

analysis methods used by feedlot nutritionists consist of crude fiber, NDF, ADF or that no fiber analysis is used. Nutritionists continue to apply different criterion and personal biases when assigning dietary fiber levels and forage types in finishing diets. Reasons for differing forage levels in finishing diets among nutritionists appears to be based upon environmental conditions, cattle type or management ability among

feedlots. Particle separation of forage has been used to measure effective fiber concentrations in finishing diets. Methods to better evaluate NDF level and forage digestibility in finishing diets should continue to be evaluated and reported.

Key Words: digestibility, feedlot diets, forage

Swine Species

263 Birth weight implications for reproductive parameters in boars. F. R. C. L. Almeida^{*1}, A. L. N. Alvarenga¹, G. R. Foxcroft², and H. Chiarini-Garcia¹, ¹Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil, ²University of Alberta, Edmonton, Alberta, Canada.

Selection for prolificacy appears to have created an imbalance between the number of conceptuses surviving to the post-implantation period and uterine capacity. These animals show characteristics of Intra-Uterine Growth Restriction (IUGR) due to a great competition among fetuses for nutrients and oxygen, resulting in lighter fetuses at term. The effects of IUGR on testes development have not been demonstrated so far. New-born male pigs (n = 6; DanBred X PIC terminal line), born to 4th - 6th parity sows and in litters of 10 to 15 pigs, were identified as falling into two birth weight groups: high (HW: range 1.8 to 2.2 kg) and low (LW: range 0.8 to 1.2 kg). They were castrated at 7 days post-partum for evaluation of testicular morphological characteristics. Evidence of IUGR on testis development was analyzed by comparing the mean numbers of gonocytes and Sertoli cells present in twenty cross sections of testicular cords per testis chosen at random. Data were analyzed as a fully randomized design and the comparison between means was performed by t-test. LW offspring had lighter testes and lower gonadosomatic index (GSI = testes wt/body wt x 100) compared to their HW counterparts. Moreover, the numbers of gonocytes and Sertoli cells per testicular cord were also lower in LW piglets (Table 1). These results show that light weight animals have smaller and less developed testes relative to body weight. As Sertoli cell number established before puberty determines adult testes size and sperm production, light birth weight boars may have lower reproductive performance. We gratefully acknowledge Fapemig and CNPq for funding this work. Reproductive characteristics in low (LW) and high (HW) birth weight boars born to multiparous sows and into litters of 10 to 15 pigs (P < 0.0001 for all parameters)

Table 1.

Parameters	LW	HW	SEM
Birth wt (kg)	1.17	2.02	0.014
Weight at d7 (kg)	2.03	3.30	0.029
Mean testicular weight (g)	0.44	0.97	0.014
GSI (birth)	0.038	0.048	0.0007
GSI (castration)	0.021	0.029	0.0004
Gonocyte / testicular cord	0.870	1.580	0.090
Sertoli cell/ testicular cord	19.22	22.36	0.419

Key Words: testes, sertoli cells, gonocytes

264 Effect of ambient temperature and light intensity on reproduction in mature gilts. D. Canaday^{*}, B. Yantis, A. Visconti, J. Salak-Johnson, and R. Knox, *University of Illinois, Champaign-Urbana.*

