

610 Effect of microbial exopolysaccharide on functionality in high moisture cheese. T. J. Singleton^{*1}, D. J. McMahon¹, J. R. Broadbent¹, and C. J. Oberg², ¹Western Dairy Center, Utah State University, ²Weber State University.

Functional attributes of cheese such as shreddability and melt are dramatically affected by cheese moisture level. Previous work by our group has demonstrated that the addition of *Streptococcus thermophilus* MR1C, a strain that produces a large capsular exopolysaccharide (EPS⁺), to cheese results in a significant increase in the cheese moisture level. The objectives of this study were to determine if the addition of MR1C could be used to improve shreddability in high moisture American style cheese. Stirred curd cheeses were manufactured to contain equivalent moisture levels using either MR1C (41.4 - 43.7% moisture) or a non EPS-producing (EPS⁻) derivative of MR1C (40.5 - 44.4% moisture). The suitability of individual cheeses for shredding was determined by rheometry and texture profile analysis. Cheese firmness was determined after 1, 3, and 6 weeks of aging, then the cheese was shredded, and 3% (wt/wt) powdered cellulose was added to prevent caking. The cheese was packaged with a nitrogen gas flush, and melt properties were measured periodically. When cheeses with the same moisture content (i.e., 41.6 ± 0.2%) were compared over the 6 wks of storage, there was no overall significant affect on hardness although there was a significant week * culture interaction ($P = 0.026$). The (EPS⁺) cheese was softer at wk 1, then became harder at wk 3, but softened by wk 6. There was also a tendency ($P = 0.095$) for the (EPS⁺) cheese to be less adhesive than the (EPS⁻) cheese. There were no overall differences in elasticity or viscosity, and the cheeses melted to the same extent after 6 wks storage from when the cheese was shredded.

Key Words: Exopolysaccharide, Functionality, American style

611 Relationship between chemical, physical and sensory properties for pasta filata and stirred curd LMPS Mozzarella cheeses. C. M. Chen^{*}, A. L. Dikkeboom, M. E. Johnson, and M. G. Zimbric, Wisconsin Center for Dairy Research.

Chemical (pH, TCA sol N) and physical properties (free oil release, melt profile) of LMPS Mozzarella (46.4.9% moisture, 42.8.9% FDM) were correlated to sensory characteristics. Descriptive taste panelists scored the degree of skinning (none to pronounced), chewiness (tough/chewy to tender/fluid), and preference (dislike to like) of cheese on pizza pies cooked in traditional and forced air ovens. Stirred curd Mozzarella tended to exhibit more skinning than pasta filata Mozzarella. In a traditional oven the degree of skinning remained constant (very slight, all ages). In a forced air oven, cheeses had an increased skinning after 10 d (slight to definite). For the stirred curd Mozzarella in a forced air oven there was a high correlation between the skinning and softening temperature (negative, $R^2 = .95$) and proteolysis (positive, $R^2 = .89$). Cheese chewiness was influenced by the age, manufacturing protocol, and to a lesser extent, oven type. Stirred curd Mozzarella was more fluid/tender than the pasta filata Mozzarella, and cheeses baked in a forced air oven tended to be more chewy. For stirred curd Mozzarella, softening temperature in the melt profile most highly correlated with

ASAS Nonruminant Nutrition: Weaning Pig Nutrient Requirements

613 Effect of threonine supply on the true ileal digestibility of amino acids and on performance in weaned piglets†. L. Babinszky^{*}, J. Tossenberger, P. Horn, and R. Kovcs, University of Kaposvar, Kaposvar, Hungary.

Weaned piglets were used in a trial aimed at determining the effect of threonine supply on true ileal digestibility of amino acids and piglet performance. Digestibility studies used a total of 8 animals per treatment, growth studies a total of 96 piglets per treatment, respectively. Initial live weight was 12.4±1.8 kg in the digestibility studies, and 7.8±1.0 kg in the growth study. Nutrient content of the wheat-barley-soybean based diets of different threonine levels complied with the NRC (1998) recommendations. One kg of the basal diet contained 13.4 MJ ME, 188 g CP, 12.2 g Lys, 8.5 g M+C and 6.2 g Thr. Endogenous amino acid excretion was determined in a separate trial group (n=8) by feeding N-free diets. In the digestibility studies we used three treatments (0, 1.3 and 2.1 g crystalline Thr per 1 kg feed), and six treatments in the growth studies (0, 0.42, 0.84, 1.26, 1.67, 2.09 g crystalline Thr per 1 kg feed). The diet chemical composition was determined in accordance with

