579 Industry productivity analysis: Grow-finish traits. C. E. Hostetler*[1] and M. T. Knauer[2], [1]*National Pork Board, Des Moines, IA,* [2]*North Carolina State University, Raleigh*

The objective of this study was to quantify US swine production benchmarks and trends for nursery and finishing traits from a representative database. Data were provided by a data management company representing approximately 1.8 million sows in North America. Production records were available from 2005 to 2010. Nursery and finishing traits included entry age, entry weight, exit age, exit weight, ADG, G:F, caloric efficiency (kcal:kg) and mortality. Nursery and finishing kcal:kg were standardized from 5.4 to 22.7 kg and 22.7 to 118 kg, respectively. Data were analyzed in SAS using PROC MIXED. Models included year and month as fixed effects. Standard errors for nursery entry age, entry weight, exit age, exit weight, ADG, G:F, kcal:kg and mortality were 0.11, 0.026, 0.22, 0.09, 0.0041, 0.0031, 38.6 and 0.19, respectively. Standard errors for finishing exit age, exit weight, ADG, G:F, kcal:kg and mortality were 0.5, 0.41, 0.007, 0.0015, 79.4, 0.34, respectively. Nursery entry age and weight increased ($P < 0.05$) from 2005 to 2010 (19.2 to 20.5 d and 5.53 to 5.85 kg, respectively). Nursery exit age decreased ($P < 0.05$) from 68.3 to 67.1 d and exit weight increased ($P < 0.05$) from 22.7 to 23.4 kg. Finishing exit age decreased ($P < 0.05$) from 191 to 190 d and exit weight increased ($P < 0.05$) from 117.7 to 119.9 kg. Means for ADG, G:F, kcal:kg and mortality are shown by year in Table 1. Finishing ADG increased ($P < 0.05$) and mortality decreased ($P < 0.05$) indicating more weight sold in a fixed amount of time. However, finishing kcal:kg did not differ ($P > 0.05$) between 2005 and 2010. Both producers and scientists can use these grow-finish benchmarks to better understand swine industry trends.

Table 1. Grow-finish means for ADG, G:F, kcal:kg, and mortality

	Year					
Trait	2005	2006	2007	2008	2009	2010
Nursery						
ADG, kg	0.367^{ab}	0.362^{a}	0.359^{a}	0.364^{a}	0.374^{b}	0.382^{c}
G:F	0.637^{c}	0.645^{b}	0.644^{b}	0.632^{c}	0.652^{a}	0.655^{a}
Kcal:kg	5183^{c}	5267^{d}	5218^{cd}	5227^{cd}	5042^{b}	4903^{a}
Mortality, %	4.6^{a}	4.4^{a}	4.4^{a}	5.9^{c}	5.2^{b}	5.0^{b}
Finishing						
ADG, kg	0.73^{a}	0.76^{b}	0.80^{c}	0.79^{c}	0.80^{c}	0.80^{c}
G:F	0.354^{d}	0.361^{b}	0.361^{ab}	0.357^{c}	0.364^{a}	0.364^{ab}
Kcal:kg	9399^{bc}	9358^{abc}	9231^{a}	9216^{a}	9257^{ab}	9464^{c}
Mortality, %	6.7^{de}	6.3^{cd}	7.1^{e}	5.9^{bc}	5.4^{ab}	5.2^{a}

$^{a–e}$Means within a row with different subscripts differ ($P < 0.05$).

