

**499 Effects of a high rate of gain for increasing lengths of time on body and mammary growth in prepubertal dairy heifers.** L. E. Davis\*, M. S. Weber Nielsen, L. T. Chapin, J. S. Liesman, and M. J. VandeHaar, *Michigan State University, East Lansing.*

A high rate of gain in dairy heifers for #8805 3 mo is detrimental to prepubertal mammary growth and subsequent milk yield. However, the effects of a high rate of gain for shorter periods have not been reported. Our objective was to compare effects of high (1200 g/d) and low (600 g/d) rates of gain over different lengths of time (0, 3, 6, 12 wk) on body and mammary growth. Heifers (age = 11 wk, n = 64, BW = 107 kg, SE = 1.0) were randomly assigned to 1 of 4 treatments: H0 (low diet fed for 12 wk); H3 (low diet fed for 9 wk followed by high diet for 3 wk); H6 (low diet fed for 6 wk followed by high diet for 6 wk); and H12 (high diet fed for 12 wk). Animals were slaughtered at 23 wk of age. Statistical analysis used the GLM procedure of SAS and tested multiple comparisons using the Bonferroni test. Statistical significance was declared at  $P < 0.05$ . Average daily gain and final live weights were different for all comparisons except H0 versus H3 (H0 = 662, H3 = 660, H6 = 848, H12 = 1124 g/d, SE = 12; H0 = 165, H3 = 166, H6 = 181, H12 = 203 kg, SE = 1). Final withers height was greater for H6 and H12 (H0 = 100, H3 = 100, H6 = 102, H12 = 104 cm; SE = 0.3). Carcass wt were different for all comparisons (H0 = 77, H3 = 82, H6 = 92, H12 = 107 kg; SE = 1). Mammary hemigland mass increased with time on high diet (H0 = 529, H3 = 591, H6 = 768, H12 = 864 g/100 kg carcass wt; SE = 43). Mass of perirenal fat also increased with time on the high diet (H0 = 900, H3 = 1181, H6 = 1608, H12 = 1794 g/100 kg carcass wt; SE = 105). Short-term changes in diet altered growth of body and mammary tissues. Composition analysis of carcass and mammary tissues are ongoing.

**Key Words:** Growth, Heifer, Mammary

**500 Long days that hasten puberty do not reduce lean body growth in heifers.** A. G. Rius\*<sup>1</sup>, P. E. Kendall<sup>1</sup>, T. L. Auchtung<sup>1</sup>, A. V. Capuco<sup>2</sup>, E. E. Connor<sup>2</sup>, and G. E. Dahl<sup>1</sup>, <sup>1</sup>*University of Illinois, Urbana,* <sup>2</sup>*USDA-ARS, BGFL, Beltsville, MD.*

Photoperiod affects growth and development in many species with long day photoperiod (LDPP; 16L:8D) hastening the onset of puberty and enhancing lean growth in cattle. Appropriate body scale is crucial in heifers at first parturition. However, accelerating prepubertal growth may diminish mammary parenchymal growth. Nutritional factors including metabolizable protein also affect the onset of puberty, body and mammary growth in heifers. Our objective was to determine if LDPP hastens the onset of puberty without limiting skeletal growth, (i.e. height). We also sought to determine if the response to LDPP is limited by protein availability. Holstein heifers (n = 32) were assigned to 1 of 4 treatments in a randomized complete block design and a 2x2 factorial arrangement to assess effects of photoperiod and dietary bypass protein on the onset of puberty and body growth. Treatments were LDPP, short day photoperiod (SDPP; 8L:16D), high or low dietary bypass protein. Blood samples were analyzed for PRL concentration to confirm a photoperiodic response and for progesterone to determine puberty. Body weight (BW), withers height (WH), hip height (HH), and heart girth (HG) were measured every two weeks. After puberty, heifers were housed under natural photoperiod and body measurements were continued to evaluate body growth postpubertally. Heifers exposed to LDPP reached ( $P < 0.02$ ) puberty 20 d earlier than animals on SDPP. Increasing dietary bypass protein did not affect growth of heifers (BW, WH, HH or HG) on either photoperiod treatment. However, heifers previously exposed to SDPP gained 22 kg more ( $P < 0.05$ ) of BW after puberty than did heifers previously exposed to LDPP. These data support the use of photoperiod as a non-invasive technique to hasten skeletal without limiting lean growth and development in heifers.

