

Swine Species

185 The effects of feeding frequency on pig performance, behavior, and tissue accretion rates. Jessica D. Colpoys*, Anna K. Johnson, and Nicholas K. Gabler, *Iowa State University, Ames, IA.*

Recent research suggests that feeding frequency may affect feed efficiency in pigs. Therefore, our objective was to compare 2 divergent feeding patterns and their effects on pig performance, tissue accretion, body composition and behavior. Following a 3 d acclimation to individual pens, 48 gilts were randomly blocked by body weight (55.9 ± 5.2 kg on test BW) into 2 feeding treatments; 1) ad libitum access or 2) twice daily gilts that were allowed to eat ad libitum between 0800 and 0900 h and again from 1700 to 1800 h. Performance was recorded weekly for 55 d and ADG, ADFI, and G:F was recorded and calculated. Body composition was assessed in 12 gilts per treatment using dual x-ray absorptiometry (DXA) at day -3 and 55, and tissue accretion rates were calculated. Video was recorded on d 51 and continuously watched from 7:00–19:00 h to assess the time pigs spent standing, sitting, lying and eating. Performance and DXA data were analyzed using the Mixed procedure and behavior data were analyzed using the Glimmix procedure of SAS. The model included the fixed effect of treatment, covariate of on test BW, and pig as the experimental unit. Gilts fed twice daily had lower ADG and ADFI compared with ad libitum gilts ($P \leq 0.01$); however, no treatment difference in G:F was observed ($P = 0.41$). No treatment differences were observed in body composition at d 55. However, gilts fed twice daily had lower fat (twice = 297 vs. ad libitum = 339 g/d), lean (twice = 673 vs. ad libitum = 737 g/day), and protein (twice = 136 vs. ad libitum = 149 g/d) daily accretion rates compared with ad libitum gilts ($P = 0.01$). No difference in bone accretion was observed. Gilts fed twice daily spent less time lying and eating compared with ad libitum gilts ($P \leq 0.05$). However, treatments did not differ in duration of time spent sitting or standing ($P \geq 0.19$). In conclusion, twice daily feeding resulted in reduced growth, tissue accretion, and lying behavior compared with ad libitum feeding. However, feeding frequency did not alter feed efficiency. This pig performance can be partly explained by the differences in caloric and nutrient intake.

Key Words: feed efficiency, feeding frequency, pig

186 Relationships between nursery stocking density and feeder space allowance with subsequent gilt estrous characteristics. E. B. Cook*, W. L. Flowers, and M. T. Knauer, *North Carolina State University, Raleigh, NC.*

The objective of the study was to determine the effect of nursery stocking density (STOCK) and feeder space (FS) on gilt estrous traits. Composite Landrace \times Large White PIC gilts ($n = 230$) were weaned at 37 d of age and 9.6 kg. Gilts were randomly assigned to a nursery STOCK of 0.42 or 0.21 m² and a FS of 14.35 or 7.175 cm per pig in a 2 \times 2 factorial arrangement. After 33 d in the nursery, gilts were moved to the finisher weighing 23.7 kg. In the finisher, gilts were remixed and housed 15 per pen (0.84 m² per pig). Starting at 181 d of age, gilts were penned daily with a mature boar for 7 min and estrous symptoms recorded. At 188 d of age, gilts were allotted 7 min of fence-line boar contact daily until breeding. Measurements of gilt reproductive performance included: whether or not a gilt reached puberty (Pubertal), age at puberty, puberty weight, vulva width at puberty (Vulva_Width1), length of estrus at puberty (LOE1), vulva width at second estrous (Vulva_Width2), and length of estrus at second estrous (LOE2). Data were analyzed in SAS using PROC MIXED for continuous traits and PROC GLIMMIX for

the categorical trait Pubertal. Fixed effects included STOCK, FS, the interaction between STOCK and FS, nursery room and age at first boar exposure. Stocking density and FS LSMEAN estimates for gilt estrous traits are shown in Table 1. Length of estrus at puberty tended ($P = 0.08$) to be greater for pigs stocked at 0.21 m² when compared with 0.42 m² (1.74 vs. 1.57 d). Yet no other estrous characteristics were affected by STOCK or FS ($P \leq 0.22$). Results suggest nursery STOCK and FS have little effect on subsequent gilt estrous characteristics.