the chewiness scores ($R^2 = .88$). For pasta filata Mozzarella, chewiness was most highly correlated to free oil release ($R^2 = .85$). Preference was influenced by the cheese age, but not manufacturing style or oven type. Cheeses were most preferred at 10 d, with stirred curd Mozzarella being slightly more liked than the pasta filata Mozzarella. The high preference scores can be attributed to lack of skinning, slightly tender/fluid chew characteristics and more acceptable strand formation. Using the linear relationship between chewiness scores and softening temperature, one can predict that if a stirred curd LMPS Mozzarella cheeses softens between 40.5 and 43.3C it will have acceptable performance on pizza pies. Similarly, pasta filata LMPS Mozzarella with free oil release between 43 and 48% (wt free oil release/wt cheese fat) will have acceptable performance on pizza pies.

Key Words: Mozzarella, physical properties, sensory analysis

612 Reversibility of pH-induced changes in the melting characteristics and calcium distribution of Mozzarella cheese. Q. Ge, M. Almena-Aliste, and P.S. Kindstedt^{*}, University of Vermont, Burlington, VT/USA.

Previously a model system was developed to increase or decrease the pH of Mozzarella cheese through exposure to volatile ammonia or acetic acid, respectively. Changing the cheese pH in this manner caused large changes in the apparent viscosity and calcium distribution. The objective of this study was to evaluate whether these pH-induced changes are reversible. In the first experiment, representative samples of shredded low moisture part-skim Mozzarella cheese were exposed to ammonia to increase the pH by ca. 1.0 pH unit in 3 increments. After equilibration at 4°C for 24 h, the samples were analyzed for apparent viscosity and water soluble calcium. Next, the sample with the highest pH value was divided into representative subsamples and then exposed to acetic acid vapor to decrease the pH by ca. 1.0 pH unit (i.e., to the original cheese pH) in 3 increments. After equilibration at 4°C for 24 h, the subsamples were analyzed for apparent viscosity and water soluble calcium. This experiment was replicated 3 times with different batches of cheese. The second experiment was similar to the first except that the cheese pH was first decreased in 3 increments to ca. pH 4.7 and then increased. In the first experiment, increasing the cheese pH from ca. 5.3 to 6.3 resulted in linear increases in apparent viscosity and linear decreases in water soluble calcium. Upon reversal of cheese pH back to ca. 5.3, apparent viscosity decreased and water soluble calcium increased in linear manners, displaying high degrees of reversibility. In the second experiment, decreasing the cheese pH from ca. 5.3 to 4.7 resulted in nonlinear increases in apparent viscosity and water soluble calcium. Upon reversal of cheese pH back to ca. 5.3, apparent viscosity and water soluble calcium decreased in nonlinear manners, displaying high degrees of reversibility. Results indicate that the melting characteristics of Mozzarella cheese can be altered substantially and then restored by manipulating cheese pH and shifting calcium between the water soluble and casein-associated states.

Key Words: Mozzarella, Functionality, Calcium

AOAC. Trial data were subjected to variance and regression analyses. Our results show that 586 mg/kg DM intake threonine was excreted in the endogenous protein. From non-essential amino acids, excretion rate of proline was highest (2321 mg/kg DM intake). The varying threonine supply did not affect the true digestibility of amino acids ($P \geq 0.05$), the digestibility of threonine, however, was improved significantly ($P \leq 0.05$). Based the regression analysis and performance studies data the true ileal digestible threonine content for weaned piglets (8 to 30 kg) can be recommended at 6.6 g per kg of diet, which corresponds to a true ileal digestible threonine to lysine ratio of 62:100.

†Trials were supported by DEGUSSA-HLS AG/Germany

Key Words: Threonine, Piglets, Digestibility

614 The optimum threonine:lysine ratio in nursery diets to maximize growth performance of weanling pigs. B. W. James*, R. D. Goodband, M. D. Tokach, J. L. Nelssen, J. M. DeRouchey, and J. C. Woodworth, *Kansas State University, Manhattan.*