The effect of variation in the environment for sows housed in crates on animal reproduction and well-being is uncertain. The objectives of this study were to determine whether differences in temperature and lighting would have a detrimental impact on fertility measures for gilts housed in crates. In replicate one, thirty-six mature cyclic gilts were synchronized with Matrix. At last Matrix feeding (LMF), gilts were assigned by age and weight in a 3 x 2 factorial treatment design to an ambient room temperature (HOT: 30°C, THERMAL NEUTRAL [TN]: 20°C, COLD: 16°C) and lighting intensity at pig level (DIM: 40 Lux, BRIGHT: 350 Lux). Estrous detection and real-time ultrasound (RTU) were performed daily from LMF until ovulation to determine onset of estrus and assess follicle growth and ovulation, respectively. For all gilts, AI occurred at onset of estrus and 24-h later. Measurements of feed intake, body temperature and weight occurred weekly. All gilts were sacrificed on day 30 and reproductive tracts evaluated for ovarian status, pregnancy and litter characteristics. Data were analyzed in SAS using Proc Mixed for the effect of temperature and lighting on response variables. Our preliminary results showed no significant effect of temperature and lighting, nor any interaction, on expression of estrus (100%), LMF to estrus (130 h), duration of estrus (58 h), gilts ovulating (100%), number of corpora lutea (17 ± 3.5), pregnancy rate (97%), litter size (14.0 ± 3.8), fetal weight (2.3 g) or fetal length (26.6 mm). Measures of within litter variation for fetal weight (0.32 ± 0.1 g) and length (1.1 ± 0.4 mm) also did not differ. Rectal temperature (38.4 ± 0.73°C) and daily feed intake (2.7 kg) did not differ among treatments. Initial body weights were not different (141.8 ± 1.8 kg), but weight gain during the treatment period was affected (P < 0.01) by temperature (COLD: 25.1; TN: 29.6; and HOT: 30.0 kg). These preliminary results suggest that wide temperature and lighting levels may have little effect on reproduction during breeding and early gestation in gilts housed in gestation crates.

Key Words: housing, reproduction, temperature

265 Cloning and expression of porcine lactoferrin N-lobe gene in *Pichia methanolica* and effects of recombine protein on growth performance of weanling piglets. F. Han^{*}, Y. Xie, Y. Liu, Y. Gao, and Y. Wang, *Institution of Feed Science, Zhejiang university, Hangzhou, Zhejiang, China.*

The porcine lactoferrin N-lobe (PLF-N) gene was cloned from mammary gland cells of lactating sows, inserted into the recombinant plasmid pGEM-3Z-PLF-N and sequenced. This analysis indicated that the cloned gene sequence is 1038bp in length and is 99% identical to the published sequence (Gene bank L77887). PLF-N was amplified using two new primers with the template pGEM-3Z-PLF-N and cloned into pMET-B, subsequently was linearized and transformed into PMAD11 competent cells by eletroporation. Ade⁺ (Mut^{*}) recombinants were selected by PCR and Mut phenotype determination. SDS-PAGE and western blot results showed that PLF-N was extracellularly expressed in *Pichia methanolica* successfully. The yeast powder containing 10 g/kg

PLF-N were produced by recombinant strain fermentation, fermentation fluid filtration and spray drying methods. Then a total of 90 crossed-bred (Duroc×Landrace×Yorkshire) weaning piglets were used in a 15 days growth experiment to investigate the effect of yeast powder containing 10g/kg PLF-N on growth performance. The piglets were allocated on the basis of weight and litter to 3 dietary treatments in a randomized complete block design. There were three replicate pens per treatment and piglets were grouped with 50 g/kg general yeast powder (control group), basal diet supplemented with 50 g/kg yeast powder containing 10 g/kg PLF-N (PLF-N group), basal diet supplemented with 50 g/kg general yeast powder and 100 mg/kg chlortetracycline (antibiotics group) respectively. Supplementation with 50 g/kg yeast powder containing 10 g/kg PLF-N significantly increased the ADG by 31.67% ($p<0.01$), decreased the F/G by 11.22% ($p<0.05$) and diarrhea rates by 66.25% ($p<0.01$), respectively as compared with the control group. Compared with antibiotic group, there were no significant difference of ADG, F/G and diarrhea rates were observed when 50 mg/kg yeast powder containing 10 g/kg PLF-N was supplied in diet.

Key Words: porcine lactoferrin N-lobe, *Pichia methanolica*, grow performance

266 Influence of seasonality of the growing-finishing period on carcass characteristics of heavy barrows and gilts. M. A. Latorre^{*1}, S. Calvo¹, and L. Ariño², ¹Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain, ²Integraciones Porcinas SL, Teruel, Spain.