**Key Words:** Photoperiod, Growth, Heifer

## PSA World Poultry Science Lecture

**501 Reducing the carriage of foodborne pathogens by livestock and poultry.** M. P. Doyle\*, *Center for Food Safety, University of Georgia, Athens.*

Livestock and poultry are frequently asymptomatic carriers of human enteric pathogens. Salmonella, Campylobacter and Escherichia coli O157:H7 can reside in the animal's gastrointestinal tract and be shed in feces that subsequently contaminates food and water. Practical, effective on-farm interventions are needed to provide greater protection of the environment and the food supply. Progress is being made on several

fronts in developing useful strategies for pathogen control in animals. Examples include competitive exclusion microorganisms, vaccines, bacteriophages, water/feed treatments, and husbandry practices. Reducing pathogen carriage by animals on the farm can have a major impact on reducing contamination of the environment, water and food, thereby providing greater public health protection.

**Key Words:** Foodborne Pathogens, Competitive Exclusion, Preharvest Interventions

## Animal Behavior & Well Being II

**502 Correlating spatial learning, social recognition and aggression in young pigs.** J. M. Siegford\*, A. S. Souza, J. Jansen, and A. J. Zanella, *Department of Animal Science, Michigan State University, East Lansing.*

We examined cognitive abilities and agonistic behavior in young female pigs to determine whether spatial learning (SL) was correlated with social recognition (SR) and post-mixing aggression. SL and SR require activation of the hippocampus, thus they may be correlated. Therefore, pigs performing well in SL should remember other pigs more easily in SR and might use information of previous social encounters to avoid fights when mixed. SL of pigs was tested twice (d13 and d14) using a modified water maze (WM) in which pigs in a pool of opaque water locate a submerged platform (5 exposures per pig separated by 10min). Good (GP; n=23) and poor performers (PP; n=24) were selected based on latencies from previous WM results for pigs of this age. Using average latencies from exposures 2-5 on both days, criterion for GP was  $< 55$ s and criterion for PP was  $> 70$ s. Animals were familiarized at d20 and d21 in arenas divided by flexible netting. SR testing was subsequently carried out at d21 and d22. At d23, all pigs were weaned. On d24, piglets were retested in the WM. Latency continued to decrease, suggesting weaning did not disrupt memory of the WM task, but no difference in latency was seen between GP and PP ( $F_{1,47}=0.04$ ;  $p=0.84$ ). At d25, pigs were mixed in groups of 6 GPs (n=4) or PPs (n=4) and duration and number of fights were monitored for 1 day. Pre-mixing familiarization led to a decrease

in post-mixing fights ( $F_{1,43}=4.75$ ;  $p=0.03$ ;  $7.26 \pm 1.49$  vs.  $4.46 \pm 0.69$ ). In the first 3 hours post-mixing, unfamiliar PPs fought more than other groups ( $F_{1,43}=14.33$ ;  $p < 0.001$ ;  $13.67 \pm 2.32$  vs.  $5.22 \pm 2.22$ ), suggesting a correlation between SL and post-mixing aggression. Duration of fights was affected by interaction of day with familiarity ( $F_{1,43}=4.61$ ;  $p=0.04$ ) and time of day with WM performance ( $F_{1,43}=4.41$ ;  $p=0.04$ ). Additional animals are being tested to strengthen findings, which suggest familiar pigs and possibly GP fight less. Protocols could be developed to familiarize litters to reduce post-mixing aggression in production.

**Key Words:** Behavior, Welfare, Learning

**503 Acute stress impairs spatial learning and social recognition in early-weaned pigs.** A. S. Souza\*, K. Laughlin, J. M. Siegford, and A. J. Zanella, *Department of Animal Science, Michigan State University, East Lansing.*

We investigated whether weaning age and social isolation disrupt spatial learning (SL) and/or social recognition (SR) in newly-weaned pigs. Female pigs were early-weaned at d11-12 (EW; n=48) or conventional-weaned at d23 (CW; n=48) and social isolation (SI) for 15 minutes occurred immediately before testing each pig once in either SL or SR. We assessed SL using a modified water maze, in which pigs in a pool of opaque water and must locate a submerged platform. The latency to reach the platform from a pre-determined release point was recorded