The objective of this 21-d growth assay was to determine the optimal apparent digestible threonine:lysine ratio in nursery pig diets to maximize growth performance. A total of 210 pigs (initially 8.2 kg and approximately 25 d of age, PIC C22 × 327) were blocked by weight and allotted randomly to seven dietary treatments. Each treatment had six replicates and five pigs per pen. Corn, soybean meal, and spray-dried whey were analyzed for amino acid concentrations prior to diet formulation. Crystalline L-threonine was added to the basal diet (14.1% CP; 1.07% apparent digestible lysine) to provide 0.48, 0.54, 0.59, 0.64, 0.70, and 0.75% apparent digestible threonine (45, 50, 55, 60, 65 and 70% of lysine). A negative control diet (Neg) contained less L-lysine-HCl and provided 0.97% apparent digestible lysine and 0.75% apparent digestible threonine to ensure that lysine did not exceed the pigs' requirement. During the 21-d experimental period, ADG increased (linear, $P < 0.02$) as the ratio of apparent digestible threonine:lysine increased and was maximized for pigs fed 65% apparent digestible threonine:lysine. Feed intake tended to decrease (quadratic, $P < 0.09$) with increasing concentrations of apparent digestible threonine. Feed efficiency (G:F) improved (linear, $P < 0.01$) as the ratio of apparent digestible threonine:lysine increased and was maximized at 55% threonine to lysine. Plasma urea N measured on d 14 tended to decrease (linear, $P < 0.08$) with increasing apparent digestible threonine. The two-slope broken-line method predicted an approximate apparent digestible threonine requirement of 65 and 52% of apparent digestible lysine for ADG and G:F, respectively.

Item	% Threonine:Lysine						Neg
	45	50	55	60	65	70	
Days 0 to 21							
ADG, g	442	447	460	448	485	447	479
ADFI, g	804	762	758	732	815	787	829
G:F	0.55	0.59	0.61	0.61	0.60	0.61	0.58

Key Words: Threonine, Lysine, Weanling pigs

615 Effects of diet and crystalline glutamine supplementation on growth performance and small intestine morphology of weanling pigs. S. J. Kitt*, P. S. Miller, A. J. Lewis, and R. L. Fischer, *University of Nebraska, Lincoln.*

The objective of this experiment was to determine whether crystalline glutamine affects weanling pig growth and/or small intestine morphology. A total of 115, 18 (± 2)-d-old, mixed-sex pigs were used in this study. Four pigs were killed on d 0 to determine base-line intestine morphology. The remaining pigs were blocked by initial BW (6.1 \pm 1.1 kg) and randomly allotted to 16 pens and one of four dietary treatments in a 2 × 2 factorial arrangement. Treatments were two diet types (simple or complex) and two supplemental concentrations of crystalline glutamine (0 or 1%). The simple diet consisted primarily of corn and soybean meal. The complex diet consisted primarily of whey, corn, soybean meal, spray-dried plasma, and fish meal. All diets (total dietary lysine = 1.60%) were formulated to exceed all nutrient requirements (NRC, 1998). Average daily gain and ADFI were measured on d 4, 7, 14, and 21. Four pigs from each treatment were killed and duodenal and jejunal samples were collected on d 4. Intestine samples were fixed in 10% formalin and stored in 70% ethanol. Tissues samples were mounted on slides and villus height was analyzed using a commercially available software program. The complex diet improved ($P \leq 0.10$) ADG of pigs during d 0 to 4, 7 to 14, and 14 to 21. The complex diet increased ($P \leq 0.05$) ADFI during d 0 to 4, 4 to 7, 7 to 14, and 14 to 21. The simple diet increased ($P \leq 0.05$) ADG/ADFI during d 7 to 14, and 14 to 21. The addition of glutamine increased ($P \leq 0.05$) ADG/ADFI during d 14 to 21. Villus height was not affected ($P \geq 0.10$) by diet type or glutamine supplementation during d 0 to 4. These data suggest that glutamine improves growth performance in weanling pigs but does not affect villus height during the first four days after weaning.

Key Words: Glutamine, Small intestine morphology, Pigs

616 Responses of pigs and chicks to phosphorus supplementation in casein- vs soybean meal-based diets. E. G. Xavier*, G. L. Cromwell, and M. D. Lindemann, *University of Kentucky, Lexington.*