Table 1 (Abstr. 186). Effect of nursery stocking density and feeder space on subsequent gilt estrous characteristics

Trait	Stocking density, m ²			Feeder space, cm/pig		
	0.42	0.21	SE	14.35	7.175	SE
Pubertal, %	79.4	74.5	4.0	78.7	75.3	4.0
Age at puberty	203.5	202.5	2.7	203.9	202.1	2.7
Puberty weight, kg	138.1	135.7	5.4	136.7	137.1	5.4
Vulva_Width1, cm	38.6	37.7	0.72	38.3	38.1	0.72
LOE1, d	1.57	1.74	0.10	1.65	1.65	0.10
Vulva_Width2, cm	38.2	38.4	1.11	37.9	38.6	1.10
LOE2, d	1.89	1.90	0.15	1.94	1.85	0.15

Key Words: estrus, gilt, nursery

187 Relationships between nursery stocking density and feeder space allowance with gilt growth performance. E. B. Cook*, W. L. Flowers, and M. T. Knauer, *North Carolina State University, Raleigh, NC.*

The objective of the study was to determine the effect of nursery stocking density (STOCK) and feeder space (FS) on gilt growth performance. Composite Landrace \times Large White PIC gilts ($n = 500$) were weaned at an average age and weight of 39.3 d and 9.6 kg, respectively. Gilts were randomly assigned to either 5 or 10 pigs per pen to achieve a STOCK of 0.42 or 0.21 m² and FS of 14.35 or 7.175 cm per pig in a 2 \times 2 factorial arrangement. In 2013 and 2014 pigs remained in the nursery for 33 and 45 d, respectively, and left at an average weight of 23.7 and 39.0 kg, respectively. In the finisher, pigs were randomly placed into groups of 15 gilts per pen (0.84 m²). Data were analyzed in SAS using PROC GLM. Fixed effects included STOCK, FS, year, nursery room and the interaction between year and room. All interactions between STOCK and FS were $P \geq 0.24$. In 2013 nursery ADG did not differ ($P = 0.27$) between STOCK. However, in 2014 nursery ADG was greater ($P < 0.01$) for pigs stocked at 0.42 m² when compared with 0.21 m². Overall nursery ADG was greater ($P < 0.01$) for pigs stocked at 0.42 m² when compared with 0.21 m² and numerically greater ($P = 0.21$) for pigs housed with 14.35 cm of FS when compared with 7.175 cm. Overall finishing ADG tended ($P = 0.08$) to be greater for pigs previously housed with 7.175 cm of FS when compared with 14.35 cm. In 2013 wean-to-finish ADG did not differ ($P = 0.84$) between STOCK. However, in 2014 wean-to-finish ADG tended ($P < 0.08$) to be greater for pigs stocked at 0.42 m² when compared with 0.21 m². Overall wean-to-finish ADG was greater ($P = 0.03$) for pigs stocked at 0.42 m² when compared with 0.21 m². Results suggest nursery FS, but not STOCK, affected subsequent finishing growth rate.

Contd.

Table 1 (Abstr. 187). Effect of nursery stocking density and feeder space on gilt growth performance

ADG	Stocking density, m ²			Feeder space, cm/pig		
	0.42	0.21	SE	14.35	7.175	SE
2013 nursery	0.431	0.409	0.019	0.428	0.411	0.020
2014 nursery	0.693	0.619	0.016	0.665	0.647	0.017
Overall nursery	0.563	0.513	0.013	0.547	0.530	0.013
2013 finisher	0.906	0.893	0.015	0.891	0.908	0.015
2014 finisher	0.869	0.877	0.012	0.865	0.881	0.013
Overall finisher	0.887	0.885	0.01	0.878	0.894	0.01
2013 wean-to-finish	0.804	0.787	0.013	0.791	0.799	0.013
2014 wean-to-finish	0.816	0.797	0.011	0.803	0.810	0.011
Overall wean-to-finish	0.810	0.792	0.008	0.798	0.805	0.008

