

and their lambs but, in relation to lamb growth rate, the outdoor grass-based system (T1) was equally good. The lower creep intake of the lambs on the brassica-based treatment (T2) was probably a reflection of the highly succulent nature of this crop.

**Key Words:** Ewe, Lamb, Growth

**1871 Feedlot performance, wool production, and carcass characteristics of Merino/Rambouillet wether lambs as affected by breed and dietary forage to concentrate ratios.** S. L. Lake\*, H. S. Hussein, H. A. Glimp, B. D. Kindred, T. P. Ringkob, and D. W. Holcombe, *University of Nevada - Reno*.

The objective of this study was to determine the effects of sheep breed and finishing diet on feedlot performance, wool production, and carcass characteristics of lambs. Forty lambs (initial BW = 42.47 kg) from two breed (Merino [M]/Rambouillet [R]) combinations (20 each) were assigned at random to 2 dietary treatments in a completely randomized design experiment. Treatments were arranged as a 2 × 2 factorial. The main factors were 2 breed combinations (.5 M-.5 R or .875 M-.125 R) and 2 dietary forage (alfalfa pellets) to concentrate (cracked corn) ratios (i.e., high forage [HF; containing 60% alfalfa] and high concentrate [HC; containing 80% corn]). The diets contained 14.2 and 11.1% CP on DM basis, respectively. The lambs were housed in individual pens in a temperature-controlled room, had ad libitum access to feed, water, and salt blocks, and were harvested at 55.2 kg of BW. No interactions ( $P > .05$ ) between lamb breed and diet were detected for any of the measurements evaluated. Therefore, results of the main factors were summarized. Feedlot performance and wool production were not affected ( $P > .05$ ) by lamb breed but they were influenced ( $P < .05$ ) by diet. Lambs fed the HF diet consumed more DM (1.69 vs 1.38 kg/d), gained faster (.29 vs .21 kg/d), and had higher gain/feed ratio (.171 vs .147). The wool data were derived from evaluation of wool produced in 10 cm × 10 cm midrib patches that were shorn at the beginning of the study. Lambs fed the HF diet produced less grease (8.1 vs 9.9 g) and clean (5.1 vs 6.4 g) wool. Carcass characteristics were not altered ( $P > .05$ ) by the treatments. The only exceptions were less ( $P < .05$ ) kidney, pelvic, and heart fat (2.6 vs 4.0%) and a tendency ( $P=.199$ ) for better yield grade (1.77 vs 1.99) when lambs consumed the HF diet. Results suggest that finishing M/R wether lambs on HF diets (provided by alfalfa pellets) may be beneficial in reducing days on feed, improving efficiency, and producing carcasses with higher yield of boneless cuts. Increasing M genetics from .5 to .875 did not negatively affect lamb

performance. Compared with recommended requirements (NRC, 1985), lambs were either consuming 30% more (HF) or 17% less (HC) CP. It appears that CP requirements of M/R lambs must be equal to or higher than those recommended (NRC, 1985).

**Key Words:** Sheep, Carcass characteristics, Finishing diet

**1872 Comparison of carcass data and ultrasound measures using both cattle and swine standoffs for loin eye area, loin eye depth and external fat in lambs.** B.D. Banks\*, M.E. Benson, J.D. Cowley, G.C. Good, M.T. Shane, and T.M. Villumsen, *Michigan State University, East Lansing, MI/USA*.

The objectives of this study were to determine accuracy of ultrasound measures for loin eye area (LEA), loin eye depth (LED) and external fat at the 12<sup>th</sup> rib (BF). Data were collected by real-time ultrasound (Pie 200 SLC, Pie Medical, Tequesta, FL) with cattle (USC) and/or swine (USS) standoffs. Ultrasound measures were compared to carcass measures. Commercial ewe and wether lambs (n=120) born in 1999 and 2000 were harvested at an average weight of 59.36.0 kg. Post-harvest LEA, LED and BF were measured on the carcasses. Actual carcass LEA averaged 17.74 cm<sup>2</sup> (n=120), USC LEA averaged 18.39 cm<sup>2</sup> (n=119), and USS LEA averaged 17.87 cm<sup>2</sup> (n=56). The range in standard deviations across all measurements was 1.94 to 2.26 cm<sup>2</sup>. Actual carcass LED averaged 3.23 cm (n=68), USC LED averaged 2.97 cm (n=68), and USS LED averaged 3.12 cm (n=30). Standard deviations ranged from 0.18 to 0.30 cm. Mean carcass BF was 0.69 cm (n=120), average USC BF was 0.48 cm (n=119), and average USS BF was 0.51 cm (n=56). Standard deviations ranged from 0.13 to 0.25 cm. Correlations between carcass LEA and ultrasound measurements were .30 and .57 for USC LEA and USS LEA, respectively. The correlations between carcass LED and ultrasound measurements were .52 and .68 for USC LED and USS LED, respectively. Carcass BF was correlated with USC BF (0.69) and USS BF (0.78). The linear regression coefficients for carcass LEA on USC LEA and USS LEA were 0.278 ( $P<0.01$ ) and 0.550 ( $P<0.01$ ), respectively. The regression of carcass LEA on USC LED and USS LED were 1.963 ( $P<0.01$ ) and 2.737 ( $P<0.01$ ), respectively. Carcass BF linear regressions on USC BF and USS BF were 1.348 ( $P<0.01$ ) and 1.369 ( $P<0.01$ ), respectively. Both standoffs overestimated the average carcass LEA and underestimated carcass BF. The swine standoff predicted carcass LEA, LED and BF closer to carcass estimates.

