavioral responses following heat stress in 2 strains of laying hens. *Poultry Science*, **92**: 285-294.
- Mack, L.A.**, **Lay, D.C., Jr.**, **Eicher, S.D.**, Johnson, A.K., Richert, B.T. and Pajor, E.A. (2014) Growth and reproductive development of male piglets are more vulnerable to midgestation maternal stress than that of female piglets. *Journal of Animal Science*, **92**: 530-548.
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- Marchant-Forde, J.N.**, Matthews, D.L., **Poletto, R.**, McCain, R.R., Mann, D.D., DeGraw, R.T., Hampsch, J.M., Peters, S., Knipp, G.T., and Kissinger, C.B. (2012) Plasma cortisol and noradrenalin concentrations in pigs: automated sampling of freely moving pigs housed in the PigTurn® versus manually sampled and restrained pigs. *Animal Welfare*, **21**: 197-205.
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- Mendes, A.S., Paixao, S.J., Restelatto, R., **Morello, G.M.**, de Moura, D.J., and Possenti, J.C. (2013) Performance and preference of broiler chickens exposed to different lighting sources. *Journal of Applied Poultry Research*, **22**: 62-70.
- Mendes, A.S., Moura, D.J., Naeaes, I.A., **Morello, G.M.**, Carvalho, T.M.R., Refatti, R., Paixao, S.J. (2013) Minimum ventilation systems and their effects on the initial stage of turkey production. *Brazilian Journal of Poultry Science*, **15**: 7-13.
- Morello, G.M.**, Overhults, D.G. Day, G.B., Gates, R.S., Lopes, I.M. and Earnest, Jr., J.W. (2014) Using the Fan Assessment Numeration System (FANS) *in situ*: a procedure for minimiz-

Recent Publications continued



ing errors during fan tests. *Transactions of the ASABE*, **57**: 199-209

Muir, W.M. and **Cheng, H.W.** (2014) Genetic influences on the behavior of chickens associated with welfare and productivity, *Genetics and the Behavior of Domestic Animals, 2nd* (ed. T. Grandin and M.J. Deesing). Pp.317-359.

Rault, J.L., Carter, S.C., Garner, J.P., **Marchant-Forde, J.N.**, Richert, B.T. and **Lay Jr., D.C.** (2013) Repeated intranasal oxytocin administration to pigs in early life dysregulates the hypothalamic-pituitary-adrenal axis and alters social behavior. *Physiology & Behavior*, **112-113**: 40-48.

Rault, J.-L., **Mack, L.A.**, Carter C.S., Garner, J.P., **Marchant-Forde, J.N.**, Richert, B.T. and **Lay Jr., D.C.** (2013) Prenatal stress puzzle, the oxytocin piece: Prenatal stress alters the behaviour and autonomic regulation in piglets, insights from oxytocin. *Applied Animal Behaviour Science*, **148**: 99-107.

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Mirror, mirror on the wall.....

Within a biomedical setting, the pig may be housed individually, in a bare environment. As an animal that has evolved to be social and highly active within a complex environment, this type of housing may impose stress. We examined different ways to improve or enrich the environment and to have the pig tell us which it preferred by seeing which enrichments it would spend more time with. We offered the pig a choice between 4 different pens; one pen was a standard rectangular pen with metal floor and solid sides (CTRL), one pen had a rubber mat on part of the floor (MAT), one pen had a mirror on one wall (MIR) and one pen had a barred gate instead of a wall through which it could see another pig across a passageway (COM). Pigs preferred to spend more time in the COM pen compared to the CTRL pen, with the other pens intermediate. When the human was present, the pigs spent much more time in one of the social-type pens (COM or MIR) compared to when the human was absent. Within the social pen category, COM or MIR were equally chosen. These results show that the pig's choice was affected by changes in the experimental setting. When undisturbed, the pigs clearly chose to spend more time across from the other pig, which could lead us to



conclude that only that enrichment was important. However, when the human entered the room, the choice shifted and the mirror became as important as the other pig. The reflection of the pig in the mirror may be perceived as a closer companion pig but more research would be needed to confirm this. However, it could be that a mirror is a useful way of improving a pig's ability to cope with stressful situations in environments in which they have to be housed alone.

Cranberries and piglets

Neonatal pigs are vulnerable to infection by pathogenic bacteria resulting in decreased growth rates and increased mortality. Cranberry products have shown potential to reduce colonization by pathogens without harming the microbial populations necessary for digestive processes. ARS and Purdue collaborators found that cranberry products (cranberry juice,



whole cranberry powder, and cranberry fiber) helped the piglets to resist *Salmonella* allowing a quicker recovery from a



Salmonella challenge. This research suggests that the whole cranberry powder may provide protection from some enteric pathogens in weaned pigs. The research was supported in part by NATUREX-DBS LLC, Carver, MA.