Key Words: gilt, growth, nursery

188 Apparent total-tract digestibility (ATTD) of total dietary fiber (TDF) between and within high fiber feed ingredients in finishing pigs. Zhimin Huang*, Pedro Urriola, and Gerald Shurson, *University of Minnesota, St. Paul, MN.*

Fibrous ingredients, such as distillers dried grains with solubles (DDGS), are a price competitive source of energy in swine diets, but TDF may decrease nutrient digestion and absorption as well as energy utilization. However, we know little about the effects of ATTD of TDF on nutrient digestibility and energy utilization. Therefore, the objective of this study was to evaluate the effect of different fiber sources on ATTD of TDF and GE of finishing pigs. A total of 34 barrows and 2 gilts (Large White × Danish Landrace) with an average BW of 84.0 ± 7.2 kg were used in a changeover design with 2 consecutive 13-d periods, and involving 10-d of adaptation and 3-d of fecal and urine collection. During each period, the 36 pigs were allotted to 4 blocks by BW, 9 pigs in each block were fed 9 different experimental diets. Diets were formulated to contain similar concentration of TDF, from 3 sources of 3 ingredients (wheat straw, WS; soybean hulls, SBH, and DDGS). TiO₂ (0.5%) was used in diets as an indigestible marker. The direct procedure was used to measure ATTD of DM, GE, CP, acid ether extract (AEE), and TDF in the diets. Results showed that ATTD of DM, GE, and TDF of pigs fed the diet with SBH (87.4, 86.8%, and 78.9%) were greater ($P < 0.01$) than those fed DDGS (82.6, 80.1%, and 43.0%), which were greater ($P < 0.01$) than those fed WS (75.1, 75.8%, and 26.7%). The ATTD of DM and GE were ($R^2 = 0.84$ and $R^2 = 0.85$) correlated with ATTD of TDF among diets. Between sources of the same ingredient, we observed differences ($P < 0.01$) in ATTD of TDF among 3 DDGS sources (36.0, 43.1, and 49.8%), but not for WS, or SBH. Among sources of DDGS, the correlation between ATTD of DM and GE to ATTD of TDF was poor ($R^2 = 0.62$ and $R^2 = 0.51$). In conclusion, ATTD of TDF is a good predictor of ATTD of DM and GE among fibrous ingredients, but it is less predictive among sources of the same ingredient because ATTD of TDF does not affect ATTD of GE, CP, or AEE.

Key Words: apparent total-tract digestibility, pig, total dietary fiber

189 Net portal-drained viscera flux of volatile fatty acids in Iberian and Landrace pigs. Gonzalez-Valero Lucrecia¹, Rojas-Cano Maria Luz¹, Lachica Manuel¹, Ranilla Maria Jose¹, and Fernandez-Figares Ignacio*², ¹Estacion Experimental del Zaidin-CSJC, Granada, Spain, ²Universidad de Leon. Dept. Produccion Animal, Leon, Spain.

Iberian pigs are traditionally reared outdoors where they feed on acorns and herbage. The capacity of volatile fatty acids (VFA) absorption could be of importance for these animals although it has never been determined. The aim of the present work was to evaluate the capacity of VFA absorption in Iberian compared with Landrace gilts fed a standard corn-soybean meal diet (160g/kg; 14.25 MJ ME/kg DM), using arterio-venous preparations. Iberian and Landrace gilts (30 kg BW; n = 4 Landrace and 6 Iberian) were used. Diets were formulated with protein of high biological value and offered at 85% ad libitum. Gilts were fasted for 24 h prior surgery. Catheters were implanted in the portal and mesenteric veins and carotid artery. Then, pigs were placed in metabolism cages and fed the diet for 6 d. On d 7, *p*-aminohippuric acid (PAH) was continuously infused through the mesenteric vein and pigs were offered 25% of their daily intake. Blood was withdrawn simultaneously from portal vein and carotid artery at 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 5 and 6 h after feeding, centrifuged for plasma harvest and stored at -20°C until analysis for PAH and VFA. Compared with Landrace, Iberian gilts had greater net portal absorption (μmol/min) of acetic acid (252 vs. 178; $P = 0.000$), butyric acid (17.0 vs. 12.7; $P = 0.007$) and isovaleric acid (10 vs. 4.7; $P = 0.010$), and lower of valeric acid (-8.5 vs. 12.9; $P = 0.007$), than Landrace gilts. No differences ($P > 0.10$) in net portal absorption of propionic (146 vs. 153), isobutyric (13 vs. 9) and caproic (4.5 vs. 5.5) acids were found. The greater capacity of net portal absorption of VFA in Iberian pigs could constitute a meaningful contribution to the energy requirement for maintenance and constitute an advantage when fed outdoors fibrous rich feeds.