**Key Words:** Sheep, Lamb carcass, Ultrasound

## ASAS Swine Species

**1873 Lysine requirement of growing (35.1 to 60.5 kg) pigs, when formulated on ideal protein basis.** I. Moreira\*, M. Kutschenko, A.C. Furlan, A.E. Murakami, E.N. Martins, and C. Scapinello, *Universidade Estadual de Maringá, Maringá-PR, BRAZIL*.

An experiment was performed to determine the optimum lysine (total) level in the diet of the growing pigs when formulated on ideal protein basis. A corn-soybean meal basal diet contained 13% crude protein, 3.4 Mcal of digestible energy/kg and 0.75 % lysine. Treatment diets were supplemented with .15, .30, .45% of lysine to attain dietary concentration of .90, 1.05 and 1.20% lysine (total). Crystalline methionine, threonine and tryptophan were added in all diets to maintain constant ratios of these essential amino acids to the lysine content in each treatment diet. All other nutrients met or exceeded NRC (1998) nutrient requirement of pigs. Thirty-two crossbred pigs with an average body weight of 35.1 kg were blocked by weight and randomly assigned to the four experimental diets for a 28-d growth study. The experiment was a randomized complete design and was conducted in four replicates, with two pigs per experimental unit (pen). Pigs had access to their treatment diets on an ad libitum basis. Pigs were weighed, pen feed intakes determined and individual pig blood samples taken every 14 days. Plasma urea nitrogen (PUN) was determined. Backfat thickness (BF) was obtained using ultrasound on live pigs at the end of the growing phase. Gain:feed and backfat thickness were not affected by lysine levels. The regression models estimated the total lysine (%) requirement to be .90, .89 and 1.03% when average daily feed intake, average daily gain and PUN, are the measurement criteria respectively.

**Key Words:** Amino Acid Requirement, Ideal Protein, Pigs

**1874 Substitution of Corn to Coffee Hulls in a Isoenergetic Diets for Growing and Finishing Pigs.** E. T. Fialho\*<sup>UFLA</sup>, V. Oliveira<sup>UFLA</sup>, J. A. F. Lima<sup>UFLA</sup>, and R.T. Freitas<sup>UFLA</sup>, <sup>1</sup>*Universidade Federal de Lavras - UFLA/BRAZIL*.

A metabolism assay and a performance trial were carried out at the University of Lavras (UFLA) in Brazil in order to evaluate the technical and economical viability of substitution of corn with Coffee Hulls (DM 86.7%; CP 10.2%; FDN 55.0% and 2500Kcal DE/Kg) in isoenergetic growing and finishing pig diets. The metabolism assay was conducted utilizing 24 crossbred (LDxLW) barrows with 12 in the growing phase (34.8 Kg) and 12 in the finishing phase (60.7 Kg) which were randomly assigned to a metabolism cage with six replicates per phase. In the performance trial a total of 96 crossbred (LDxLW) barrows and gilts with mean initial weight of 34.4 Kg were utilized. The experiment was in a randomized block design with four treatments and six replicates with pigs distributed in a pen with four pigs (2 barrows and 2 gilts). The treatments consisted of the inclusion of Coffee Hulls (CH) at 0.0;5.0;10.0 and 15.0%, replacing corn in isoenergetic diets (16% and 14% CP and 3350 Kcal DE/Kg) for growing and finishing phases, respectively. Increasing the level of CH decreased linearly ( $P<0.01$ ) the digestibilities of nutrients as well as energetic values (DE and ME) of the diets. The performance assay showed that weight gain decreased linearly ( $Y=876.3-13.17R=0.932$ ) and feed intake decreased linearly ( $Y=2.685-34.26R=0.899$ ) with increasing CH. Considering the price of corn and CH in January/2001 the use of Coffee Hulls was technically

and economically viable at levels up to 5% in growing and finishing pig diets.

**Key Words:** pigs, metabolism assay, alternative feedstuffs

**1875 Effect of deletion of vitamin and trace mineral premixes from diets on daily gain, feed:gain ratio, backfat thickness, red blood cell count in finishing pigs.** S. C. Lee<sup>\*1</sup>, C. E. Lee<sup>2</sup>, and K. I. Kim<sup>1</sup>, <sup>1</sup>*Cheju National University, Cheju, Rep. of Korea*, <sup>2</sup>*Cheju Agr. Exp. Station, RDA, Cheju, Rep. of Korea*.

A study was done to determine the effect of deletion of vitamin and trace mineral premixes from diets on growth and feed:gain ratio, hemoglobin content, hematocrit and red blood cell count in finishing pigs. Three replicates of 5 pigs each (average weight, 70 kg) were assigned to a control (with complete premixes), 50% or 100% deletion of the premixes and fed to market weight. They had free access to feed and water. Average daily gain  $\pm$ SEM was  $0.78 \pm 0.04$ ,  $0.73 \pm 0.03$  and  $0.74 \pm 0.05$  kg for control, 50% deletion and 100% deletion over a 7-week feeding period, respectively. Feed:gain ratio, and carcass backfat thickness (mm) were  $3.86 \pm 0.05$ ,  $3.90 \pm 0.20$  and  $3.96 \pm 0.05$ , and  $23.7 \pm 2.49$ ,  $24.5 \pm 4.68$  and  $25.3 \pm 4.86$  for control, 50% deletion and 100% deletion, respectively. Hemoglobin content (g/100 mL blood); hematocrit (volume %); and red blood cell count (millions/mL) were  $14.2 \pm 0.7$ ,  $13.4 \pm 1.1$  and  $13.7 \pm 1.3$ ;  $44.5 \pm 2.0$ ,  $42.6 \pm 3.6$  and  $44.2 \pm 4.0$ ; and  $734 \pm 42$ ,  $697 \pm 79$  and  $719 \pm 69$  for control, 50% deletion and 100% deletion, respectively. All of these measurements were not different ( $P > 0.05$ ) among the dietary groups. These findings together with others' clearly demonstrate that supplementary vitamins and trace minerals are not necessary for finishing pig diets.