Two Presidents...

The LBRU is home to the Presidents of 2 academic societies. **Dr. Susan Eicher** has taken office as President of the American Association of Veterinary Immunologists and **Dr. Jeremy Marchant-Forde** is current President of the International Society for Applied Ethology.

Susan took the reins of AAVI in Jan. 2014 and will serve for a year. AAVI is dedicated to the development, promotion, and dissemination of knowledge in veterinary immunology. This includes

immunology of livestock and poultry, companion animals, fish and marine mammals. Susan has been very active in the association for the last 10 years, serving on the Board of Directors and as Vice-President and President-elect. She will serve as Past President for 2015.

Jeremy took over ISAE Presidency in July 2013 and will serve until August 2015 before moving into an Senior Vice-President role for a further 2 years. He has been a member of the society since

1990 and has served as Treasurer and Junior Vice-President previously. ISAE is the leading academic association for scientists interested in the behavior and welfare of confined or domesticated animals, including companion, farm, zoo and managed wild animal species across the world. LBRU researchers have been active in the society for many years and hosted ISAE's 45th Congress in Indianapolis in 2011.



American
Association
of Veterinary
Immunologists



Oxytocin and social behavior in pigs

Pigs and other farm animals typically experience several regroupings depending on their production stages, which can result in social stress. These situations can involve aggression and social stress which leads to detrimental effects on swine health and productivity. In contrast to aggressive interactions, positive social interactions can reduce the adverse effects of social stress.

These beneficial effects derived from positive interactions may be mediated by oxytocin, a neuropeptide underlying social behavior. Social behavior is a major concern for farm animal welfare. To date, no study has investigated the role of oxytocin in the social behavior and stress coping abilities of farm animals. To investigate this, in each of six litters, two pigs per litter received oxytocin intranasally and two control littermates received saline at 1, 2 and 3 days of age. Pigs were weaned at 17 days of age and mixed individually with four unfamiliar pigs. This



social mixing was repeated at 8 weeks of age. On each occasion, we analyzed behavior, and collected blood samples to measure stress hormones. Oxytocin administered pigs were involved in more aggression when mixed and showed a greater stress response

after weaning at 17 days of age, with a few effects persisting at mixing at 8 weeks of age. Overall, this study confirmed that pigs repeatedly administered oxytocin after birth show behavioral and physiological differences compared to non-treated pigs. However, these modifications could be detrimental as oxytocin treated pigs showed increased aggression and a long-term dysregulation of their stress response. A better knowledge of the neurobiological mechanisms of social behavior will help to clarify how different husbandry practices can lead to various outcomes in animal health and well-being



USDA-ARS-MWA

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The mission of the Livestock Behavior Research Unit is to develop scientific measures of Animal Well-being, through the study of animal behavior, stress physiology, immunology, neurophysiology, and cognition; that will allow an objective evaluation of animal agricultural practices. This method of study will allow the improvement of existing practices and invention of new practices that can enhance animal well-being and increase animal productivity. In addition, this unit is dedicated to address Food Safety concerns by understanding how bacteria manifest infestation in livestock and to investigate production strategies by which to limit this infestation to increase animal health and to increase food safety. The optimization of Animal Well-being and Pre-harvest Food Safety will assist in improving animal health, increasing productivity and decreasing human exposure to dangerous pathogens.

*Finding solutions to
agricultural challenges*

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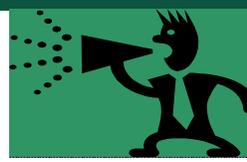


Out & About - disseminating LBRU research



LBRU scientists attended and presented at the following conferences:

- 46th Congress of the International Society for Applied Ethology, Vienna, Austria, August 2012.
- 47th Congress of the International Society for Applied Ethology, Florianopolis, Brazil, June 2013.
- Conference of Research Workers in Animal Disease, Chicago, IL, December 2012.
- Conference of Research Workers in Animal Disease, Chicago, IL, December 2013.
- 2012 Joint Annual Meeting - ASAS-ADSA-AMPA-CSAS, Phoenix, AZ, July 2012.
- 2013 Joint Annual Meeting - ASAS-ADSA, Indianapolis, IN, July 2013.



- American Association of Veterinary Immunologists Mini-symposium, Chicago, IL, December 2012
- American Association of Immunologists - Veterinary Immunology Committee Symposium, Honolulu, HI, May 2013
- 2012 Annual meeting of the Poultry Science Association, Athens, GA. July 2012.
- 2013 Annual meeting of the Poultry Science Association, San Diego, CA. July 2013.
- 2013 Midwest Section ASAS, Des Moines, IA. March 2013.
- 2013 World Pork Expo, Des Moines, IA. June 2013