Key Words: net portal absorption, volatile fatty acids, Iberian pig

190 Effects of a phytogetic feed additive in a protein-reduced diet in growing/finishing pigs. Carina Schieder*¹, Christiane Schwarz², Christine Hunger¹, Barbara Rueel¹, Jose Soto³, and Karl Schedle², ¹Biomim Holding GmbH, Herzogenburg, Austria, ²University of Natural Resources and Life Sciences, Vienna, Institute of Animal Nutrition, Products, and Nutritional Physiology, Vienna, Austria, ³Biomim USA Inc., San Antonio, TX.

The experiment was conducted to evaluate the efficacy of a phytogetic feed additive (PFA) on body weight gain, carcass composition and quality of 72 fattening pigs [(Large White × Landrace) × Piétrain]. Animals were distributed into 3 treatment groups with 3 replicates of 8 pigs per replicate, with an initial weight of 32.2 ± 0.4 kg. Control group (CON) and one phytogetic group (PFA+normal; Digestarom® Finish 150 ppm, BIOMIN PhytoGenics GmbH, Germany) received a diet containing 17% and 15% CP in the growing and finishing period, respectively. Another phytogetic group (PFA+low; Digestarom Finish 150 ppm) received a ration with a reduced protein content (-0.4% CP) throughout the whole growing and fattening period. Feed and water was provided ad libitum. At 73.2 ± 0.6 kg of BW, feed changed from growing to finishing diet. Body weight was measured weekly and individual feed intake was recorded daily. Pigs were slaughtered at 117.5 ± 0.2 kg and carcass composition and quality were evaluated. Data were analyzed with procedure GLM (SAS 9.4) and a multiple comparison was conducted with Tukey's range test. Results for the whole fattening period show significantly improved gain:feed ratio ($P < 0.05$; 0.389 and 0.388 in PFA+normal and PFA+low, respectively, compared with 0.368 in CON). Average daily feed intake was 2298 g/d in the CON compared with 2288 g/d in the PFA+normal and 2275 g/d in the PFA+low group. Daily weight gain tended to be higher ($0.05 < P < 0.10$) in the PFA+normal and PFA+low group (889.0 and 881.7 g/d) compared with CON (844.5 g/d). Carcass composition and quality parameters did not differ significantly ($P > 0.05$) between treatments besides conductivity of meat which has been

improved for PFA+low group compared with CON 1 h post mortem (4.35 vs. 5.02 mS/cm, respectively). Overall, the supplementation of a PFA improved the performance of pigs and a protein reduction was efficiently compensated through the supplementation of PFA.

Key Words: fattening pig, nutrient-sparing, phytogetic feed additive

191 Effect of milky derived flavor inclusion in creep-feed diets on suckling piglet performance and litter homogeneity. Laia Blavi*¹, David Solà-Oriol¹, Francisco Javier Crespo², María del Mar Serra², and José Francisco Pérez¹, ¹*Animal Nutrition and Welfare Service, Department of Animal and Food Sciences, Universitat Autònoma de Barcelona, Bellaterra, Spain*, ²*Interquim S.A (Ferrer Health Tech), Barcelona, Spain*.