Key Words: benchmark, finishing, nursery

580 Periweaning failure to thrive syndrome in nursery pigs is associated with gastrointestinal lesions, but not enteric pathogens. C. K. Jones,* D. M. Madson, R. G. Main, N. K. Gabler, and J. F. Patience, *Iowa State University, Ames.*

Periweaning failure to thrive syndrome (PFTS) has challenged both the profitability and welfare of the US pork industry in recent years. However, it is unknown if PFTS is associated with increased disease incidence. Our objective was to determine if light birth weight (BRW) pigs or those from the bottom 10th percentile of transition ADG (tADG) have a higher incidence of gastrointestinal lesions and enteric pathogen presence compared with their heavier or faster-growing contemporaries. A total of 1,500 pigs were weighed at birth and divided into 5 BRW categories: <1 kg, 1–1.25 kg, 1.25–1.5 kg, 1.5–1.75 kg, >1.75 kg. At weaning, 1,054 randomly selected pigs were moved to a commercial wean-to-finish barn. Pigs were weighed individually at 0, 3, 6, and 22-weeks post-weaning. Gain from 0 to 3 weeks post-weaning was calculated and termed tADG. Pigs from 3 tADG percentiles were of interest: 10th, 30th, and 70th. Forty pigs from each of the 3 tADG percentiles were matched for sex, litter size, and sow parity, but not BRW to create 20 matched sets of 60 total pigs. This allowed for the main effects of BRW and tADG to be studied as a 5 × 3 factorial design. At 3-weeks post-weaning, pigs were necropsied and lesions on the gastrointestinal tract and other organ systems were characterized. Lung, lymph node, and fecal samples were analyzed for presence of various pathogens by PCR. Colon samples were cultured for *E. coli* and *Salmonella* spp. Data were analyzed using PROC GLIMMIX, where pig served as the experimental unit. The fixed effects were BRW and tADG; and the random effect was matched set. There were no BRW × tADG interactions ($P > 0.16$). Presence of lesions decreased linearly with increasing tADG in the large intestine ($P = 0.03$; 62, 55, 26% for 10th, 30th, and 70th percentiles, respectively) and total gastrointestinal tract ($P = 0.05$). However, tADG was not associated with increased incidence of pathogens ($P > 0.44$). Increasing birth weight was associated with a linear decrease in stomach lesion presence ($P = 0.05$; 29, 10, 15, 0, 0% for <1 kg, 1–1.25 kg, 1.25–1.5 kg, 1.5–1.75 kg, >1.75 kg, respectively), and was quadratically associated with the presence of *Salmonella* spp. ($P = 0.02$; 43, 10, 15, 40, 63% for <1 kg, 1–1.25 kg, 1.25–1.5 kg, 1.5–1.75 kg, >1.75 kg, respectively). In summary, PFTS appears to be associated with increased gastrointestinal lesions, but not with the presence of enteric pathogens.

Key Words: enteric disease, pig, periweaning failure to thrive

581 Umbilical vein blood-oxygen relationship with pre-weaning growth in piglets. E. A. Hale*[1], T. J. Safranski[1], M. C. Lucy[1], J. N. Rhoades[1], J. W. Ross[2], N. K. Gabler[2], R. P. Rhoads[3], and L. H. Baumgard[2], [1]*University of Missouri, Columbia,* [2]*Iowa State University, Ames,* [3]*Virginia Tech, Blacksburg.*

Management techniques to improve piglets′ chances of surviving are common, but North American farms still lose nearly 20% of piglets as stillborns plus pre-weaning mortalities. This project was to characterize the range in blood-oxygen levels in neonatal piglets and its effects on viability and growth. A group of 23 parity-one Large White × Landrace sows were monitored for 24h daily over one week beginning at the time the first sow was due and ending when the last sow farrowed. Each piglet was caught at birth and dried. A 3mL blood sample was taken from the umbilical vein and the sample ran through an IRMA blood analyzer. At birth piglet weight and rectal, rump, and back temperatures were recorded. After approximately 5 min under a heat lamp the piglets were placed at the udder to nurse. Piglets were weighed again at 2 h and 24h post birth and at weaning around 21d. All piglet processing was one day after farrowing. Of the total 264 piglets born alive, blood samples were obtained from 137 piglets (52%). Of the 264 piglets, 12 pre-wean mortalities were recorded, only 3 of which were successfully blood sampled. Birth order of all piglets in their respective litter was recorded. For analyses piglets with a 2 h weight change exceeding 400 g were excluded as were arterial samples resulting in 126 records. Weight changes at 2 h and 24 h as well as pre-weaning ADG were fitted to a least squares regression model including rectal temperature and weight at