Previously, we have assessed the bioavailability of P in feedstuffs using a dextrose-dehulled soybean meal (SBM) diet (0.22% total P, 0.15% phytate P) with P sources substituted for dextrose. In some instances, it would be desirable to utilize a low-P basal diet containing no phytate P. This study was conducted to assess the suitability of semipurified diets with casein vs SBM as the protein source without and with added P (as monocalcium phosphate) for young pigs and chicks. In Exp. 1, 20 pigs (4 reps, 10.8 kg BW) were fed 5 diets (1.2% lys, 0.8% Ca) for 35 d: sucrose-dextrose (SD)-casein (15%) with 0, 0.1, and 0.2% added P or SD-SBM (40%) with 0.04 and 0.24% added P. The bioavailable P in both basal diets was 0.11%. AA (lys, thr, trp, met, arg) were added as needed. ADG, feed/gain, and breaking strength of the femurs and metatarsals were: 461, 520, 644, 470, 652 g; 2.04, 1.98, 1.89, 1.91, 1.74; 45, 80, 169, 48, 147 kg; 14.9, 22.7, 38.9, 19.6, 39.8 kg. Performance and bone traits of pigs fed the two basal diets were similar as were the linear ($P < 0.01$) responses to added P in both diets. A 14-d study was conducted with 3-d-old chicks fed casein or SBM-based diets. Chicks (4 reps of 6 chicks/pen) were fed: dextrose-starch (DS)-casein (20%) with 0.10, 0.15, 0.20, 0.25, 0.30, and 0.35% added P or DS-SBM (40%) with 0.16, 0.26, and 0.36% added P. Ca was 1.0% in all diets. The two basal diets contained 0.25 and 0.43% total P, and 0.25% non-phytate P. AA were added as needed. ADG and tibia strength were: 20.6, 23.0, 25.1, 24.4, 23.8, 25.7, 19.6, 28.5, 33.7 g; 4.6, 7.4, 9.9, 10.9, 9.7, 11.2, 2.8, 7.8, 13.9 kg. Performance was similar for chicks fed the two basal diets. Growth and bone responses to added P were linear ($P < 0.01$) for both diet types; however, responses were greater for the SBM vs casein diet, primarily due to greater feed intake (43 vs 35 g/d), thus greater P intake, of chicks fed the high-P, SBM diet. The results indicate that casein-based diets containing no phytate P should be acceptable for future P bioavailability studies with pigs and chicks.

Key Words: Pigs, Chicks, Phosphorus

617 Ideal dietary tryptophan regimen for pigs as influenced by antigen exposure. C. P. Machado*¹, T. S. Stahly¹, and T. J. Stabel², ¹Iowa State University, Ames, ²National Animal Disease Center, Ames, IA.

Pigs from a high lean strain were reared via a SEW procedure and self-fed a basal diet containing 100% of ideal ratio (IR; NRC, 1998) of digestible tryptophan (Trp) to digestible lysine (Lys). At 30 d of age, pigs were allotted within litter to one of four dietary ratios of Trp:Lys: 50, 75, 100 or 125% (day 0). The basal diet consisted of a corn-SBM-gelatin mixture containing a growth limiting amount of digestible Lys (0.95%) and all other essential amino acids, except Trp, at ratios greater than 100% of IR. Tryptophan was added as L-Tryptophan at the expense of cornstarch. Half of the pigs were administered subcutaneously a non-replicating antigen, autoclaved BCG (13 × 10⁶ CFU/mg), at a dose of 0.20 mg/kg BW on d 4, 8 and 12. BCG induces IFN-gamma synthesis and thus indoleamine 2-3 dioxygenase release, which degrades tryptophan in several body tissues. BW gain, gain:feed ratio (GF) and body nitrogen accretion (NA) were determined for three consecutive four-day periods (d 4-16). As dietary Trp:Lys ratios increased, daily BW gain (79, 280, 518, 528 g), GF (.26, .52, .71, .68) and daily NA (3.6, 8.7, 13.9, 14.3 g) increased quadratically ($P < .01$) independent of BCG and period. BCG depressed ($P < .05$) BW gain (316 vs. 386 g), GF (0.51 vs. 0.57) and NA (9.2 vs. 11.1 g) with the magnitude of the depression increasing from d 8 through 16. In conclusion, the IR of Trp:Lys (NRC, 1998) was not altered by exposure to autoclaved BCG, a non-replicating antigen.

Key Words: Pigs, Tryptophan, BCG

618 Pyridoxine (B6) metabolism and requirement in weaned piglets. J. J. Matte*, A. Giguere, and C. L. Girard, *Dairy and Swine R & D Centre, AAC, Lennoxville, QC, Canada.*

Three trials were carried out in order to determine the effects of dietary B6 and its interactions with riboflavin (B2) on metabolic criteria such as blood B6 and B2 status, insulinemic responses to *i.v* and gastric glucose, and on growth performance of piglets weaned at 2 wks of age. In