Hyper-prolific sows provide a higher number of piglets born per litter and year but, this promotes greater within-litter birth weight variation with high percentage of small animals. It was hypothesized that the inclusion of a milky derived flavor into the creep-feed (CF) would improve the number of eaters, creep-feed intake, piglet performance and litter homogeneity. A total of 35 litters (418 piglets) of Landrace × Large White sows were used. At cross-fostering (max 48 h after birth) all litters were standardized and were distributed into 3 experimental treatments; a basal CF (2480 kcal/kg, 1.53% digestible Lys) diet without flavor (T1), and 2 different milky derived flavors (T2 and T3) according to number of piglets, litter weight and coefficient of variation (CV). Creep-feed was offered from d 2 to d 28 and indigo carmine (5g/kg) was used as indigestible marker to register the number of creep-feed eaters on d 7, 14, 21 and 28. Creep-feed disappearance and individual BW were registered on d 2, 7, 14, 21 and 28 to calculate the within litter CV and the average daily weight gain (ADG) and mortality rate. No differences ($P > 0.10$) in BW (6.9 kg), CF disappearance (1571 g) and the number of eaters (4.1 piglets per litter) were observed among treatments. However, lower ($P < 0.05$) CV was observed for piglets fed the T2 (0.16 and 0.17%) than those fed the T3 (0.21 and 0.20%) and T1 (0.25 and 0.26%) diets on d 21 and 28, respectively. In addition, animals categorized as small (<180 g/d at 28 d) in T2 presented higher ADG ($P < 0.001$) than T1 (153.5 g/d vs 119.1 g/d, respectively from d 0 to 28). Higher ($P < 0.01$) piglet mortality was observed in litters fed T1 than T2 and T3 (6.9, 3.0 and 4.1%, respectively). These results suggest that the use of a milky derived flavor in the creep-feed improves growth in small piglets and may reduce the CV of the BW within the litters and piglet mortality obtaining higher homogeneity BW at weaning.

Key Words: flavor, creep-feed, piglet

192 Effects of cathelicidin-BF on growth performance, intestinal morphology and inflammation in weanling piglets. Hongbo Yi*, Caihua Yu, Haiwen Zhang, Huahua Du, and Yizhen Wang, *Institute of Feed Science, College of Animal Sciences, Zhejiang University, Hangzhou, Zhejiang, China*.

The objective of this study was to investigate the effects of cathelicidin-BF (C-BF) derived from the Chinese endemic genera *Bungarus fasciata* on postweaning diarrhea, growth performance, intestinal morphology and inflammation in weanling piglets. Eighteen piglets (Duroc × Landrace × Yorkshire) were weaned at 21 d with an initial BW of 6.63 ± 0.13 kg and randomly assigned to one of 2 treatments to give 3 pens per treatment and 3 piglets per pen. Piglets were intraperitoneally injected with normal saline (control group) or 0.55 mg/kg BW C-BF (C-BF group) once a day and offered diets and water on an ad libitum basis for 7 d. Diarrheal index was scored twice daily according a 4-point system (0,

normal; 1, soft feces; 2, mild diarrhea; and 3, severe diarrhea). The ADG, ADFI and G:F were calculated at the end of study. All piglets were euthanized to determine serum immunoglobulin, serum cytokines, intestinal morphology and intestinal inflammation. Our data showed that C-BF treatment increased ADFI (245.4 vs. 157.9 g/d, $P < 0.05$) and ADG (181.9 vs. 112.9 g/d, $P < 0.05$) compared with control group. Meanwhile, C-BF treatment reduced diarrheal index compared with control (0.47 vs. 1.67, $P < 0.05$). Serum IgG, IL-6, IL-22 and TNF- α production were decreased ($P < 0.05$) by C-BF treatment. C-BF increased ($P < 0.05$) villus height of jejunum and reduced ($P < 0.05$) crypt depth of ileum. We demonstrated that C-BF reduced ($P < 0.05$) the expression of the inflammatory cytokines TNF- α , IL-6 and IL-8, but increased the expression of the anti-inflammatory cytokine IL-10 ($P < 0.05$) in the jejunum. Furthermore, we demonstrated that C-BF suppressed inflammation by downregulating the nuclear factor- κ B (NF- κ B) signaling pathway in the jejunum. In summary, these data suggest that intraperitoneal injections of C-BF ameliorated postweaning diarrhea and improved growth performance along with suppressing intestinal inflammation by downregulating the NF- κ B signaling pathway in weanling piglets.