**Key Words:** Vitamins, Minerals, Pigs

**1876 Fatty acid polyunsaturation of boar semen: Positive effects on gilt reproduction.** P.C Penny<sup>\*1</sup>, R.C Noble<sup>1</sup>, and A. Maldjian<sup>1</sup>, <sup>1</sup>*JSR Healthbred Ltd, Southburn, Driffield, YO25 9ED, UK*.

The major differentiated regions of the spermatozoan cell, display their own unique lipid compositions involving a high degree of polyunsaturation. Idealisation of the polyunsaturation profile of boar spermatozoa by nutritional supplementation (Prosperm<sup>TM</sup>), has demonstrated highly beneficial effects on spermatozoa characteristics. The aim of this study was to determine if gilts inseminated with spermatozoa from boars with enhanced polyunsaturated spermatozoa composition would enhance female reproductive output beyond standard boar spermatozoa. Thirty five boars were allocated to the study, with four hundred and seventy eight gilts (JSR Genepacker) being randomly allocated to two insemination treatments, either standard or optimised polyunsaturated semen (post eight week spermatozoa synthesis). All gilts were artificially inseminated twice (75ml, 2.5 billion spermatozoa. Insemination timing schedule (days) either d1+2, d2+3 and d3+4 was balanced between semen treatments. Significant positive effects were observed for conception rate (90 vs. 83 %,  $P < .05$ ), born alive (10.6 vs. 10.2, s.e.d. 0.19,  $P < .05$ ) and overall fecundity, number of piglets born alive per 100 services (954 vs. 846, s.e.d. 19.5,  $P < .001$ ) in those gilts inseminated with enhanced polyunsaturated spermatozoa. Polyunsaturated fatty acids which are concentrated in the cell membrane and tail region of spermatozoa, have been shown to play a pivotal role in both spermatozoa capacitation and the interaction between spermatozoa cell membrane and uterine surface. The increased female reproductive efficiency demonstrated here by utilising enhanced polyunsaturated spermatozoa, can be associated with improved spermatozoa characteristics and survivability properties during the critical time window from semen insemination to fertilisation.

**Key Words:** Boar, Polyunsaturation, Spermatozoa

**1877 Effect of docosahexaenoic acid (DHA) and cryopreservation on boar spermatozoa.** A Maldjian<sup>1</sup>, P.C Penny<sup>\*1</sup>, S Cerolini<sup>2</sup>, and R.C Noble<sup>1</sup>, <sup>1</sup>*JSR Healthbred Ltd, Southburn, Driffield, YO25 9ED, UK*, <sup>2</sup>*Istituto Zootecnico, Via Celoria 10, 20133 Milano, Italy*.

Lipids present within boar spermatozoa play a key role in physiological and structural formation. Cryopreservation of boar semen is not routinely used due to variable spermatozoa survival rates. Changing specific fatty acids within the spermatozoa could deliver both fresh and frozen

benefits. The aim of this study was to investigate the effect of providing a supplement containing docosahexaenoic fatty acid (DHA) plus antioxidants (Propserm<sup>TM</sup>) on the fresh quality of boar spermatozoa and subsequent cryopreservation of such derived spermatozoa. Fourteen boars were randomly allocated to either a standard boar diet or standard diet + nutritional supplement (Prosperm<sup>TM</sup>), for 16 weeks. Both fresh and thawed samples of normal and DHA manipulated spermatozoa were assessed for motility and viability. Ejaculate concentration and fatty acid profile were assessed on fresh spermatozoa only. Samples were frozen using the Westendorf procedure (1975). The level of DHA increased from 28.1 % to 43.3 % of total fatty acids ( $P < .01$ ) in spermatozoa from supplemented boars. Sperm concentration was also significantly higher (571 vs. 695 million per ml;  $P < .05$ ) in boars receiving the supplement. Following cryopreservation and thawing sperm quality parameters were similar for normal and DHA manipulated spermatozoa. DHA supplementation of boars provided a major benefit for improving fresh spermatozoa quality. Altering other fatty acids in-conjunction with DHA may be required to improve cryopreservation of boar spermatozoa.

**Key Words:** Boar, Docosahexaenoic, Spermatozoa

**1878 Response of weaned pigs housed in large groups to alternative feeding strategies.** P.C Penny<sup>\*1</sup> and S Tibble<sup>2</sup>, <sup>1</sup>*JSR Healthbred Ltd, Southburn, Driffield, YO25 9ED, UK*, <sup>2</sup>*SCA Iberica S.A., Mequinenza, Spain*.

The uptake by pig producers of large group (LG) weaning systems provides complex nutritional challenges. Defining an appropriate nutritional strategy to accommodate the extensive weaning weight variation within LG is not easy. The aim of this study was to investigate specific nutritional feeding regimes to maximise the overall performance of weaned pigs housed in LG. A total of 1300 weaned piglets were used in a randomised block design involving two treatments (group size 130). 1. Fixed feeding regime of four diets, each offered for a specific number of days (FX). 2. Choice feeding regime, same four diets but offered in paired combinations over time (CH). Feeder allocation, feeder type and water availability were standardised. All pigs were weighed individually at weaning, d 7, 14, 21, 28 and 35. Average daily gain (ADG) during d0-7 was significantly reduced for FX compared to CH, 0.117 vs. 0.143 kg ( $P < 0.01$ ). From d8-14 ADG for FX was significantly higher than CH, 0.340 vs. 0.315 kg ( $P < 0.01$ ). Live weight at d35 was significantly lower for FX compared to CH, 19.9 vs. 20.7 kg ( $P < 0.01$ ). Pigs on CH showed clear evidence of being able to choose between diets offered. This study demonstrates positive nutritional solutions for improving the performance of weaned pigs in LG. Further work is necessary to synergistically combine specific attributes from both FX and CH feeding strategies.

