

529 Experimental chlorate product treatment reduces *Salmonella* populations in swine during lairage. T. R. Callaway^{*1}, R. C. Anderson¹, T. S. Edrington¹, K. J. Genovese¹, C. H. Stahl², Y. S. Jung¹, K. M. Bischoff¹, T. L. Poole¹, R. B. Harvey¹, and D. J. Nisbet¹, ¹USDA-ARS, Food and Feed Safety Research Unit, College Station, TX, ²Iowa State University, Ames, IA.

Each year more than 1.3 million human cases of salmonellosis are reported in the United States. Swine can be a reservoir of *Salmonella* that can be transmitted to human consumers of pork products. *Salmonella* have the ability to respire anaerobically by reducing nitrate to nitrite via the intracellular enzyme nitrate reductase (NR). However, NR does not differentiate between nitrate and its valence state analog chlorate, which can be converted within the bacterium to cytotoxic chlorite. When added to pure and mixed cultures of bacteria, chlorate killed both *E. coli* and *Salmonella* within 24 h. Preliminary in vivo studies indicated that chlorate supplementation reduced *E. coli* O157:H7, wild-type *E. coli* and *Salmonella* in cattle, sheep and swine, respectively. Therefore, an experimental chlorate-containing product (ECP) has been developed for use in food animals. The current study was undertaken to evaluate the effectiveness of ECP during the short-term lairage period immediately prior to harvest. Pig manure (10 kg) was inoculated with 10³ CFU/g *Salmonella* Typhimurium and was spread throughout pens housing pigs (n=10) to simulate the introduction of swine to dirty lairage facilities. After 2 h, pigs were given ad libitum feed (controls) or feed supplemented with ECP for 4 h. Animals were humanely sacrificed and tonsils, ileocecal lymph nodes, cecal and rectal contents were collected. Fewer pigs treated with ECP had *Salmonella*-positive tonsils, but not unexpectedly due to the continuous exposure to *Salmonella*-contaminated feces this difference was not significant ($P>0.05$). No differences were noted in lymph node or intestinal content *Salmonella* status, likely due to the very short duration of ECP treatment. However, in a follow-up study using pigs (n=10) naturally colonized with *Salmonella*, ECP treatment ($P<0.05$) reduced natural cecal *Salmonella* colonization. Thus, these results indicate that ECP could be a viable pre-harvest intervention strategy to reduce *Salmonella* concentrations in swine, however further research is needed to optimize the effectiveness of ECP during lairage and transport to the slaughter facility.

Key Words: *Salmonella*, Swine, Lairage

Growth & Development: Intestinal development - colostrum symposium

531 Over-expression of IGF-I effects on piglet intestinal growth. S. M. Donovan^{*}, J. L. Hartke, M. H. Monaco, and M. B. Wheeler, *University of Illinois*.

Porcine milk contains hormones and growth factors that are thought to be responsible for the rapid postnatal intestinal growth and development of piglets. Work in our lab has shown that the addition of recombinant human IGF-I to sow milk replacer at 0.1 to 1.0 mg/L increased intestinal villus growth, lactase (LPH) activity and LPH mRNA expression in piglets. Further, stable isotope tracer studies suggest that IGF-I up-regulates LPH activity by suppressing proteolytic degradation of LPH and its precursor (proLPHh). Others have shown that oral IGF-I at 10 mg/L increased mucosal growth and sodium-dependent nutrient transport compared to piglets fed formula alone. However, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in milk under the direction of the regulatory elements of the bovine α -lactalbumin (α -LA) gene were developed. The α -LA/IGF-I gene construct was designed by inserting exon 4 of the human IGF-I gene, which contains the coding sequence for the mature peptide, into exon 1 of the bovine α -LA gene construct. IGF-I content in colostrum IGF-I transgenic sows ranged from 0.6 to 1.4 mg/L, compared to 0.15 mg/L in colostrum from non-transgenic full-sibling sows. The milk IGF-I content of transgenic sows is maintained at 0.6 mg/L or 60-fold higher than milk IGF-I of non-transgenic sows. Milk IGF binding protein (IGFBP) -2 and -5 are also higher in the milk of transgenic sows. To assess the impact of IGF-I over-expression on piglet intestinal development, piglets suckling IGF-I transgenic or non-transgenic sows were killed on days 3, 7, 14, and 21 of lactation. Consistent with our data from piglets fed formula with IGF-I, no effect on overall piglet body weight, or intestinal weight and length was observed. However, piglets suckling IGF-I transgenic sows had greater intestinal mucosal weight

530 Vermont Cattle Health Improvement Project. C.A. Rossiter-Burhans^{*1}, J.W. Barlow², and T.E. Johnson³, ¹Poulin Grain Inc., Newport, VT, ²University of Vermont, Burlington, VT, ³Vermont State Department of Agriculture, Montpelier, VT.