A trial was conducted to study the influence of gender (barrows; gilts) and seasonality of the growing-finishing period (S: summer; W: winter) on carcass quality of Duroc × (Landrace × Large White) pigs. A total of forty animals were slaughtered at 131 kg BW (239 ± 3 d old for S pigs and 228 ± 3 d old for W pigs). The farm was located at 715 m altitude in North-Eastern Spain (40.87° North latitude and -0.1° West longitude). The average temperature in S period was 20.5°C (range $14.2\text{--}33.7^\circ\text{C}$) and in W period was 7.4°C (range $1.5\text{--}16.5^\circ\text{C}$). All the animals fed commercial corn, barley, wheat, and soybean meal diets that contained 9.20 MJ NE/kg, 16.9% CP and 1.00% total lys from 20 to 70 kg BW, and 9.75 MJ NE/kg, 14.4% CP and 0.86% total lys from 70 to 130 kg BW. Each treatment was replicated ten times and the experimental unit was the pig. No significant interaction between gender and seasonality was detected. Carcasses from barrows were shorter ($P<0.01$) but tended ($P<0.10$) to be fatter at the level of *gluteus medius* muscle (26.8 vs. 24.3 mm) and to show lighter loins (6.7 vs. 7.2 kg) and hams (27.1 vs. 28.5 kg) than carcasses from gilts. The S pigs had thinner fat depth over the *gluteus medius* muscle (23.7 vs. 27.3 mm; $P<0.01$) and longer ($P<0.10$) and narrower ($P<0.05$) hams than W pigs. The S pigs had heavier shoulders ($P<0.01$) and loins ($P<0.05$) than W pigs but the weight of hams was similar. Consequently, higher total trimmed cut yield (shoulder+ham+loin) was detected in S pigs (47.4 vs. 45.3%; $P<0.001$) than in W pigs due to the higher ($P<0.001$) proportion of shoulders (15.6 vs. 14.1%) and loins (6.6 vs. 6.0%). It is concluded that the differences between barrows and gilts were scarce and any effect of seasonality was independent of gender. Under Spanish natural-environment conditions and at 131 kg of slaughter weight, the S pigs were 11 d older but had better carcass quality than W pigs because of the higher yield of primal trimmed lean cuts.

Key Words: seasonality, carcass quality, pigs

267 Artificial sweeteners enhance the capacity of the swine small intestine to absorb glucose. A. Moran^{*1}, D. Arora¹, M. Al-Rammahi¹, D. Batchelor¹, E. Coulter¹, N. Jones¹, C. Ionescu², D. Bravo², and S. Shirazi-Beechey¹, ¹Department of Veterinary Preclinical Sciences, University of Liverpool, Liverpool, UK, ²Pancosma SA, Geneva, Switzerland.

Weaning piglets at the age of 3-4 weeks has major consequences for their digestive functions. Strategies have been developed with the aim of counteracting post-weaning problems and to stimulate feed intake and growth. Inclusion of artificial sweeteners in the piglet's diet is a common practice. It was assumed that artificial sweeteners increase palatability and hence increased food intake. However, recent findings that artificial sweeteners may enhance the capacity of the gut to absorb carbohydrates have important implications for the nutrition of piglets and avoidance of post-weaning digestive problems. In this study we weaned 4 groups of 28 day old piglets to isocaloric diets containing 35.9% or 60.3% digestible carbohydrate, or 43% digestible carbohydrate with or without sucram. The animals were maintained on these diets for 3 days and had access to water at all times. At the end of the experimental period piglets were sacrificed by giving intravenous pentobarbitone (Approved by the UK Home Office under schedule 1). Intestinal tissue samples were either fixed or frozen in liquid nitrogen for further analysis. We show that there is a 3-4 fold enhancement ($p=0.004$) in SGLT1 expression and glucose absorptive capacity in the intestine of piglets maintained on a 60.3% carbohydrate diet compared to piglets fed 35.9% carbohydrate. Furthermore, addition of sucram to the 43% carbohydrate - containing diet increased SGLT1 expression and glucose absorptive rates 4.5-fold ($p=0.0063$) more over the diet without sucram. These finding has important implications in feed formulation and management. Statistical analyses were performed using Student's t-test.