**Key Words:** Large group, Nutrition, Pig

**1879 Increased progeny performance by elevating nutrient intake to sows during gestation.** P.C Penny<sup>\*1</sup>, M.A Varley<sup>2</sup>, and S Tibble<sup>3</sup>, <sup>1</sup>*JSR Healthbred Ltd, Southburn, Driffield, YO25 9ED, UK*, <sup>2</sup>*SCA Nutrition Ltd, Thirsk, UK*, <sup>3</sup>*SCA Iberica S.A., Mequinenza, Spain*.

Previous work has demonstrated a positive effect on progeny performance from increasing nutrient intake to sows between d 28-56 of gestation. This first in-field experiment was undertaken with limited numbers and although results obtained were positive, further data is necessary to deliver producer acceptance. The aim of this study was to extrapolate and confirm the effectiveness of implementing increased nutrients d28-56 and the effect of offering two diets to derived progeny during the growth phase (2x2 factorial design). Forty eight multiparous sows were randomly allocated between two treatments, Standard (ST) 2.5 kg/d or Elevated (EL) 5.0 kg/d. Pigs from each sow were housed in groups of twelve, received identical nutrition and were weighed on d 57, 85, 127 and 157. Two diets differing in lysine content (1.05 vs. 1.25 %) were offered to ST and EL progeny during d85-127. Quantity of feed consumed during gestation was lower ( $P < 0.01$ ) for ST than EL. ST progeny produced a significantly lower average daily gain from d 85-127 ( $P < .05$ ) compared to EL progeny (0.866 vs. 0.910 kg). This was also evident for both diets. Food conversion for ST progeny was substantially increased (2.201 vs. 2.060,  $P < .05$ ) compared to EL, again represented by both dietary treatments. These results confirm that increased maternal

nutrients, d28-56, provides enhanced progeny performance and suggests the possibility of reducing the nutrient density of the diet offered.

**Key Words:** Sow, Gestation, Performance

**1880 Effect of storage and pelleting temperature on the activity of bacterial alkaline endoprotease (E.C. 3.4.21.14), Alpha D-(1,4) amylase (E.C. 3.2.1.1) and combination of both enzymes.** I Prez-Portabella<sup>1</sup>, J Sol, and E Roura\*, <sup>1</sup>Lucta, s.a.

The objective of this study was to examine the ability of bacterial alkaline endoprotease (E.C.3.4.21.14), Alpha D-(1,4) amylase (E.C.3.2.1.1) and the combination of both enzymes (Luctazyme Pro-Pig<sup>®</sup>) to withstand storage and exposure to moist heat. In experiment 1 enzymes were incubated in a water bath at different temperatures for 1 minute simulating pelleting heat conditions (table). In experiment 2 protease stability in the combined product at a three different storage conditions (5C, 22C and 40C) was assessed. Enzyme activities were determined using the methods developed by Lucta, s.a. after modification of previously published laboratory procedures. One unit of amylase activity is defined as the amount of enzyme which liberates 1 mmole of reducing sugars from potato starch per minute at pH 7 and 40C. One unit of protease activity is the amount of enzyme which liberates 1.5 mg/ml of L-tyrosine from casein per minute at pH 7 and 37C. The effect of different heat treatments on protease and amylase activity are shown in table 1 and 2.

Both, the endoprotease and the alpha-amylase, are highly stable even at 80C when assayed separately (84% and 90.5% of residual activity respectively) and in combination (80% and 84%). Loss of endoprotease activity in combination with alpha-amylase after 6 month storage was 18% at 40C, 4.5% at 22C and 3% at 5C. It is concluded that the combination of endo-protease and alpha-amylase is stable to moist heat and a 6 month storage at 40, 22 and 5C.

% protease activity	50 C	60 C	70 C	80 C
Bacterial alkaline endoprotease	99.0	1.0	95.5	2.5
Combination of both enzymes	99.0	1.0	96.0	1.5
% amylase activity	99.0	1.0	94.0	2.0
Alpha D-(1,4)amylase	99.0	1.0	94.0	2.0
Combination of both enzymes	98.0	2.0	92.0	1.0

**Key Words:** Alkaline endoprotease, Alpha-amylase, Stability

**1881 *Saccharomyces cerevisiae* for breeding sows in a Parvoviral challenge.** V. G. Perez<sup>1</sup>, M. L. Angeles<sup>2</sup>, A. M. Anaya<sup>2</sup>, and J. A. Cuaron<sup>2</sup>, <sup>1</sup>FES-C, UNAM, <sup>2</sup>C. N. I. Fisiología y Mejoramiento Animal, INIFAP. Queretaro, Mexico.