over 7 exposures (separated by 10 minutes). A decrease in latency across exposures has been validated as a measure of SL. For SR, 2 litters at time were habituated to each other for 8h in an arena divided by netting, preventing mixing and fighting. The day following habituation pairs of pigs from habituated litters were re-habituated for 20min, then pigs were exposed to a familiar or an unfamiliar conspecific for 3min to test SR. Duration of social investigation is a valid measure of SR as familiar conspecifics spend less time in social investigation than unfamiliar animals. Social isolation of pigs caused significant impairment in SL (GLM;  $F_{1,48}=18.59$ ,  $p=0.0001$ ) and interaction of weaning age and SI (GLM;  $F_{1,48}=11.14$ ,  $p<0.0018$ ), with EW pigs showing no decrease in latency following isolation. A significant interaction existed between weaning age and SI during SR between familiar animals (GLM;  $F_{1,17}=23.13$ ,  $p=0.0002$ ). Socially isolated EW pigs investigated familiar animals more than non-SI EW animals ( $66.57s\pm 5.92$  vs.  $14.28s\pm 3.54$ ,  $p<0.0001$ ), SI CW ( $18.60s\pm 5.92$ ,  $p<0.0001$ ) or non-SI ( $20.80s\pm 7.26$ ,  $p<0.0001$ ) CW pigs. The amount of social investigation did not differ in unfamiliar animals. The observed deficits in SL and SR with EW and SI suggest potential cognitive disruption and may be affected by age at which the developing brain is exposed to increases in stress hormones, such as those accompanying weaning. Possible neural mechanisms for this disruption are being investigated.

**Key Words:** Welfare, Behavior, Stress

#### 504 Relationships among pre- and post-weaning oral-nasal behaviors and growth rates in newly weaned pigs. S. Torrey\* and T. M. Widowski, *Department of Animal and Poultry Sciences, University of Guelph, Guelph, ON, Canada.*

Previous studies have found large differences in the amounts of time that individual piglets spend belly-nosing in the first few weeks post weaning, but the individual characteristics that predispose some pigs to perform oral vices are not known. The objectives of this experiment were to discern whether piglets that perform the most nursing behaviors during and in-between nursing bouts pre-weaning also perform the most belly-nosing and pig-directed behaviors post-weaning and to determine any relationships between these behaviors and growth rates. Sixty-six pigs from seven litters of Yorkshire pigs were individually identified and observed for nursing-related behaviors during and in between three nursing bouts on each of three days pre-weaning (days 7, 12, 17 of age) and weaned at 21 days. Pigs were penned with littermates post-weaning and behaviors were scan sampled from video-recordings for 21 days. In addition, individual piglets were weighed at birth, at days 7, 12 and 17 of age, at weaning and at days 7, 14 and 21 post-weaning. Pearson partial correlations were performed on individual pig data with litter used as a partial covariate. The performance of nursing behaviors during a nursing bout tended to be negatively related to belly-nosing post-weaning ( $P = 0.07$ ;  $r^2 = -0.22$ ). Birth weight ( $P < 0.05$ ;  $r^2 = -0.26$ ) and post-weaning average daily gain ( $P < 0.01$ ;  $r^2 = -0.35$ ) were also negatively related to belly-nosing. Alternatively, there were positive relationships between nosing behavior directed onto objects post-weaning and pre-weaning ( $P < 0.001$ ;  $r^2 = 0.45$ ) and post-weaning ( $P < 0.05$ ;  $r^2 = 0.29$ ) average daily gains. Pre-weaning behaviors and growth rates are related to the performance of oral-nasal behaviors post-weaning, with the low birth weight, slower-growing piglets performing the most belly-nosing.

**Key Words:** Belly-Nosing, Nursing, Weaning

#### 505 Effects of induced mixing and pen size on performance and serum concentration of acute phase proteins in growing pigs. C Piñero\*<sup>1</sup>, J Morales<sup>1</sup>, M Piñero\*<sup>1</sup>, F Lampreave<sup>2</sup>, and G.G Mateos<sup>3</sup>, <sup>1</sup>PigCHAMP Pro Europa, S.A., Spain, <sup>2</sup>U. de Zaragoza, Spain, <sup>3</sup>UP. de Madrid, Spain.

There is a growing interest to assess the response to stressors in pigs. The objective of this study was to determine the response of serum levels of two acute-phase proteins (APP's) (Pig-MAP; MAP and haptoglobin; HPT) and performance due to mixing and pen size at the entry at the fattening unit. A total of 240 pigs (LW x LW-LD)  $20.2\pm 0.9$  kg BW was randomly distributed in 24 pens in a  $2 \times 2 \times 2$  factorial that included the effects of mixing (mixing or same piglets than in nursery), pen size (8 or 12 pigs per pen), and sex. Piglets were controlled every 14 d from 60 to 116 d of age to determine ADG, FC and FI). Blood samples were taken at d 1, 5, 14, 28, and 42 d of the study. Mixing affected APP's concentration. The day following placement at the fattening barn, mixed pigs had higher MAP values ( $2.07$  vs  $1.36$  mg/mL;