birth and birth order with dam fitted as a random effect. Two-hour weight change was affected by birth order; piglets born later in the litter gained less weight. No model effects affected 24hr weight change. Pre-weaning average daily gain was increased in piglets having higher blood oxygen or rectal temperatures at birth and unaffected by birth order. The low pre-weaning mortality precludes meaningful analyses of the effect of blood gas on this variable. While surprising that neonatal growth was affected by birth order and not blood oxygen at birth, the effect of the latter on subsequent growth is intriguing and implies a long-term impact on the physiology of the pig. Supported by USDA NIFA #2011–67003–30007

Key Words: neonatal growth, blood oxygen, piglet viability

582 Breed difference of porcine sirtuin 1 and its regulation by insulin. Y. Ren,* T. Z. Shan, L. N. Zhu, J. Huang, and Y. Z. Wang, *Institute of Animal Science, Zhejiang University, Key Laboratory of Molecular Animal Nutrition, Ministry of Education, Key Laboratory of Feed and Animal Nutrition of Zhejiang Province, Hangzhou, Zhejiang Province, China.*

Sirtuin 1 (*Sirt1*) plays an important role in insulin signaling pathway especially insulin sensitive organs. However, there were few data about the differences of *Sirt1* expression between fatty breed and lean breed of pigs. Furthermore, whether insulin could feedback or regulate the expression of *Sirt1* is unclear. Therefore, in the current study, the breed difference and the expression pattern of *Sirt1*, as well as key lipid metabolism enzyme adipose triglyceride lipase (*ATGL*) and hormone sensitive lipase (*HSL*), in adipose tissue, liver and pancreas between Jinhua pigs (a local fatty breed of China) and Landrace (a leaner breed) were investigated. In addition, the effect of insulin on gene expression of *Sirt1*, *ATGL* and *HSL* in fat metabolism was also studied in vitro. Results showed that at the age of 180 d, the body fat content of Jinhua pigs were significantly higher ($P < 0.01$). Serum triglyceride (TG), total cholesterol (TCHO) ($P < 0.01$) and glycerol ($P < 0.01$) of Jinhua pigs were lower comparatively. Higher serum insulin and leptin concentrations were consistent with higher fat percentage in Jinhua pigs. When compared with Landrace, *Sirt1* protein abundance and mRNA levels of Jinhua pigs were lower ($P < 0.01$) in adipose tissue. Likewise, in liver and pancreas, protein abundance and mRNA level of *Sirt1* were also lower ($P < 0.01$) in Jinhua pigs. Consistent with *Sirt1* gene, the mRNA expression of *ATGL* and *HSL* in Jinhua pigs were lower ($P < 0.01$) than Landrace in the 3 tissues. In vitro treatment with different doses of insulin (10, 50 and 100 nM) significantly decreased ($P < 0.01$) glycerol release and *Sirt1*, *ATGL* and *HSL* mRNA levels in porcine adipocytes. These results indicated that porcine *Sirt1* and key fat metabolic enzymes (*ATGL* and *HSL*) expressions are different between fatty breed and lean breed and insulin can decrease gene expression of *Sirt1*, *ATGL* and *HSL* in adipocytes. This will provide some information for further study of porcine *Sirt1* gene function and regulating fat metabolism in pigs and for dietary manipulation of expression of these genes.