A total of 94 sows were challenged by a management induction of a parvoviral outbreak in 50% of the herd at breeding. Parvovirus surviving piglets are weaker and more susceptible to secondary infection; therefore the disease was used as a challenge to possible protective effects on productivity by a live yeast strain. Starting at d-30 of gestation sows were randomized to 2 treatments: Control (CTR) and the addition of 3 kg/ton of feed of live *Saccharomyces cerevisiae*, strain 47 (S47); treatments identity was conserved upon weaning. Parity (first litter gilts, mature sows, 2-5, and old 6+ farrowings) was included in a factorial arrangement. Parvovirus infection was confirmed by clinical signs, including number of piglets born alive. Challenged sows farrowed 7.6 live pigs and weaned 5.5 piglets vs. 10.7 and 9.1 in healthy animals (P<.01). Litter size effects were those expected and no interaction was detected (P>.23) with S47 addition or parity. Feed intake during lactation was 5.2 kg/d (P>.32), but yeast addition resulted in heavier litters at weaning (P<.01): 53.6 vs. 46.5 kg, for a mean litter size of 7.3 piglets after a lactation period of 24-d. Sow parity and S47 interacted (P<.11) in sow lactation wt. loss: first litter gilts in S47 lost 20.4, while CTR gilts 6.9 kg; sows in all treatment combinations lost 16.7 kg. Milk protein and fat was analyzed at d-10 of lactation and mean composition was similar: CP, 9.7 and fat, 7.3% (P>0.8). However, total milk CP and ME yield was calculated higher in S47 fed sows (P<.05). No differences (P>.25) were observed in subsequent reproductive performance, including pigs at parturition. The effect of S47 was the induction of greater

(by 15%) litter weaning weight; live yeast in the dam's diet did not protect piglets from Parvovirus side effects, but may be favoring a better metabolic response for milk synthesis.

**Key Words:** Yeast, Lactating sows, Parvovirus

**1882 *Saccharomyces cerevisiae* for lactating sows in a septic environment.** V. G. Perez<sup>1</sup>, S. Solorio<sup>2</sup>, A. Juarez<sup>3</sup>, J. Becerri<sup>3</sup>, E. O. Castaneda-Silva<sup>4</sup>, and J. A. Cuaron<sup>5</sup>, <sup>1</sup>FES-C, UNAM, <sup>2</sup>PAIEPEME, A.C., <sup>3</sup>Grupo Delta, S.A., <sup>4</sup>Nutrimentos Concentra, S.A. de C.V., <sup>5</sup>C. N. I. Fisiología y Mejoramiento Animal, INIFAP. Queretaro, Mexico.

In a commercial farm suffering several infectious diseases (among others PRRS), a total of 322 sows were used to conduct an experiment in two phases. Phase 1 was supervised feeding to ensure *ad libitum* intake, while in Phase 2, feeding was done by laborers applying the feeding method as a routine. Treatments were the addition or not of 2 kg/ton of a live culture of *Saccharomyces cerevisiae* strain SC47 (S47), to the lactation diet. Productive performance was measured during lactation and re-breeding. Experimental lactation diets were offered from gestation d-100, at 2 kg/sow/d. From farrowing sows' feed allowance was increased by .5 kg/d until *ad libitum* intake. Sows' parity group (1st, 2nd, 3rd and greater than 5 parities) was included in the model as a factor. Overall, number of piglets born alive was 10. In Phase 1, S47 fed sows had greater (P<.08) daily feed intake (5.72 vs. 5.45 kg) during the 16-d lactation period. Sows fed S47 weaned heavier (P<.02) litters (45.84 vs. 42.71 kg) and exhibited less (P<.01) piglet mortality (7.01 vs. 12.83%). Sow wt. change during lactation was similar (P>.25) between dietary treatments (mean of -3.5 kg). In Phase 2, mean daily feed intake was similar (P>.8) between dietary treatments, but differences in litter wt. at weaning were maintained (P<.05; 44.9 vs. 42.8 kg), resulting in greater (P<.01) sow wt. loss: 6.77 vs. 2.53 kg. In both phases, sow parity and S47 showed (P>.2) no interactions for any of the response criteria. Days to 1st estrus, conception rate and prolificacy to the following farrowing were unaffected (P>.7). It is inferred that the greater litter wt. gain in yeast fed animals was a consequence of a better metabolic status, possibly by enhancing immune responsiveness of the sows to acute sub-clinical challenges.

**Key Words:** Yeast, Lactating sows, Health status

**1883 *Saccharomyces cerevisiae* for growing-finishing pigs in a septic environment.** V. G. Perez<sup>1</sup>, S. Solorio<sup>2</sup>, A. M. M. Martinez<sup>3</sup>, E. O. Castaneda-Silva<sup>4</sup>, and J. A. Cuaron<sup>5</sup>, <sup>1</sup>FES-C, UNAM, <sup>2</sup>PAIEPEME, A.C., <sup>3</sup>CNID-Microbiología, INIFAP, <sup>4</sup>Nutrimentos Concentra, S.A. de C.V., <sup>5</sup>C. N. I. Fisiología y Mejoramiento Animal, INIFAP. Queretaro, Mexico..

A total of 630 growing-finishing barrows and gilts (mixed in similar proportions) of an avg. initial wt. of 41.7±7 kg (a covariable) were used in a single experiment in which pigs were weaned and raised to initial wt. from sows fed diets containing 2 kg/ton of a live culture of *Saccharomyces cerevisiae*, strain SC47 (S47). In three treatments, S47 was kept in the diets to starting wt. (W40), up to 70 kg BW (W70) or to market wt. (105±6 kg), no withdrawal (NOW). The experiment was a RCB, being blocks 2 identical open front buildings in which pigs were housed in pens of 21 head. There were 10 pen replications per treatment. In all cases, antibiotics were used in feed up to 70 kg BW, as recommended by the resident veterinarian. Feed intake was measured daily and body wt. gain by weighing pens every 14-d. Real time ultrasound measurements (backfat and muscle depth at P2) were recorded initially and in 28-d intervals. Clinical observations were recorded and animals losing BW in two consecutive weighings were removed and counted as mortality. Average feed intake was 2.42 kg/d and no differences were noted (P>.7) between treatments. However, BW gain showed differences (P<.07): W40, .718 < W70, .747 and NOW, .762 kg/d and gain:feed was: W40, .29 < W70, .31 and NOW, .32 (P<.03). Noted differences (P<.05) in carcass composition were on P2 backfat at the last rib, which paralleled daily BW gain: W40, 15.4 < W70, 16.4 < NOW, 17.6 mm. During the experiment an outbreak of complicated mycoplasmosis resulted in high mortality during a 2 week span, starting at about d-125 of age. Final mortality rate was: W40, 6.54 > W70, 3.64 and NOW, 2.32% (P<.08). Live S47 yeast in feed possibly conferred better resistance to disease, provided that the culture was present in the diet at time of challenge.