$P=0.0006$ ) than not-mixed pigs and the differences were still significant 5 d after placement ( $1.18$  vs  $0.90$  mg/mL;  $P=0.04$ ). At d 14, mixed pigs tended to have higher MAP values ( $0.69$  vs  $0.54$  mg/mL;  $P=0.07$ ) than non-mixed pigs but the difference disappeared thereafter. No consistent pattern was observed for HPT, but the concentration was always higher for mixed pigs and in fact the effect was significant at d 14 ( $1.83$  vs  $1.31$  mg/mL;  $P=0.05$ ). The differences in APP's concentrations correlated with differences in productive performance and from 74 to 88 d of life non-mixed pigs showed a higher ADG than mixed pigs ( $667$  vs  $624$  g/d;  $P=0.02$ ). Pen size did not have any effect on APP serum concentrations but ADG were higher for pigs kept in groups of 8 than in pigs kept in groups of 12 ( $736$  vs  $712$  g/d;  $P=0.03$ , respectively). Boars were more sensitive to both stressors than females and showed higher MAP concentration ( $P<0.05$ ) and lower growth ( $P<0.05$ ) than females. We conclude that mixing of pigs at the start of the fattening period induces stress independently of pen size and that serum concentration of APP's can be used to detect the intensity of the stress.

**Key Words:** Pigs, Stress, Acute-Phase Proteins

#### 506 Gestation induced changes in behavior and autonomic regulation of cardiac activity in gilts. R. M. Marchant-Forde\* and J. N. Marchant-Forde, *USDA-ARS, West Lafayette, IN.*

Gestation in mammals is a time of considerable physical, physiological and behavioral change necessary for the continuance of the pregnancy. Gestating pigs are often used in behavior and well-being studies yet there is little published data describing how gestation affects normal behaviour and patterns of autonomic regulatory control of cardiac activity. The objective of this work was to evaluate gestation induced modifications in the longitudinal dynamics of behavior and autonomic regulation of cardiac activity using heart rate variability parameters in primiparous pigs. The behavior and cardiac activity of ten gilts were recorded at fixed time points over gestation as follows: 1 weeks before oestrus and mating (week 1), 14 days post-mating (week 2), day 30 (week 4), day 44 (week 6), day 65 (week 9), day 79 (week 11), day 93 (week 13) and day 107 (week 15) of pregnancy. Temporal changes in behavior patterns were present in all gilts over the course of gestation. Pre-test levels of general activity progressively declined between weeks -1 and 15 as indicated by a decrease in the proportion of observations spent rooting ( $p<0.001$ ), walking ( $p<0.001$ ) and standing ( $p<0.001$ ). There was a corresponding increase in inactivity ( $p<0.001$ ) and the proportion of time spent sleeping, as opposed to lying alert, increased also ( $p<0.001$ ). Apart from RR-min and its corresponding HR-max indices, all time domain parameters of cardiac activity were substantially influenced by stage of gestation. Specifically, mean HR increased ( $p<0.001$ ) whereas RMSSD and SD decreased ( $p<0.001$ ). Pregnancy further impacted on frequency domain measures of heart rate variability. From week 1 to week 15 the absolute magnitude of Total power ( $p<0.001$ ) decreased, HF power decreased, ( $p<0.001$ ) and LF power increased ( $p=0.004$ ). In conclusion, pregnancy induced widespread changes in behavior and in sympathovagal regulation of cardiac activity in pigs that were reflected in both time and frequency domain indices of heart rate variability analysis.

**Key Words:** Gestation, Behavior, Heart Rate Variability

#### 507 Circadian rhythmicity in behaviour and cardiac activity of gilts and heifers. R. M. Marchant-Forde\*<sup>1</sup>, J. N. Marchant-Forde\*<sup>1</sup>, and R. Hofman<sup>2</sup>, <sup>1</sup>USDA-ARS, West Lafayette, IN, <sup>2</sup>Institute of Animal Husbandry and Welfare, University of Veterinary Medicine, Vienna, Austria.