Key Words: sirtuin 1, insulin, pig

583 Growth response and blood profile of weaner pigs fed additive-enhanced agro-industrial by-product based diet. A. O. K. Adesehinwa*[1], O. O. Mgbere[2], O. O. Obi[1], B. A. Makanjuola[1], and I. A. Okere[1], *[1]Institute of Agricultural Research & Training, Obafemi Awolowo University, Ibadan, Oyo State, Nigeria, [2]Hatfield International Biometrical Service Centre, Houston, TX.*

Ninety (90) weaner pigs (average initial weight 9.78 ± 0.36kg) were randomly assigned to 3 dietary treatment groups in a completely randomized design to evaluate the growth response and blood profile of weaner pigs fed additive-enhanced [directly-fed microbial (DFM) or Hemicell] agro-industrial by-product based diets. The 19.85% crude protein basal diet was formulated to contain 35, 20, 20, 12, 3 and 5% of yellow maize, brewers dried grain, palm kernel cake, groundnut cake, 72% fish meal and micro-nutrients respectively. The additive-enhanced diets contained either 1.5 L of direct-fed microbial, a source of live (viable), naturally occurring microorganism, also known as Rumen Enhancer 3 (RE-3)/tonne of basal diet, or 200 g Hemicell (a mannanase)/tonne of the basal diet. There were 6 pen replicates per treatment, with each pen containing 5 pigs. The pigs were allowed ad libitum access to the diets and water throughout the 35-d study period. Weekly weight and feed intake were recorded and used to determine the weight gain, average daily gain (ADG), average daily feed intake (ADFI) and gain:feed ratio (G:F). At the end of the study, blood samples were collected from 2 pigs/replicate to evaluate the hematological and biochemical profile. Data were analyzed as a completely randomized design using ANOVA procedures as described by Steel and Torrie (1997). The addition of DFM resulted in a higher ($P < 0.05$) ADFI compared with the results obtained with the basal-control and Hemicell-enhanced diets. However, pigs fed the DFM-enhanced diet consequently had a superior ADG (0.40kg) compared with the basal-control (0.35kg) but not the Hemicell-enhanced diet, as the gains were comparable ($P > 0.05$). The efficiency of feed conversion (G:F), hematological and biochemical indices were not significantly ($P > 0.05$) influenced by either of the additives but for a higher serum glucose obtained with Hemicell-enhanced diet. Arising from the comparable results obtained with direct-fed microbial and Hemicell-enhanced diets, it could be inferred that both diets could be used as animal feed additives to enhance the utilization of agro-industrial by-products in diets of this class of pigs.

Key Words: weaner pigs, feed additives, agro-industrial by-product

584 An evaluation of the effects of a blend of essential oil compounds (Crina Piglets AF), a feed-grade antibiotic program, and their combination in nursery diets on the growth and economic performance of pigs in a commercial research facility. J. Bergstrom*[1], D. Campbell[1], C. Paulus[2], and M. DeBeer[1], *[1]DSM Nutritional Products, Parsippany, NJ, [2]DSM Nutritional Products, Kaiseraugst, Switzerland.*

A total of 880 pigs (initially 6.8 kg) were used in a 42-d experiment to evaluate the effects of dietary supplementation with a blend of essential oil compounds (Crina Piglets AF, EO), a feed-grade antibiotic program (AB), and their combination on the performance of pigs in a commercial research facility. After weaning (d 0), pigs were randomly placed into 44 pens of 20 pigs each and allotted to one of 4 dietary treatments to provide 11 replicate pens per treatment. Treatments were arranged in a 2 × 2 factorial to evaluate possible EO and AB interactions. Dietary treatments consisted of 1) a control diet without EO and AB, 2) EO added, 3) AB added, and 4) both EO and AB added. Supplementation occurred at the expense of corn in the control diets and all pigs were fed the same 4-phase program of commercial starter diets. Diet phases were d 0 to 7, 7 to 14, 14 to 28, and 28 to 42. Pigs fed EO were supplemented with 100 mg/kg throughout the study. Pigs fed AB were supplemented with 39 mg/kg Denagard + 441 mg/kg Aureomycin from d 0 to 14 and 55 mg/kg Mecadox from d 14 to 42. Economic performance was also determined using costs of $0.94, $0.46, $0.29, and $0.28/kg for the phase 1 thru 4 control diets, respectively. Added costs for treated diets were $0.029/kg for Denagard + Aureomycin, $0.026/kg for Mecadox, and $0.004/kg for EO. Value of BW gain was determined using $1.33/kg. Growth performance, diet costs, and value of gain were used to