**Key Words:** Yeast, Growing pigs, Health status

**1884 Molecular typing of hemolytic *Escherichia coli* isolated from swine.** D. Parrott<sup>\*1</sup>, T. Rehberger<sup>1</sup>, and M. Holt<sup>2</sup>, <sup>1</sup>Agtech Products, Inc., Waukesha, WI, <sup>2</sup>Varied Industries Corporation, Mason City, IA.

*E. coli* is known to cause edema disease and coliform gastroenteritis in swine leading to an important economic loss and mortality between weaning and market. Understanding the genetic diversity between isolates is an important aspect when trying to prevent and treat this disease. Forty-eight hemolytic *E. coli* isolates were obtained from animal diagnostic laboratories in Iowa, Oklahoma, Arkansas, Georgia, Indiana, and Texas as a causative agent in infected swine herds presenting with diarrhea or edema disease. All isolates were biochemically tested to confirm their identification. The isolates were genetically analyzed using pulse-field gel electrophoresis (PFGE) and random amplified polymorphic DNA analysis (RAPD). PFGE was performed using chromosomal DNA embedded in agarose beads and digested with *Xba* I. PFGE analysis classified isolates into 22 genotypes with no genotype containing more than four isolates. RAPD was performed using two 10-base pair oligonucleotide primers. RAPD analysis with the first primer classified isolates into 15 genotypes with no genotype containing more than five isolates. RAPD analysis with the second primer classified isolates into 10 genotypes with no genotype containing more than eight isolates. The classifying of swine *E. coli* into 10-22 different genotypes demonstrates the genetic variability within hemolytic *E. coli* isolated from infected swine herds. Both PFGE and RAPD analysis are useful techniques for isolate typing, with PFGE being the more discriminatory method.

**Key Words:** Swine *E. coli*, Pulsed-field gel electrophoresis, Random amplified polymorphic DNA analysis

**1885 Effect of three dietary growth promoting additives on performance of nursery pigs.** B. P. Corrigan<sup>\*1</sup>, B. F. Wolter<sup>1</sup>, M. Ellis<sup>1</sup>, and S. Moreland<sup>2</sup>, <sup>1</sup>University of Illinois, Urbana, IL/USA, <sup>2</sup>Braes Feed Ingredients, Wheeling, IL/USA.

This study was carried out over a 4-wk period to investigate the impact of dietary additions of 3 growth-promoting agents on growth performance of nursery pigs. A randomized-block design was used with four treatments and fifteen replicates per treatment, blocked by weaning date. The treatments were: 1) Control (no additive); 2) Zinc oxide (to provide 3000 ppm added zinc); 3) Antibiotic CSP 250<sup>®</sup> (at 0.25% of the diet to provide 110 mg of chlortetracycline, 110 mg of sulfamethazine, and 55 mg of penicillin per kg); 4) Apex<sup>TM</sup> 3050 (at 0.10% of the diet). Apex<sup>TM</sup> 3050 is a blend of specific plant extracts, mixed herbs, essential oils and Allinex<sup>TM</sup>, a natural form of allicin. A total of 360 crossbred pigs were weaned at 21 ± 1.2 d of age and allotted to treatment groups (mixed-sex) of 6 pigs on the basis of weaning weight, sex, and litter. Pigs were given ad libitum access to feed and water. A two-phase feeding regimen was used with the Phase I diet (3438 kcal/kg ME, 23.8% CP, 1.63% lysine) fed as a pellet for the first two weeks and the Phase II diet (3421 kcal/kg ME, 22.68% CP, 1.46% lysine) fed as a meal in weeks 3 and 4. Morbidity (pigs removed due to poor health or lameness) was higher for the control compared to the other treatments (17.7 vs 5.6 vs 3.3 vs 3.3 %, for the Control, Zinc oxide, CSP 250<sup>®</sup>, and Apex<sup>TM</sup> 3050, treatments, resp., P<0.01). Two pens of pigs on the control treatment were removed from the study because of high levels of morbidity and the data from these pens were not included in the growth performance analysis. Over the 4-week study period, ADG (229 vs 324 vs 277 vs 259 g, SE 7.8 g, resp., P < 0.05), ADFI (392 vs 469 vs 430 vs 408 SE 10.8 g, resp., P<0.05), and G:F (0.66 vs 0.76 vs 0.72 vs 0.71 SE 0.015 g/g, resp., P<0.05) were lowest for the control and highest for the Zinc oxide treatment, with the other two treatments generally being similar and intermediate for these traits. These results suggest the growth promoting additives evaluated in pigs weaned at 21 d of age were effective in reducing morbidity and increasing growth performance for 4-wk post-weaning.

**Key Words:** Pigs, Weanling, Growth

**1886 Effect of iron supplementation and dietary iron source and level on bioavailability of iron in weanling pigs.** B. K. Anderson<sup>\*1</sup>, N. R. Augspurger<sup>1</sup>, M. Ellis<sup>1</sup>, and D. E. Nuzback<sup>2</sup>, <sup>1</sup>University of Illinois at Urbana-Champaign, <sup>2</sup>Albion Laboratories, Inc.