Biological rhythms are of universal occurrence in animals and it is usually easy to demonstrate adaptive explanations for them. The aim of this work was to examine circadian patterns of behavior and cardiac activity in gilts and heifers, to determine if any rhythms present followed general sleep/wake cycles and the degree to which they were influenced by activity levels. Continuous behavior and cardiac data were simultaneously recorded in non-gravid gilts and heifers over a 24h period. Scan sample were used to extract behavior data from videotapes and hourly means for all behaviors, as well as the proportion of time spent active or inactive, were determined. Cardiac data was processed for error before undergoing heart rate variability (HRV) analysis. Hourly means for all cardiac indices were also calculated. Cosinor analysis was used to evaluate circadian rhythms from which the MESOR, amplitude, acrophase, and Pearsons correlation coefficient were determined. Results

found that gilts and heifers differed largely in their 24h behavioral time budgets. Heifers were considerably more active ( $p < 0.01$ ), spent more time standing ( $p < 0.01$ ) and less time investigating their surroundings ( $p < 0.01$ ) than gilts. Gilts showed more circadian rhythmicity in behavior and HRV indices than heifers. Circadian patterns in time domain indices were generally similar, but with gilts demonstrating higher correlation coefficients than heifers in all bar one parameter. Relative to the sleep/wake cycle, rhythms in cardiac activity in gilts were closely associated with the sleep/wake cycle with mean HR being highest and parasympathetic indicators lowest at the end of the sleep period. While heifers demonstrated little circadian rhythmicity in behavior, rhythms in cardiac activity followed obvious circadian patterns, though their rhythmicity was still considerable lower than those in gilts. In summary, gilts showed strong circadian patterns in behavioral and HRV parameters, which were strongly interrelated, whereas heifers showed much weaker evidence of behavioral circadian patterns, but exhibited surprisingly strong circadian rhythmicity in HRV measures.

**Key Words:** Circadian Rhythms, Behavior, Heart Rate Variability

**508 Behavior and heart rate of crated gestating sows given an ICV CRH or a CRH receptor antagonist.** L. E. Hulbert<sup>\*1</sup>, J. M. Hellman<sup>1</sup>, J. W. Dailey<sup>2</sup>, J. L. Morrow<sup>2</sup>, and J. J. McGlone<sup>1</sup>, <sup>1</sup>*Pork Industry Institute, Texas Tech University, Lubbock*, <sup>2</sup>*USDA-ARS, Livestock Issues Research Unit, Lubbock, TX*.

Third-parity, crated Camborough-28 (PIC USA) sows ( $n=3$ ) were used to determine the effects of intracerebroventricular (icv) corticotropin releasing hormone (CRH) or a CRH antagonist (Astressin, AST) on sow behavior and heart rate. Specifically, we sought to determine if oronasal-facial (ONF) stereotyped behaviors were caused by elevations in central CRH. Sows were surgically fit with an icv canulae in the lateral ventricle during mid gestation. Following an 8-d recovery period, sows were fed and then 30 min later given icv saline (SAL), CRH or AST. Heart rates (Polar 610 IR) and sow behavior were recorded for 48 h after icv injection. Behaviors included sitting, standing, feeding, drinking, sham chewing, ONF directed towards the bars, floor, or feeder and total ONF duration and frequency. Central CRH increased ( $P < 0.01$ ) ONF directed towards the bars and the floor and total ONF compared with icv SAL. AST did not ( $P > 0.10$ ) change ONF or general activity. Total ONF duration was 187.8, 2,253.1 and 203.1 s for SAL, CRH and AST, respectively ( $P < 0.001$ ; SE = 117.8). Lying down duration was lower for CRH-treated sows than for sows in the other treatments (3,261, 1,153, 3,175 s for SAL, CRH and AST, respectively,  $P < 0.001$ ; SE = 127). Heart rate was increased among CRH-treated sows compared with the other treatment groups (75, 114 and 86 bpm;  $P < 0.01$ ; SE = 5.8). Increasing central CRH dramatically increased ONF, general activity and heart rate. Central AST did not reduce (or increase) ONF or heart rate. We conclude that elevated basal levels of CRH among crated sows does not cause ONF behaviors (because AST did not reduce this behavior). However, elevated central CRH increases both ONF behaviors and heart rate. Sow bar-biting behaviors, at the levels observed in crated sows, is not caused by elevated central CRH.

**Key Words:** Pigs, CRH, Welfare

**509 Behavioural description of cannibalism in fattening pig production.** D. Saffray<sup>\*1</sup>, I. Madec<sup>1</sup>, C. Lafont<sup>1</sup>, J.-F. Gabarrou<sup>2</sup>, and P. Pageat<sup>1</sup>, <sup>1</sup>*Pherosynthese, Saint Saturnin d'Apt, France*, <sup>2</sup>*ESA-Purpan, Toulouse, France*.