Trial 1, 36 piglets fed through a permanent gastric tube received 4 combinations of B6 and B2 supplements (ppm), 0-0, 0-25, 50-0 and 50-25. There was a marked effect ($P \leq .01$) of the B6 supplement on B6 in red blood cells (RBC) but no effect ($P \geq .20$) of B2 on B2 metabolites (riboflavin, FMN and FAD) in plasma. C-peptide and insulin responses to *i.v.* glucose decreased ($P \leq .08$ and $.03$, respectively) with B2. This B2 effect disappeared in presence of B6 after gastric glucose (interaction B6*B2, $P \leq .02$); the response was maximized with both vitamins. It seems that B6 acts via the entero-insular axis of insulin secretion. No treatment effect ($P \geq .30$) was observed on growth rate. In trial 2, treatments used in trial 1 were given to 544 piglets in commercial conditions. No effect ($P \geq .39$) of either B6 and/or B2 supplements, given during the 2 wks after weaning, was observed on growth performance between 2 (weaning) and 10 wks of age. However, the B6 profile in RBC suggested that the lack of effect on growth performance could be due to the short duration of the B6 supplementation. Another trial, under similar conditions to Trial 2, was therefore undertaken to measure the effect of the B6 supplement alone (50 ppm) given between 2 (weaning) and 10 weeks of age. Despite a marked and persistent increase ($P \leq .01$) of B6 in RBC, the effect on growth performance was marginal and even slightly (less than 2 %) detrimental ($P \leq .03$). In conclusion, although a dietary supplement of 50 ppm of B6 was necessary to saturate the RBC pool in B6, the basal provision of dietary B6 (analytical level of 7.6 ppm) in the present diets, already 5 times higher than the NRC (1998) recommendation, appears sufficient for growth performance during the post-weaning period in piglets.

Key Words: Early-weaned piglets, Pyridoxine, Riboflavin

619 Effect of desiccated bile salts on fat digestibility in early-weaned pigs. J. Orban*¹ and B Harmon², ¹*Southern University*, ²*Purdue University*.

Thirty-six early-weaned pigs averaging 13 to 14 days of age were fed diets containing 7% hog fat and desiccated hog bile at 0, 0.15, 0.30, and 0.45 % in a metabolism study to determine the response of the pigs to fat digestibility and nutrient metabolism. The study was conducted in two trials. In Trial 1, a total of 24 barrows were used, placing 2 barrows per pen in a metabolism room with 12 metabolism crate-pens. Dietary treatments were replicated 3 times among pens and pigs in a pen constituted an experimental unit. Trial 2 was conducted similarly to Trial 1, except 12 barrows were used with one barrow per pen. In both trials, pigs were acclimated for 6 days and fasted 24 h prior to providing diets at the rate of 5% of the pigs' body weight. Fecal samples were collected in a 5 to 6-d period for digestibility assay. Results showed that the inclusion of desiccated hog bile in diets of early weaned pigs resulted in a significant ($P < 0.01$) linear increase in fat digestibility (from 93 to 97%) with respect to bile level (from 0 to 0.45%) in the diet. General animal performance (feed intake, weight gain and feed efficiency) was not affected by the presence of bile in the diet. The digestibility of dry matter, nitrogen and gross energy also was not affected by the presence of bile in the diets of early-weaned pigs. Results suggest that the inclusion of desiccated hog bile in the diets of early-weaned pigs improved their ability to digest dietary fat with no adverse effect on general performance and nutrient metabolism.

Key Words: Desiccated hog bile, Fat digestibility, Early-weaned pigs

620 The efficacy of zinc methionine and zinc oxide in promoting nursery pig performance. G. A. Hollis*, D. C. Mahan, S. D. Carter, T. D. Crenshaw, G. L. Cromwell, G. M. Hill, A. J. Lewis, and T. L. Veum, *NCR-42 Swine Nutrition Committee*.

Previous research has suggested that organic Zn sources could be added to pig nursery diets at dietary levels below the pharmacological levels of ZnO commonly used in pig starter diets and still produce similar growth promotion benefits. A regional study was therefore conducted using five treatments to compare the efficacy of supplemental Zn methionine at levels of 125, 250, and 500 ppm Zn, 2,500 ppm Zn from ZnO, and a basal diet that contained a conventional Zn level. A total of 616 pigs was used in a randomized complete block design conducted at seven university research stations in 26 replicates. Pigs were weaned at an average of 21 d of age and 6.3 kg BW, and housed with 4 to 6 pigs/pen (pig number per pen was constant within replicate). Diets fed during d 0 to 14 and 15 to 28 d were formulated to contain 1.40% and 1.25% lysine (total) levels, respectively. Diet analyses demonstrated that the basal diets averaged 124 ppm Zn. Analyzed Zn contents of treatment