Concerns about Johne's disease (JD) prevalence, economics, food safety, and public health risks have prompted industry, state and federal level initiatives recently. Vermont (VT) Department of Agriculture initiated a pilot program, Vermont Cattle Health Improvement Project (VTCHIP), in 2001 to develop a cooperative (state and industry) cattle health program requiring active participation by veterinarians and producers. Objectives included enhancing farm viability by promoting improved preventive herd health and disease control practices. VTCHIP broadly addressed herd health issues but focused on JD education, requiring comprehensive review of farm goals, herd health parameters, and management bottlenecks. Enrolled veterinarians (n=55) and producers (n=145) engaged in a systematic review process concluding with written management strategies addressing identified health concerns. A VTCHIP workbook guided a 4-step assessment process for: 1. farm goals and health parameters 2. estimating JD herd prevalence 3. farm management risk factors relative to the spread of JD, and 4. specific management plans to prevent or control JD and address other identified health concerns. VTCHIP funding supported the herd veterinarian's involvement in executing risk assessments and farm plans (\$350/farm) and initial herd diagnostic testing (\$300/farm). Funding was a one-time State appropriation supplemented by a USDA and a private grant. Future goals for VTCHIP include 1. securing support for an ongoing program 2. adopting the voluntary JD herd status program whereby VT herds can establish a national low-risk status and create a value added market for low risk animals, 3. expanding industry and state cooperation, and 4. addressing other economically significant health issues using the VTCHIP framework. Advantages of the VTCHIP approach include 1. cooperative implementation through herd veterinarians, 2. management focus, 3. systematic format, and 4. flexible application to multiple herd health issues. Advantages, successes, and challenges of the initiative will be presented.

Key Words: Johne's disease, Herd health

and disaccharidase activity than piglets suckling non-transgenic sows. (Funded by the USDA CSREES under project NRICGP 00-35206).

Key Words: Transgenic, IGF-I, Lactase

532 Intestinal growth and development in piglets suckling insulin-like growth factor-I (IGF-I) transgenic sows. J. L. Hartke^{*}, M. H. Monaco, M. B. Wheeler, and S. D. Donovan, *University of Illinois, Urbana, IL*.

Our lab and others have shown that piglets fed formula containing IGF-I have increased villus growth, lactase activity, and nutrient transport, however, the impact of IGF-I over-expression in sow milk on piglet intestinal development was unknown. To answer this question, transgenic sows that over-express IGF-I in a mammary- and lactation-specific manner were created (IGF). IGF-I in colostrum of IGF transgenic swine (1.0 mg/L) is 5-fold higher than non-transgenic (CON) sows and milk IGF-I content (0.6 mg/L) is 60-fold higher than CON. Herein, the impact of ingestion of elevated milk IGF-I throughout lactation on piglet intestine was assessed. Piglets (n=160) were studied in 2 replicates. Farrowing was induced on d 113 of gestation and piglets were removed prior to ingestion of colostrum. Within 4 h, 10 piglets were randomly distributed to each sow, such that each litter contained piglets from all other sows within that replicate. On days 3, 7, 14, and 21 postpartum, one CON litter and one IGF litter were euthanized following a 12h fast. Serum IGF-I and IGF-I binding proteins were measured. Intestinal weight, length, protein and DNA content, disaccharidase activity and villus morphology were assessed. Piglets suckling CON sows were heavier than IGF-I only on d 7 ($p<0.02$). Intestinal weight and length were similar between treatment groups. Jejunal mucosa weight was greater at d3 in IGF piglets than CON ($p<0.01$) and ileal mucosal weight was increased in IGF piglets at d3, 7, and 21 vs. CON ($p<0.01$). Jejunal and ileal lactase and sucrase activities were greater ($P<0.05$) in IGF piglets than CON on d21. When data from all time points were combined, IGF

piglets had greater jejunal lactase and sucrase activity ($P < 0.0001$) as well as increased ileal sucrase activity ($P < 0.0001$) than CON. In summary, piglets suckling IGF had greater intestinal mucosal weight and disaccharidase activity than piglets suckling CON sows, however, body weight was not affected. (Funded by NRICGP 00-35206).