Cannibalism in fattening pigs' production refers to a special behavioural problem characterised by repeated bites between pen-mates, leading to wounds of variable severity. Stress and infections following these bites generate decrease of growth rate, emergency slaughter and carcass rejection at the abattoir. Cannibalism is at once a health, welfare and economic problem. Many solutions have been suggested but treatments showed a variable efficiency. A major reason of this situation is that the true causes of cannibalism are still unknown. To find out these causes, an accurate behavioural description is essential to establish if different types of individuals with particular behavioural patterns exist. From a list of 137 pig farms with cannibalism historical records, 12 farms were selected. Inclusion criteria were type of production, performance, genetic, type of cannibalism, type of buildings, feeding parameters, breeding methods and health status. Consequently, the selected farms were similar, allowing the constitution of a single database, with enough data for statistical analysis. In each pig farm, 2 to 4 pens were

filmed. For each pen, we realized 2 sequences of 30 minutes of video recording. Video recordings were analysed by means of a reading grid, focused on the bite act. We recorded wound status, bite type, motor act before the bite and motor act after the bite (for both the biter and the victim). With the resulting database, we carried out both a single variable descriptive analysis and a Multiple Correspondence Analysis. The part of the population involved in at least one bite is substantial (70 %) and is divided into four categories of individuals: biters who bite different body parts, biters who always bite the same body part, victims showing loss of tissue and individuals who are both biter and victim. Depending on the fattening pen in question, all or some of these categories are present, leading to suppose that we observed either different types of disorders or different stages of the same disorder. To settle this point, we need to carry out a study on cannibalism evolution in a same pen.

**Key Words:** Cannibalism, Description, Pig

**510 Maternal pheromone application before and(or) after weaning: effects on pig behavior and performance.** N. Krebs<sup>\*</sup> and J. J. McGlone, *Pork Industry Institute, Texas Tech University, Lubbock*.

Weaning is a stressful event for piglets. A synthetic maternal pheromone was studied to determine its effects on behavior and performance of groups of weaned piglets when applied either before and(or) after weaning. Ninety-six 4-wk-old piglets from 30 litters were randomly assigned to 4 treatments arranged factorially with pheromone (PH) treatment (1 mL per pig Suiience; Ceva Sante Animale) or control (CO) in the pre-weaning farrowing environment and PH treatment (1 mL) or CO in the nursery. Each block contained 32 pigs (1 castrated male and 1 female from 4 litters per treatment). Observers recorded live pig behavior pre-weaning using a 10-min scan sample for 40 min before treatment and 80-min after treatment. Prior to weaning, Suiience was applied on sows' teats (or not), to test the hypothesis that the maternal pheromone may increase teat-contact behavior and post weaning feeding behavior. Pigs were weaned into pens that contained either nothing or the maternal pheromone while being video taped in time lapse for 48 h. Pigs were weighed at weaning and each week for 4 wk. Feed disappearance was recorded and feed efficiency was calculated. The maternal pheromone applied in farrowing environment decreased piglet-teat contact behavior (16.2 vs. 8.5 %, SE = 1.91,  $P = 0.047$ , for CO and PH, respectively). The farrowing treatment by period effect was significant ( $P = 0.03$ ) for post-weaning agonistic behavior; CO pigs had higher % time engaged in agonistic behavior than PH pigs during the first 8 h and 20 to 24 h after weaning. Pigs given PH in the nursery environment had a higher ( $P = 0.02$ ) % of observations standing close to the feeder than CO piglets. There were no significant differences among treatments in pig weaning weights, post-weaning gain or feed intake. In conclusion, the application of PH on the sows' teats before weaning did not increase piglet-teat contact but PH reduced post-weaning agonistic behaviors and increased piglet time spent near the feeder.

**Key Words:** Pigs, Pheromone, Behavior

**511 Pig behavioral responses to biologically relevant and non-relevant odors.** N. Krebs<sup>\*</sup> and J. J. McGlone, *Pork Industry Institute, Texas Tech University, Lubbock*.

Pigs use olfaction to detect biologically-relevant odors including pheromones. The objective of this study was to quantify pig behavioral responses to biologically-relevant and non-relevant odors. Pigs were evaluated for their behavioral type. High responder pigs (HR) showed 3 or more escapes in a back test; low responder (LR) piglets showed 2 or less escape attempts in a back test; medium responders (MR) were not consistently LR or HR. Sixty 14-d old piglets (30 castrated males and 30 females) were assigned to randomly experience one odor treatment (isopropyl alcohol [ISO], n-butanol [NB], amyl acetate [AA], maternal feces [MF], synthetic maternal pheromone [MP] and the boar pheromone androstenone [AN]) with the odor applied once in liquid and once in aerosol form. The aerosol was out of reach of the pigs' touch. Piglets displayed the same behaviors regardless of the form of the odors (liquid or aerosol). Piglets oriented their snout away from AA compared to ISO ( $P = 0.04$ ). There was a treatment by back test effect ( $P < 0.01$ ) for lying behavior (indicator of general activity), parallel-facing the fan (PFF;  $P < 0.01$ ) and parallel orienting away from the odor source (PAF;  $P < 0.01$ ). MR pigs spent more time lying down