Key Words: cathelicidin-BF, weanling piglet, intestinal inflammation

193 Improving growth performance of weaning pigs with different dosages of combined natural growth promoter products. Jose A Soto*¹ and Attila Kovacs², ¹*Biomin America Inc., San Antonio, TX*, ²*Biomin Holding GmbH, Herzogenburg, Austria*.

A combination of organic acids OA (formic, propionic and acetic), phytochemical (PC) and permeabilizing substance (PS) which alters the permeability of the outer membrane in gram-negative bacteria, has shown synergistic effect on the inhibition of bacterial growth in vitro as well as improved growth performance in weaning pigs in vivo. The aim of the trial was to determine the efficacy of the combination of OA, PC and PS in the form of combined natural growth promoter (NGP) Biotronic Top3, at 3 different levels (0.1, 0.15, and 0.2%) on the growth performance of wean pigs. 600 pigs weaned at 28 d were assigned to 4 treatments: (1) basal diet, (2) basal diet combined with 0.1 NGP, (3) basal diet combined with 0.15 NGP and (4) basal diet combined with 0.2% NGP with 6 replicates by treatment. Starter diet from d 28 to d 56 (ME 14.00 MJ/kg, CP 17%, Met 0.45% and Lys 1.40%) and grower diet from d 56 to d 71 (ME 13.4 MJ/kg, CP 17.50%, Met 0.36% and Lys 1.20%) were fed. BW of the animals was recorded at d 28, 56 and 71. ADG and FCR were calculated. Dietary supplementation of NGP at inclusion levels of 0.1, 0.15 and 0.2% enhanced growth performance. The BW (kg) was improved on d 56 (quadratic $P < 0.01$; 17.2^a, 18.4^b, 18.7^b and 18.9^b for 0, 0.1, 0.15 and 0.2% of NPG, respectively) and d 71 (quadratic $P < 0.01$; 26.9^a, 28.1^b, 28.3^b, and 28.3^b for 0, 0.1, 0.15 and 0.2% of NPG, respectively) as well as feed intake (g/d) (quadratic $P < 0.01$; 762^a, 804^b, 816^c, and 818^c for 0, 0.1, 0.15 and 0.2% of NPG, respectively). ADG (g) ($P < 0.1$) was only numerically different among treatments (439, 458, 465, and 465 for 0, 0.1, 0.15, and 0.2% of NPG, respectively). There were no differences in FCR ($P > 0.1$). Diet supplemented 0.15% combined NGP had the highest final BW and ADG tended to be greater compared with other groups. The supplementation with the combined NGP at a level of 0.15% was most beneficial.

Key Words: natural growth promoter, organic acids, phytochemical

194 The effects of exogenous protease enzyme on growth performance, nutrient digestibility, blood profiles, fecal microflora, fecal gas emission, and fecal score in weanling pigs. Glenmer B. Tactacan*¹, Se-young Oh¹, Jin H. Cho², and In H. Kim³, ¹*Innovation and Development Department, Jefe Nutrition, Saint-Hyacinthe, Quebec, Canada*, ²*Department of Animal Science, Chungbuk National University, Cheongju, Chungbuk, Korea*, ³*Department of Animal Resources and Science, Dankook University, Cheonan, Korea*.