determine feed cost per kg of gain (fd$/kg) and income-over-feed-cost (IOFC). Overall (d 0 to 42), there were EO × AB interactions for ADG ($P \leq 0.07$) and final BW ($P \leq 0.03$). No interactions occurred for other response criteria. Although EO and AB each improved ($P \leq 0.01$) ADG (490, 499, 513, and 562 g/d; treatment 1 thru 4, respectively) and final BW (27.6, 27.8, 28.4, and 30.8 kg), these improvements were considerably greater when EO and AB were used in combination. Pigs fed AB had greater ($P \leq 0.01$) ADFI (726, 708, 758, and 798 g/d) and pigs fed EO had improved ($P \leq 0.01$) G:F (0.67, 0.71, 0.67, and 0.70 g/g). Pigs fed AB had greater ($P \leq 0.01$) fd$/kg ($0.66, $0.64, $0.71, and $0.68), but fd$/kg was reduced ($P \leq 0.01$) for pigs fed EO; however, IOFC ($15.07, $15.89, $14.70, and $16.79) was only improved ($P \leq 0.01$) for pigs fed EO.

Key Words: essential oils, feed-grade antibiotics, pigs

585 Dietary antioxidant (Agrado Plus) sparing vitamin E in nursery pigs fed distillers dried grains with solubles (DDGS). J. Zhao*[1], T. Engle[2], T. Wineman[1], M. Vazquez-Anon[1], and R.J. Harrell[1], *[1]Novus International Inc., St. Charles, MO, [2]Colorado State University, Fort Collins.*

Synthetic dietary antioxidants have been shown to improve liver and plasma vitamin E levels in broilers regardless of dietary vitamin E levels. The objective of this trial was to test whether synthetic antioxidants spare vitamin E in nursery pigs fed distiller dried grains with soluble (DDGS). A total of 924 weanling pigs (PIC, 28 d of age, 7.0 ± 0.07 kg) were randomly assigned to 6 treatments blocked by sex and body weight, with 7 replicates per treatment and 22 pigs per pen. The trial was a 3 × 2 factorial arrangement with 3 levels of dietary vitamin E (0, 22, and 44 IU/kg) with or without synthetic antioxidant (Agrado Plus liquid, at 0.025%). Agrado Plus is a blend of synthetic antioxidants containing ethoxyquin and propyl gallate (Novus International Inc., St. Charles, MO). All pigs were fed a common nursery diet for 7 d post-weaning, and started the experimental diets on d 8. After 7 d, pigs were fed 2-phase commercial diets (d 0–14, d 14–35) with 20% and 30% DDGS, respectively. At the end of the study, one pig per pen was harvested for tissue vitamin E (liver and plasma) and oxidation status measurement. Growth performance (ADG, ADFI, G:F) was not affected by vitamin E, AOX, or their interaction ($P > 0.24$). Dietary AOX increased plasma (33%, $P < 0.01$) and liver vitamin E concentration (30%, $P = 0.04$) regardless of dietary vitamin E level (interaction, $P > 0.17$). Vitamin E concentration in the liver ($P < 0.01$) but not in plasma was linearly increased with dietary vitamin E supplementation. The non-responsive plasma vitamin E might due to transportation stress immediately before harvest. The result suggests that liver vitamin E is a better indicator of vitamin E status than blood vitamin E levels No statistical differences were observed on loin drip loss ($P > 0.26$), plasma free carbonyl ($P > 0.16$), plasma 4-hydroxynonenal (HNE, $P > 0.22$). In summary, AOX spared vitamin E in vivo based on liver and plasma vitamin E concentration, and can be used to spare dietary vitamin E in swine diets fed high DDGS diets.

Key Words: antioxidant, vitamin E, swine