when experiencing MP than all other treatments. LR pigs did not differ in lying time among odor treatments. HR piglets exposed to AA, NB or MF had decreased lying time compared with ISO. MR pigs spent more time PFF (interested in the odor) when exposed to MF or NB compared with ISO. LR pigs showed similar PFF when exposed to each odor. HR piglets showed more PFF when exposed to MF than ISO. MR piglets showed more PAF (avoided the odor) when exposed to MP and AA than ISO-exposed piglets. LR and HR did not differ in their PAF behaviors among odors. These experiments demonstrated that pig behavioral type interacted with piglet behavioral responses to relevant and non-relevant biological odors.

**Key Words:** Pigs, Odors, Backtest

**512 Effects of mixing stress on plasma cortisol, corticosteroid-binding globulin and free cortisol index in prenatally-stressed pigs.** D. C. Lay Jr<sup>\*1</sup>, H. G. Kattesh<sup>2</sup>, M. P. Roberts<sup>2</sup>, M. J. Toscano<sup>1</sup>, and K. A. McMunn<sup>1</sup>, <sup>1</sup>USDA-ARS Livestock Behavior Research Unit, West Lafayette, IN, <sup>2</sup>University of Tennessee, Knoxville.

Exposing a pregnant sow to stress has been shown to have negative effects on her resulting offspring. However, little knowledge exists regarding the mechanisms of this process or the effects of specific stressful events. Our objective was to determine if exposing a sow to stress altered the response of her offspring to mixing stress at 4 mo of age. Sow

treatments consisted of i.v. injections of adrenocorticotrophin (ACTH, 1 IU/kg BW) (ACTH), exposure to rough handling for a 10-minute duration (ROU), or no treatment (CONT) once a week during d 42 to 77 of gestation. At 4 mo of age, one pig from each litter (n = 14, 14, 15) was taken from its home pen and placed in a pen of unfamiliar pigs. Blood samples were collected three times per week for two weeks and then once a week for four more weeks. Blood samples were analyzed for cortisol and corticosteroid-binding globulin (CBG), and a free cortisol index (FCI; total cortisol/CBG) was calculated. In response to treatments, ACTH sows had greater concentrations of cortisol than did ROU sows, which had greater concentrations than CONT sows (77.1, 46.0 and 32.1 ng/mL, P < .004). CBG concentrations in pigs from CONT sows tended to be lower (P < .06) than pigs from ROU sows and was lower (P < .008) than pigs from ACTH sows (4.75 ± .10, 5.2 ± .12, and 5.51 ± .13 mg/L, respectively). An effect of gender was also detected with females having greater (P < .001) concentrations of CBG than males. No treatment differences (P < .10) were found for either plasma cortisol concentrations or FCI. A treatment by repetition (P < .02) and repetition effect (P < .04) were noted for both plasma cortisol and FCI. Prenatal stress, induced either artificially with injections of ACTH, or via rough handling, changes CBG responses compared to controls but does not alter either FCI or plasma cortisol concentrations. The degree to which effects of prenatal stress are induced in production livestock needs to be sought.

**Key Words:** Swine, Prenatal Stress, Corticosteroid Binding Globulin

## Animal Health: Dairy Cattle Health – Transition Cows and Mastitis

**513 Negative energy balance during the periparturient period is associated with uterine health disorders and fever in Holstein cows.** D. S. Hammon<sup>\*1</sup>, I. M. Evjen<sup>1</sup>, T. R. Dhiman<sup>1</sup>, and J. P. Goff<sup>2</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>USDA, National Animal Disease Center, Ames, IA.