The effect of iron (Fe) supplementation and dietary Fe source on Fe bioavailability was determined by hemoglobin (Hb) depletion and use of a slope-ratio assay. Ninety Fe-deprived piglets (Hb 5.17 ± 1.21 g/dL) from 11 litters were used in a 2 × 3 × 5 factorial design, the factors being Fe supplementation level, dietary Fe source and dietary Fe concentration. Piglets were randomly allotted at birth to one of two Fe supplementation levels, 0 or 30 mg Fe via Fe dextran. Injections were administered on d1 with all piglets receiving either 1 ml saline or 1 ml Fe dextran 30 mg Fe/ml. At weaning, pigs were blocked by Fe supplementation level, then randomly allotted across 13 dietary treatments comprised of 4 levels of 3 dietary Fe sources and a common control. Diets were based on a common basal diet employing dried skim milk and corn to yield 27 mg/kg of iron. Twelve diets were formulated from aliquots of the basal diet to contain 25, 50, 75, and 100 mg Fe/kg iron from either ferrous sulfate, an Fe-amino acid chelate or a combination of ferrous sulfate and chelated product mixed in a 70:30 ratio (Fe concentration). Performance measures (ADG, ADFI, and G:F) were recorded individually for all piglets. Blood Hb concentration was determined at the start and end of the 3-wk feeding period during which pigs were offered feed and water ad libitum. Estimates for Fe bioavailability of both Fe chelate and ferrous sulfate/chelate combination were based on the ratio of the regression slopes of blood Hb levels on dietary Fe intake for both sources vs. ferrous sulfate. Those values were calculated to be 98.5% for the chelated product and 107.6% for the ferrous sulfate/chelate combination. These values are generally higher than previously reported for iron complexes.

**Key Words:** pigs, iron, bioavailability

**1887 The response of starting pigs to increasing levels of dietary lysine, when formulated on ideal protein basis.** I. Moreira<sup>\*</sup>, A.L. Fraga, A.C. Furlan, A.O. Bastos, R.P. Oliveira, and D. Paiano, *Universidade Estadual de Maringa, Maringa-PR Brazil.*

A trial was carried out to evaluate the effect of increasing lysine levels (LYS) in the diet of starting pigs when formulated on ideal protein basis. A corn-soybean meal basal diet contained 13.1% crude protein, 3.4 Mcal of digestible energy/kg and 0.80% lysine. Treatment diets were supplemented with .2, .4, or .6% lysine to attain dietary concentrations of 1.0, 1.2 and 1.4% lysine (total). Crystalline methionine, threonine and tryptophan were added in all diets to maintain a constant ratio of these essential amino acids to the lysine content. All other nutrients met or exceeded NRC (1998) nutrient requirements of pigs. Sixty-four crossbred pigs with an average body weight of 15.3 kg were blocked by weight and randomly assigned to the four experimental diets for a 26-d growth study. The experiment was a randomized complete block design and was conducted in eight replicates with two pigs per pen (experimental unit). Pigs had access to their treatment diets on an ad libitum basis. Pigs were weighed, pen feed intakes determined and individual pig blood samples taken at 14 days and at the end of experimental period. Plasma urea nitrogen (PUN) was determined. Neither PUN nor average weight gain was altered (P≥.05) by lysine levels. Increasing lysine levels resulted in linear (P≤.05) responses in average feed intake (AFI = 1.378331 - .1905×LYS) and feed:gain (F:G = 2.16182 - .174625×LYS).

**Key Words:** Ideal Protein, Plasma Urea Nitrogen, Starting Pig

**1888 Effect of a GnRH-analogue at estrus on reproductive performance of gilts.** J.A. Romo<sup>\*1</sup>, R. Barajas<sup>1</sup>, and M.A. Luque<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective of determining the effect of the application of an analogue of gonadotropin releasing hormone (GnRH-A) at estrus on reproductive performance of gilts, two experiments were carried out. Experiment 1. One hundred seventy four hybrid gilts (YLHD; 1-5 parities) that had shown estrus between December and February (cool season) were used in a randomized design experiment. Gilts were designated to receive one of two experimental treatments: 1) Injection (im) of 50 µg of GnRH-A at first acceptance of a boar (GnRH-A; n=84); or 2) Injection of 2 mL of water (control; n=84). Experiment 2. One hundred thirty two hybrid gilts (YLHD; 1-5 parities) having shown estrus between June

and September (hot season) were used in a randomized design experiment, and received similar treatments as in experiment 1 (GnRH-A, n=70; and control, n=62). In experiment 1, farrowing was between March and June. GnRH-A application had no effect on the number of total piglets born (11.35 vs. 11.44) or the number of liveborn piglets (10.73 vs. 10.78). Fertility was similar (P>0.10) across treatments (90% vs. 85.71%). In experiment 2, farrowing was between October and January. GnRH-A injection had no effect (P>0.10) on the num-

ber of total piglets born (11.25 vs 11.20) or number liveborn (10.14 vs 10.22). Fertility of gilts receiving GnRH-A (91.43%, 64/70) and control gilts (85.48%, 53/62) was not different (P>0.10). It is concluded that injection of GnRH-A at service time does not affect the reproductive performance of gilts.

**Key Words:** GnRH, Reproduction, Gilts

## ASAS Horse Species

**1889 Temporal variables of the flat walk of the Tennessee Walking Horse weanling.** K.M. Holt\*<sup>1</sup> and M.C. Nicodemus<sup>1</sup>, <sup>1</sup>Mississippi State University, Mississippi State, MS/USA.