Key Words: intestine, artificial sweetener, glucose absorption

268 Changes in expression of swine intestinal Na⁺/glucose cotransporter in response to increased dietary carbohydrates. A. Moran^{*1}, M. Al-Rammahi¹, D. Arora¹, D. Batchelor¹, E. Coulter¹, N. Jones¹, C. Ionescu², D. Bravo², and S. Shirazi-Beechey¹, ¹Department of Veterinary Preclinical Sciences, University of Liverpool, Liverpool, UK, ²Pancosma SA, Geneva, Switzerland.

Absorption of glucose in the intestine is accomplished by the Na⁺/glucose cotransporter, SGLT1. It has been shown that SGLT1 expression is upregulated in response to increased dietary carbohydrates in a number of mammalian species. However, very little information is available on the regulation of swine intestinal SGLT1 by dietary carbohydrates. In order to assess the response of intestinal glucose transport to increased dietary carbohydrates, 28d old piglets of both sexes were weaned to isocaloric diets containing either 7%, 35.9%, 43%, or 60.3% digestible carbohydrates. The animals were maintained on these diets for 3d and had access to water at all times. At the end of the experimental period, piglets were sacrificed by giving intravenous pentobarbitone (Approved by the UK Home Office under schedule 1). Intestinal tissue samples were either fixed or frozen in liquid nitrogen and used for further analyses. Our data indicate that SGLT1 expression at the level of mRNA, protein and function remains the same when piglets are maintained on diets containing either 7%, 35.9% or 43% digestible carbohydrates. However, there was a 4-fold increase ($p=0.004$) in SGLT1 expression and glucose absorptive capacity in animals maintained on a 60.3% carbohydrate - containing diet. This increase was manifested in SGLT1 expression in all villus enterocytes, and was independent of any changes in total area for absorption. We conclude that there is a basal level of

SGLT1 expression in the intestine capable of absorbing dietary glucose. However this pathway becomes limited and is upregulated in response to high concentrations of dietary carbohydrate, i.e. 60.3%. This finding has important implications for the nutrition of pigs, in particular during the post-weaning period. Statistical analyses were performed using Student's t-test.

Key Words: intestine, SGLT1, dietary carbohydrate

269 Individual piglet birth weight, sow parity, gestation length, number of fully formed pigs and within litter birth weight variation affect incidence of stillborns. J. S. Fix^{*1}, J. W. Holl², W. O. Herring², and M. T. See¹, ¹North Carolina State University, Raleigh, ²Smithfield Premium Genetics Group, Rose Hill, NC.

Litters (n = 463) from commercial Large White × Landrace sows bred to Duroc boars were used to evaluate the effect of sow parity, number of fully formed pigs (FFP) (stillborns + born alive), gestation length, standard deviation of individual piglet birth weight (SD) and individual piglet birth weight (IBW) on incidence of stillborn pigs. All FFP (born alive: n = 5747; stillborns: n = 513) were weighed and individually identified within 24 h of birth. No sows were induced to farrow during the study. The model to evaluate incidence of stillborns in a litter (SB) included fixed effect of sow parity; covariates of linear and quadratic effects for gestation length and FFP. The model to evaluate effect of IBW on likelihood of a piglet being stillborn included fixed effects of sex and sow parity; covariates of IBW, gestation length (linear and quadratic) and FFP (linear and quadratic). For both analyses parity was divided into three groups (group 1 = parities 1, 2, 3; group 2 = parities 4, 5; group 3 = parities > 6). Groups were selected based on comparison of LS means. Descriptive statistics (min, max, mean): IBW (0.29, 2.77, 1.41 kg), gestation length (108, 119, 114.5 d), FFP (4, 20, 13.4 pigs) and SB (0, 15, 1.1 pigs). Number of SB differed (P < 0.01) between parity groups (group 1: 0.83±0.09; group 2: 1.23±0.14; group 3: 2.03±0.18). Quadratic relationships for gestation length (0.056 and -12.76; P < 0.01) and FFP (0.024 and -0.439; P < 0.01) with SB were observed. Number of SB reached a minimum at 114-115 d of gestation and 9-10 FFP, respectively. A 100 g increase (P = 0.05) in SD resulted in 0.15 pig increase in SB. Mean litter birth weight did not affect SB. As IBW decreased the odds of a piglet being stillborn increased (odds ratio: 0.13; P < 0.01). Both short (< 113 d) and long (> 115 d) gestation lengths had greater numbers of stillborn pigs. Incidence of stillborns was greatest in small litters (FFP < 8) and large litters (FFP > 11). Litters with greater variation in piglet birth weight had increased stillborns. Pigs with lower birth weights were more likely to be stillborns.