Eighty-three multiparous Holstein cows were used to investigate the association between periparturient energy balance and uterine health disorders and fever. Blood samples were collected weekly from wk -2 to wk 5 postpartum for serum nonesterified fatty acids (NEFA) and Beta-hydroxybutyrate (BHB) Feed dry matter intake (DMI) was determined daily from wk -2 to wk 5 postpartum. Cows were examined at wk 3 for clinical endometritis (purulent cervical discharge on vaginal examination) and at wk 4 for subclinical (SC) endometritis (presence of neutrophils on endometrial cytological exam). Retained placentae (RP) were determined by visual and vaginal speculum examination on d 1 postpartum. Rectal temperatures were recorded from day 1-10 postpartum. Fever was defined as a rectal temperature #8805103°F for #88052 d. Differences in measurements were determined using a repeated measures of ANOVA. Of 83 cows total, 14 developed RP, 13 developed clinical endometritis, 61 developed SC endometritis, and 18 developed fever. Cows with RP had significantly (P < 0.001) lower DMI beginning 1 wk before calving and for the first 3 wk of lactation compared to cows without RP. Cows with SC endometritis had significantly (P = 0.01) lower DMI from wk -1 to wk 5, significantly (P = 0.01) higher NEFA from wk -2 to wk 4, and significantly higher (P < 0.04) BHBA from wk 1 to wk 4, compared to cows without subclinical endometritis. Cows with fever had significantly (P = 0.05) lower DMI from wk 1 to wk 4, significantly (P = 0.03) higher NEFA from wk -1 to wk 4, and significantly (P < 0.03) higher BHBA wk 1 to wk 4, compared to cows without fever. DMI, NEFA, and BHBA were similar for cows with or without clinical endometritis. From these data, we suggest that some uterine health disorders and fever are preceded by negative energy balance that begins prior to calving and extends into early lactation.

**Key Words:** Periparturient Dairy Cow, Endometritis, Negative Energy Balance

**514 The relationship between the incidence of production-limiting disease and return over feed in Ontario dairy herds.** C. McLaren<sup>\*1</sup>, K. Lissemore<sup>1</sup>, T. Duffield<sup>1</sup>, K. Leslie<sup>1</sup>, D. Kelton<sup>1</sup>, and B. Grexton<sup>2</sup>, <sup>1</sup>Department of Population Medicine, University of Guelph, Guelph, ON, Canada, <sup>2</sup>Ontario Dairy Herd Improvement Corporation, Ontario, Canada.

Production-limiting diseases are some of the most prevalent and costly conditions in the dairy industry. Displaced abomasum (DA), retained

placenta (RP), lameness, milk fever, mastitis and ketosis have a large economic impact on the individual animal. However, there are few studies that quantify their effect on herd economics. The objectives of this research were to examine the relationship between profitability as measured by the Ontario Dairy Herd Improvement (DHI) Corporation's Return over Feed herd profit index (ROF), and production-limiting disease. Clinical disease incidence risk of DA, lameness, RP, milk fever, mastitis and ketosis were calculated from participant submissions. For the determination of subclinical mastitis and ketosis cumulative incidence, the California Mastitis Test (>0) and the KetoTest<sup>®</sup> Beta-hydroxybutyrate (greater than or equal to 100 umol/l) milk test were used weekly in early postpartum cows (1-14 days). Producers were identified through the Ontario DHI Corporation ROF groups. The ROF was calculated from the difference between milk revenue and feed cost each month. Feed cost was determined from herd level dry matter intakes at each operation multiplied by fixed market prices for each feed ingredient. Revenue was calculated based on the Dairy Farmers of Ontario multiple component pricing formula for milk. There were 48 producers that submitted ROF, postpartum monitoring and clinical disease data for the period January 1st, 2002 and January 31st, 2003. Using linear regression modeling, no significant association (p>0.05) was detected for subclinical and clinical mastitis, RP, lameness and milk fever herd incidence with ROF.

Disease	Mean Herd	Coefficient <sup>1</sup>	p-value
	Incidence Risk (%)	(\$/cow/day)	
Subclinical Ketosis	61.0	-0.015	0.0239
Clinical Ketosis	2.1	0.12	0.0030
DA	3.4	0.11	0.0085

<sup>1</sup>Baseline ROF (Intercept)=\$13.13/cow/day, r<sup>2</sup>=0.33

**Key Words:** Return Over Feed, Production-Limiting Disease

**515 An evaluation of rumen-protected choline and monensin controlled release capsule on milk production, health and metabolic function of periparturient dairy cows.** L. Zahra<sup>\*1</sup>, S. LeBlanc<sup>1</sup>, K. Leslie<sup>1</sup>, T. Duffield<sup>1</sup>, T. Overton<sup>2</sup>, and D. Putnam<sup>3</sup>, <sup>1</sup>Department of Population Medicine, University of Guelph, Guelph, ON, Canada, <sup>2</sup>Department of Animal Science, Cornell University, Ithaca, NY, <sup>3</sup>Balchem Corporation, New Hampton, NY.

Three weeks prior calving, 185 Holstein cows were randomly assigned to receive one of the following: a monensin CRC, a daily top-dress of