Limited research has been done on gaited horses, particularly concerning gaited weanlings. During the first few years, proper gait development for the gaited horse is very critical. This study describes the stride variables of the flat walk for 4 Tennessee Walking Horse weanlings. Frame-by-frame analysis was done to measure the following stride variables: stride duration, fore and hind stance durations, diagonal and lateral step intervals, and percentage of limb support. Four strides of a natural, consistent flat walk were measured for each weanling. The flat walk was determined to be a symmetrical, four-beat stepping gait that alternated between periods of tripod and bipedal limb support. The majority of the stride was spent in a stance phase with a similar percent of stance for both the fore and hind limbs. Weanlings 3 and 4 had a longer diagonal than lateral step interval and longer lateral than diagonal bipedal support indicating these gaits had an irregular rhythm with lateral couplets. Weanling 2 had the most even gait by demonstrating similar lateral and diagonal step intervals, lateral and diagonal bipedal supports and fore and hind stance durations. These stride variables will assist in the better understanding of how the gaits of the gaited horse develop with age. The temporal variables of these weanlings will be measured throughout aging and training to track the development of the flat walk.

Table 1. Mean values (SD) for the stride variables in the individual weanlings and group mean (SD) values.

	Wean-ling 1	Wean-ling 2	Wean-ling 3	Wean-ling 4	Ave.
Stride Duration (ms)	908(42)	1133(96)	1150(72)	1133(64)	1081(121)
Fore Stance (ms)	542(42)	696(40)	708(57)	688(61)	659(78)
Hind Stance (ms)	546(32)	696(59)	696(69)	708(64)	662(80)
Lateral Step Interval (ms)	425(35)	584(99)	392(43)	409(66)	453(79)
Diagonal Step Interval (ms)	464(62)	534(50)	742(97)	709(92)	613(92)
Lateral Bipedal Support (%)	35(4)	27(6)	43(6)	43(6)	37(8)
Diagonal Bipedal Support (%)	25(2)	27(3)	13(1)	11(3)	19(6)
Tripedal Support-2 Hind (%)	20(4)	23(1)	21(2)	25(3)	22(3)
Tripedal Support-2 Fore (%)	19(3)	23(5)	23(3)	21(6)	22(4)

**Key Words:** Gaited weanlings, Equine locomotion, Temporal variables

**1890 In vitro fermentation characteristics of vegetative and mature grasses by equine fecal inoculum.** H. S. Hussein\*, H. Han, J. P. Tanner, and A. A. Cirelli, University of Nevada - Reno.

The objective of this study was to determine the effects of forage species and stage of maturity on digestibility of DM and OM and on VFA production after in vitro incubation of .5 g DM of each substrate with equine fecal inoculum. Three horses (replications) were maintained on a diet containing oat-alfalfa cubes (i.e., 70% alfalfa hay and 30% oat hay) and were used as donors of fecal inocula for the in vitro fermentation. In a completely randomized design, the treatments were arranged as a 4 × 2 × 4 factorial. The main factors were 4 forage species (bromegrass [BG; *Bromus inermis*], orchardgrass [OG; *Dactylis glomerata*], ryegrass [RG; *Lolium perenne*], and tall fescue [TF; *Festuca arundinacea*]), 2 stages of maturity (vegetative [V] or mature [M]), and 4 incubation times (i.e., 6, 12, 24, and 48 h). Interactions (P < .05) were only detected between forage species and stage of maturity for DM and OM digestibilities. Digestibility of DM (across incubation times) was highest (35.0%; P < .05) for OG-V and lowest (29.9%; P < .05) for RG-M. Digestibility of OM (across incubation times) was highest (41.0%; P < .05) for BG-V and lowest (33.3%; P < .05) for RG-M. With the exception of acetate, forage species had no effect (P > .05) on individual or total VFA concentrations. Acetate concentration was highest (9.32 mM; P < .05) for RG and lowest (8.03 mM; P < .05) for TF. Concentrations of acetate, propionate, butyrate, and total VFA were higher (P < .05) for vegetative (9.14, 2.64, .50, and 12.98 mM, respectively) than for mature (8.13, 2.25, .30, and 11.26 mM, respectively) forages. Evaluation of the 4 forage species indicated that OM digestibility was lowest (P < .05) for RG than for BG, OG, or TF (36.4, 39.8, 39.6, and 38.5%, respectively). The corresponding values for total VFA (12.7, 11.7, 12.7, and 11.5 mM, respectively), however, were not different (P > .05). Therefore, horses may be able to utilize BG, OG, and TF more efficiently than RG.

**Key Words:** Horses, Forages, In vitro digestibility

**1891 Environmental factors affecting racing time in Brazilian Thoroughbred horses in Cristal hippodrome.** Rodrigo Taveira\* and Marcilio Mota, <sup>Unesp</sup>Universidade Estadual Paulista.

The aim was to study environmental factors that affect the racing time of Thoroughbred that won races in the classical calendar at the Cristal hippodrome, State of Rio Grande do Sul, Brazil. The data used in this study were provided by the Study Book from the Brazilian Association of Race Horse Breeders (ABCCC) and included 1139 finishing times from 420 animals that won 100 different kinds of races taken place from 1974 to 1998. The analyses of information was carried out using the GLM procedure of the Statistical Analyses Systems (SAS, 1996). Race year (1974 to 1998), track condition, grade (5 levels), condition (sex and age combination) and distance (700 to 3000 meters) were the fixed effects considered in the linear model. The fastest time have been provided by the animals that was running on light turf and group I (the most important of the grades). There are not significant difference between the different kinds of sex and age combination and year of race. The quadratic regression of time on distance has shown decrease in average speed of 0.92 m/s, when racing distance goes from 1000 m (16.69 m/s) to 2000 m (15.77 m/s), and 0.49 m/s from 2000 m to 3000 m (15.28 m/s).

**Key Words:** Thoroughbred, Race, Time