Key Words: stillborn, birth weight, pigs

270 New DFM product (Bacillus) improves performance of grower/finisher swine. I. Knap and B. T. Lund^{*}, *Chr. Hansen, Hoersholm, Denmark.*

Bacillus spores are ideal as DFM due to thermostability and consistent performance. As the spores enter the small intestine of the pig, the

spores attach to the mucus layer and start germination. The vegetative Bacillus cells grow and multiply in the mucus layer. The probiotic effect of Bacillus is due to its immune stimulation, production of metabolites and pathogen exclusion. The research objective was to identify new improved DFM. A new strategy was implemented to select for fast outgrowth Bacillus spores at a high bile salt level and at the same time with increased production of metabolites. The first product based on this concept has been developed for grower/finisher swine. The outgrowth of the improved Bacillus spores at both 0.4 mM bile salt and 0.6 mM bile salt was increased by a factor two (in-vitro data) and the expression of metabolites was increased by a factor of 5 (in-vitro data). In the feeding study, with two treatment (control and control plus DSM) 9 pigs per pen, 12 replicate pens per treatment. Pelleted corn-soy diets were fed in 4 phases of 21, 32, 28 and 24-d each. Starting weight were approx. 57 lbs. The effect of the new improved DFM product in barrows showed a significant lower (P<0.05) FCR (-4.1%) most pronounced in the late feeding phase (-8.9%) and with a reduced back fat content compared to the control group. Growth rate were 2.223 lb/day in the treated group. No significant effects were seen in gilts. This research proves a new strategy for identifying spore based products. In the future several new high performing DFM products can be developed by this method.

Key Words: Bacillus, DFM, swine

271 Cholecystokinin excited and sensitized porcine gastric mechanoreceptors responding to distension. W. L. Grovum^{*}, W. R. Ellison, and W. W. Bignell, *Department of Biomedical Sciences, Ontario Veterinary College, University of Guelph, Guelph, Ontario, Canada.*

The purpose of the present work was to use pigs as a model for humans to learn how to manipulate gastrointestinal neural mechanisms to suppress hunger (decrease snacking) or hasten satiety (decrease meal size). Cholecystokinin (CCK-8) excited and sensitized mechanoreceptors sensing gastric distension in rats and it depressed food intakes in rats, pigs, humans and other species but the physiological significance of these data keeps being raised. This question was addressed in 22 Yorkshire pigs (29 to 64 kg) anesthetized with sodium pentobarbital. Fluid secretion from the pancreas, and pressures on fluid filled balloons in the gallbladder and duodenum were measured. Single fiber activity in the vagus nerve originating from gastric mechanoreceptors was increased stepwise by distension alone (0, 250, 500, 750 and 1000 ml air in a gastric balloon) and by intravenous CCK-8 alone (0, 0.06, 0.24, 1 and 4 µg/kg) (P≤0.001 in both cases). All combinations of these treatments were also tested. The threshold CCK-8 doses for exciting the receptors in the absence of distension and for sensitizing them to distension were similar to those for increasing small intestinal contractions, pancreatic secretion and gallbladder tone. Since the latter 2 were used to define CCK as a hormone, it now appears that controlling small intestinal motility, gastric mechanoreceptor activity and ingestive behavior may also be physiological functions of CCK in the pig.

Key Words: appetite, pigs, cholecystokinin