diets were close to calculated values when the amount in the basal diet was added to the supplemental level. During the initial 7-d period, there were no treatment differences ($P > 0.15$) in daily gains or feed intakes. Both sources of Zn improved performance responses after 7-d postweaning when compared to pigs fed the basal diet. From 7 to 14 d, 0 to 14 d, 14 to 28 d, and for the overall 28-d period, pigs fed the ZnO source had higher gains ($P < 0.05$) than pigs fed Zn methionine. Feed intakes were unaffected by treatment during the initial 14 d postweaning, but from d 14 to 28 and for the 0 to 28-d period feed intake was higher when ZnO was fed ($P < 0.05$). Overall ADG, ADFI, and G/F ratio for the basal, three levels of Zn methionine, and ZnO treatments were: 371, 391, 389, 396, 415 g/d; 586, 618, 607, 617, 642 g/d; 0.633, 0.633, 0.641, 0.642, 0.642, respectively. These results demonstrated that lower dietary levels of Zn methionine did not achieve the improved performance responses as did 2,500 ppm Zn from ZnO when fed to weaned pigs.

Key Words: Zinc, Weaning, Pigs

621 Effects of iron administration on complete blood counts of nursing pigs. S.D. Carter, S.L. Mandali, and J.S. Park*, *Oklahoma State University, Stillwater*.

Two experiments were conducted to determine the effect of iron administration on body weight and complete blood counts (white blood cells, WBC; red blood cells, RBC; hemoglobin, HGB; hematocrit, HCT; mean cell hemoglobin (MCH) and concentration, MCHC; and platelets, PLT) of nursing pigs. In Exp. 1, 12 pigs from 6 litters (2 pigs/litter) were allotted randomly by BW on the day of birth (d 0) to either a saline or 150-mg injection of Fe as iron dextran. Pigs were bled on d 0, 1, 2, 4, 8, 12, 16 and at weaning. In Exp. 2, 18 pigs from 9 litters (2 pigs/litter) were allotted as in Exp. 1 and bled on d 0, 2, 4, 8, 10, 12, 16, and at weaning. Whole blood samples were analyzed within 2 hr of collection. Injections of saline or Fe were administered on d 2 following blood collections. Average weaning age was 20.5 d in each experiment. Initial (d 0) BW and HGB, averaged across experiments, were 1.60 kg and 9.52 g/dL, respectively. There were no differences ($P > 0.10$) in BW or blood variables on d 0, 2, or 4. Body wt tended to increase at a faster rate in pigs given Fe vs saline-treated pigs from d 4 to weaning (Day x Trt, $P < 0.10$). However, pigs injected with Fe tended to be heavier ($P < 0.12$) only at weaning. HGB, HCT, MCH, and MCHC in saline-treated pigs declined with age, but they increased with age in pigs given Fe (Day x Trt, $P < 0.01$). This divergence occurred by d 4 (Exp. 2) or d 8 (Exp. 1), and pigs given Fe had greater values ($P < 0.01$) each day following d 4. Blood HGB in saline-treated pigs fell below 7 mg/dL by d 8 and 6 mg/dL by d 12 in each experiment. WBC and RBC were reduced ($P < 0.10$) from d 8 to weaning in saline- vs Fe-treated pigs; however, PLT were markedly increased ($P < 0.04$). Even though pigs treated with saline were severely anemic, survival to weaning was 100%. Body weight was not correlated ($P > 0.10$) with any of the blood counts. These results suggest that Fe administration has profound effects on blood counts, in addition to HGB and HCT. However, in these pigs weaned at less than 21 d of age, iron deficiency had minimal impact on performance or survival to weaning.

Key Words: Pigs, Iron, Hemoglobin

622 Effects of L-carnitine and soybean oil on growth performance in weanling pigs. M. J. Rincker*¹, S. D. Carter¹, R. W. Fent¹, B. W. Senne¹, and K. Q. Owen², ¹*Oklahoma State University, Stillwater*, ²*Lonza, Inc., Fairlawn, NJ*.