Although exogenous protease enzymes have been used in poultry quite extensively, this has not been the case in pigs. In general, due to their better fermentative capacity and longer digesta transit time in the gut, pigs have greater capacity to digest nutrients than poultry. In young pigs however, the digestion of nutrients, particularly of dietary proteins is marginally incomplete. Therefore, a study was conducted to elucidate the effects of a commercial protease enzyme supplemented in weanling pig diets. The indices of growth, nutrient digestibility, blood profiles, fecal microflora, fecal gas emission and fecal scores were measured during the study. A total of 50 weanling pigs (6.42 ± 0.60 kg) at 28 d of age were randomly assigned to receive 1 of 2 dietary treatments: (1) basal diet (corn-soy based) with no supplemental protease, and (2) basal diet + 200 g/ton protease for 42 d. A completely randomized block design consisting of 5 replicate pens per treatment with 5 pigs per pen was used. Growth performance in terms of bodyweight and average daily gain in pigs fed with protease enzyme (27.04 vs. 25.75 ± 0.25 kg and 491 vs. 460 ± 6 g; $P < 0.05$) was increased significantly, but gain per feed was similar between treatments. Compared with the control, protease supplementation increased ($P < 0.05$) the apparent total-tract nutrient digestibility (84.66 vs. 81.21 ± 0.91 DM and 84.02 vs. 80.47 ± 0.95 N) and decreased ($P < 0.05$) the NH_3 emission (2.0 vs. 1.2 ± 0.14 ppm) in the feces. Except for a decreased ($P < 0.05$) in blood creatinine level, no differences were observed in RBC, WBC, lymphocytes, urea nitrogen, and IgG concentrations between treatments. Fecal score and fecal microflora (*Lactobacillus* and *E. coli*) were also similar between the control and the protease-supplemented diets. Overall, the supplementation of protease enzyme in weanling pigs resulted to improved growth rate and nutrient digestibility. Exogenous protease enzyme reduced fecal NH_3 emission, thus, potentially serving as a tool in lowering noxious gas contribution of livestock production in the environment.

Key Words: protease, nutrient digestibility, weanling pig

195 Maternal betaine supplementation during gestation attenuates hepatic cell cycle and proliferation through epigenetic regulation of the STAT3-dependent pathway in newborn piglets. Demin Cai*, Mengjie Yuan, Yimin Jia, Yun Hu, and Ruqian Zhao, *Nanjing Agricultural University, Nanjing City, China*.

Betaine, which donates methyl groups through methionine metabolism for DNA and protein methylation, is critical for epigenetic gene regulation especially during fetal development. Here we fed gestational sows (8 per group) with control or betaine supplemented diets (3 g/kg, from the first day of gestation to parturition) to explore the effects of maternal betaine on hepatic cell proliferation in neonatal piglets. Newborn piglets were individually weighed immediately after birth and the piglets from the same litter were kept together in the warm creep area. One male piglets of the mean body weight were selected per litter and killed for tissue sampling before suckling. Neonatal piglets born to betaine-supplemented sows demonstrated a reduction of cell number and DNA content ($P < 0.05$) in the liver, which was associated with significantly downregulated hepatic expression of cell cycle regulatory genes ($P < 0.05$), cyclin 2 (CCND2) and presenilin1 (PSEN1). Moreover, STAT3 binding to the promoter of *CCDN2* and *PSEN1* genes was lower ($P < 0.05$) in betaine-exposed piglets, which was accompanied by strong reduction ($P < 0.05$) of STAT3 mRNA and protein expression along with its phosphorylation at Tyr⁷⁰⁵ and Ser⁷²⁷ residues ($P < 0.05$). Also, prenatal betaine exposure significantly attenuated upstream kinases ($P < 0.05$) of STAT3 signaling pathway (phospho-ERK1/2, phospho-SRC and phospho-JAK2) in the liver of neonates. Furthermore, the repressed *STAT3* expression in the liver of betaine-exposed piglets was associated with DNA hypermethylation ($P < 0.05$) and more enriched repression histone mark H3K27me3 ($P < 0.05$) on its promoter, together with significantly upregulated expression ($P < 0.05$) of H3K27me3 and enhancer of zeste homolog 2 (EZH2) protein, as well as miR-124a ($P < 0.05$) which targets STAT3. Taken together, our results suggest that maternal dietary betaine supplementation during gestation inhibits cell proliferation in the liver of neonatal piglets through epigenetic regulation of hepatic *CCDN2* and *PSEN1* genes via a STAT3-dependent pathway.

Key Words: cell cycle and proliferation, STAT3, epigenetic regulation