Two-hundred sixteen weanling pigs were used in a 2 x 2 factorial arrangement of treatments in two separate experiments to evaluate the effects of L-carnitine (0 vs 50 ppm) and soybean oil (SBO; 0 vs 5%) on growth performance. In Exp. 1, 96 weanling pigs (6.0 kg; 18 d) were randomly allotted based on BW, sex, and litter to four dietary treatments (6 pens/trt of 4 pigs/pen). In Exp. 2, 120 pigs (5.6 kg; 18 d) were randomly allotted to the same treatments as in Exp. 1 (6 pens/trt of 5 pigs/pen). The four dietary treatments were: 1) 0% SBO and 0 ppm L-carnitine; 2) 0% SBO and 50 ppm L-carnitine; 3) 5% SBO and 0 ppm L-carnitine; and 4) 5% SBO and 50 ppm L-carnitine. Pigs were fed in three dietary phases (P1: d 0-10; P2: d 11-24; and P3: d 25-38 with 1.6, 1.4, and 1.2% Lys, respectively). Phase 1 and 2 diets were complex corn-soybean meal-dried whey based containing additional protein sources, while diets for P3 were corn-soybean meal based. Pigs and feeders were weighed weekly for the determination of ADG, ADFI,

and G:F. There were no treatment by experiment interactions; therefore, data were pooled across experiments (12 pens/trt). ADG, ADFI, and G:F for the 38-d study were: 394, 398, 370, and 391 g; 566, 567, 536, and 540 g; and .696, .703, .690, and .725, respectively. Pigs fed SBO tended ($P < 0.10$) to grow slower and consume less feed compared to those not fed SBO, but G:F was not affected ($P > 0.10$). The addition of L-carnitine did not affect ($P > 0.10$) ADG or ADFI; however, it did improve ($P < 0.01$) G:F. Also, the increase in G:F associated with L-carnitine was more pronounced in pigs fed SBO than those not fed SBO (carnitine \times SBO, $P < 0.08$). The greatest response to L-carnitine occurred in P2 with an increase in ADG ($P < 0.05$) and G:F ($P < 0.01$). In contrast, the response (G:F) to SBO was greatest during P3. These results suggest that the addition of 50 ppm L-carnitine improved growth performance in weanling pigs; however, supplemental L-carnitine was more effective when SBO was provided in the diet.

Key Words: Carnitine, Fat, Weanling pigs

623 Effects of L-carnitine on carcass composition and tissue accretion in weanling pigs. M. J. Rincker^{*1}, S. D. Carter¹, R. W. Fent¹, B. W. Senne¹, and K. Q. Owen, ¹Oklahoma State University, Stillwater, ²Lonza, Inc., Fairlawn, NJ.

We have previously reported that supplementing L-carnitine to the diet of weanling pigs improved growth performance and nutrient digestibility. Additionally, the effects of L-carnitine on carcass composition and tissue accretion rates in weanling pigs were evaluated. Six sets of four

littermate barrows (4.9 kg; 18 d) were housed individually and randomly allotted to four dietary treatments containing 0, 25, 50, or 100 ppm L-carnitine. Pigs were fed in three dietary phases (P1: d 0-10; P2: d 11-24; and P3: d 25-38 with 1.6, 1.4, and 1.2% Lys, respectively). Phase 1 and 2 diets were complex corn-soybean meal-dried whey based containing additional protein sources, while diets for P3 were corn-soybean meal based. All diets contained 5% soybean oil. At the conclusion of the experiment, each pig was killed and ground for determination of carcass composition. In addition, a fifth littermate from each set of pigs was killed at the beginning of the experiment for initial body composition. Percentages of protein and fat in the carcass were, respectively: 13.42, 14.01, 13.99, and 14.07; and 8.35, 7.42, 7.17, and 6.89. Increasing L-carnitine increased (linear, $P < 0.01$) the percentage of protein and decreased (linear, $P < 0.01$) the percentage of fat. Accretion rates for protein, fat, and energy were, respectively: 33, 42, 48, and 45 g/d; 21, 21, 24, and 21 g/d; and 379, 425, 483, and 426 kcal/d. A quadratic increase ($P < 0.05$) in total (g) and rate (g/d) of protein and energy accretion was observed with increasing L-carnitine. Also, the ratio of protein accretion to fat accretion (1.59, 2.07, 2.08, and 2.23) improved (linear, $P < 0.01$) with added L-carnitine. In general, the response to L-carnitine tended to plateau at 50 ppm. These results suggest that supplementation of L-carnitine improved the rate of protein and energy accretion in weanling pigs. Furthermore, an improvement in carcass composition was observed as the ratio of protein to fat accretion increased with L-carnitine addition.

Key Words: Carnitine, Weanling pigs, Accretion

ASAS/ADSA Animal Health: Dairy

624 Prevalence of bovine mastitis increases with average linear score and has possible implications for genetic selection. David Wilson^{*1}, Ruben Gonzalez¹, George Shook², Linda Garrison-Tikofsky¹, and Ynte Schukken¹, ¹Cornell University, Ithaca, NY, USA, ²University of Wisconsin, Madison, WI, USA.

Bovine genetic selection indices are critical to ranking cows and bulls to be parents of the next generation. This retrospective study was conducted to determine the relationship between average Linear Score (AVELS) of the SCC of the current lactation and the overall prevalence of intramammary infections (IMI) among cows within each one-log interval of AVELS using the standard LS scoring system. The main objective was evaluation of AVELS as a proxy variable for mastitis and therefore a potential tool for genetic selection in favor of bulls and cows whose offspring are less likely to contract IMI. For 65,229 cows with an AVELS for the current lactation recorded at the time that they also had milk culture performed, there was a significant positive association between the log intervals of AVELS and overall prevalence of IMI in cows within each log of AVELS. This relationship was found for the mastitis pathogens *Streptococcus agalactiae*, *Staphylococcus aureus*, streptococci other than *Strep. agalactiae*, *Escherichia coli*, *Klebsiella* spp., *Serratia* spp., yeast, *Prototheca* spp., *Arcanobacterium pyogenes*, and *Mycoplasma* spp. (chi-square, $P < 0.001$). For example, for cows with AVELS < 1.0 , the prevalences of *Streptococcus agalactiae*, *Escherichia coli*, and *Mycoplasma* spp. were 0.6%, 0.2%, and 0.0%, respectively; for cows with AVELS > 9.0 , their prevalence was 7.0%, 1.6%, and 0.8%, respectively. Overall prevalence of IMI was 18% for cows with AVELS < 1.0 , and increased to 74% for cows with AVELS > 9.0 . The heritability of mastitis characteristics range from .10-.17. This together with the demonstrated value of LS as an indirect indicator of mastitis suggests a need for increased weight given to average LS in genetic value estimate equations. Results will be presented and discussed in detail for 13 mastitis agents.

Key Words: Mastitis, Linear Score, Genetics

625 Dairy farmers and veterinarians: partners in profit. A.W. Jalvingh^{*}, CR Delta, Arnhem, The Netherlands.

Modern dairy farming imposes increasing demands on farmers' management skills to maintain profit and guarantee continuity of the farm. The role of the veterinarian on the dairy farm has over time moved from curing diseases to preventing diseases and managing risks. Farmer and veterinarian together form a perfect combination to improve the health status, and thus technical and economic results. To stimulate Dutch

farmers to use the veterinarian more as their advisor in problem analysis the project "Partners in Profit" was initiated. Partners in profit is a collaboration of CR Delta, a farmers' cooperative in cattle improvement, KNMvD, the Dutch society of vets, and Pfizer Animal Health, a pharmaceutical company. The basic idea is that participating vets receive information on participating farms based on data collected by CR Delta through milk recording, AI and other services. In the first year attention is focused on fertility, the second year on udder health and the third year on other health issues. In the first year 300 veterinary practices and 8000 dairy farmers are participating and will receive the first reports on fertility in February 2001. The vet receives a report with all the relevant parameters of the past year. One overview contains the average values for the practice as a whole and for the group participating farmers in the practice, and next to that the country averages are given and the averages of the group of farms with the 25% lowest values and 25% highest values. This report gives an idea of how the farmers in the practice on average are performing related to national averages and the observed variation. Next to that there is an overview which contains the basic farm figures over the past year from participating farms in the practice. Based on this information the vet can contact the farm without any further obligations. Vet and farmer together will decide whether they want to be partners in profit. For this second step, they can order an in-depth report, with figures for the last month, quarter, half year, year as well as target values. These in-depth reports form a good starting point for the analysis of the strong and weak points of the farm and to formulate further actions to improve the farm's health status.

Key Words: Information products, Herd Health Management, Dairy Farms

626 Evaluation of early detection of induced *Staphylococcus aureus* mastitis using infrared thermography. M. M. Schutz^{*1}, S. D. Eicher², J. M. Townsend¹, G. Shaw³, and D. M. Kocak³, ¹Purdue University, ²USDA-ARS, ³eMerge Interactive.

Increased blood flow and temperature increases may accompany initial immune response to a mastitic infection. The objective of this study was to determine whether infrared (IR) thermography could aid in early detection of mastitis by identifying these symptoms. Six multiparous, late-lactation Holstein cows were kept in a tie stall barn for nine days. Cows were separated by an empty stall and milked separately from other herdmates at 0600 and 1700. One forequarter of each of four cows was randomly selected and infused on d 5 with 450 cfu of *S. aureus* (Newbould). Infrared thermographs were taken from approximately 1.5 m of