Key Words: IGF-I, Disaccharidase, Intestine

533 Intestinal development in neonatal calves: Effects of glucocorticoids and dependence on colostrum feeding. S. N. Sauter¹, P. Guilloteau², J. W. Blum¹, and H. M. Hammon*¹, ¹University of Berne, Berne, Switzerland, ²INRA, Rennes, France.

The neonatal development of the gastrointestinal tract around parturition in precocious mammals is greatly affected by endocrine factors like glucocorticoids as well as by nutritional factors. We have tested the hypothesis that glucocorticoids and colostrum (C) supply affect intestinal morphology, cell proliferation, digestive enzyme activities, and xylose absorption in neonatal calves. Calves ($n=7$ per group) of GrFD⁻ and GrFD⁺ were fed a milk-based formula (F), whereas calves of GrCD⁻ and GrCD⁺ were fed C. Dexamethasone (DEXA; 30 $\mu\text{g}/[\text{kg body weight} \times \text{d}]$) was injected to calves of GrFD⁺ and GrCD⁺. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 3 d-xylose (0.5 g/kg BW) was fed and plasma xylose concentrations were measured. Villus size and crypt depth were measured by histomorphometry and cell proliferation was evaluated immunohistochemically by labeling mitotic cells with 5-bromo-2-deoxyuridine that was intravenously injected 1 h before euthanasia. Activities of lactase (EC 3.2.1.23), maltase (EC 3.2.1.20), aminopeptidases A and N (EC 3.4.11.7 and EC 3.4.11.2, respectively) and dipeptidyl peptidase IV (EC 3.4.14.5) were measured. C feeding increased ($P < 0.05$) villus sizes in small intestine, enhanced ($P < 0.05$) xylose absorption capacity and increased ($P < 0.05$) peptidase activities in ileum. DEXA-treatment increased ($P < 0.1$) villus size in duodenum, but reduced ($P < 0.1$) villus size and reduced ($P < 0.001$) sizes of Peyer's patches in ileum. Mainly in F-fed calves DEXA increased ($P < 0.05$) cell proliferation of crypt cells in ileum, decreased ($P < 0.05$) amino peptidase N activities in jejunum, but increased ($P < 0.05$) amino peptidase A activities in ileum. C feeding enhanced intestinal villus size, xylose absorption, and enzyme activities, whereas DEXA differently affected villus size, cell proliferation and enzyme activities dependent on intestinal segments and differences in feeding.

Key Words: Neonatal calf, Gut development, Dexamethasone

534 Effects of bioactive components of colostrum and milk on neonatal health, growth and intestinal development. T. McFadden*, University of Vermont.

Colostrum and milk contain a wide variety of bioactive components that influence health and growth of the calf. Many of these components are highly enriched in colostrum and have well established effects on development, whereas the role of others remains to be defined. The objective of this paper is to review the mechanisms involved in mammary secretion of these factors and their subsequent effects on neonatal growth and development of the calf, with emphasis on factors concentrated in colostrum. Bioactive components of colostrum and milk include immunoglobulins, hormones, growth factors, cytokines, vitamins, minerals, other secretory proteins, and cellular components. The most widely recognized role of colostrum is to provide passive transfer of maternal immunoglobulins, primarily IgG1, to the calf, thereby reducing risk of calf disease. However, inadequate consumption of colostrum also results in low levels of beta-carotene and Vitamin A and alterations in plasma metabolites in the calf. Moreover, colostrum stimulates intestinal cell proliferation, perhaps through actions of its component growth factors. Cellular components of colostrum appear to enhance development of local immunity and active immunization of the neonatal intestine. Other proteins secreted in colostrum, including lactoferrin, transferrin, epidermal growth factor and immunoglobulins, are not only absorbed intact, but have been shown to be transported into the cerebrospinal fluid where they may play a role in neural development. Additional proteins, such as colostrum trypsin inhibitor, may act to prevent proteolysis of bioactive immunoglobulins, cytokines and hormones, thereby protecting their functional activity. Clearly, the bioactive components of colostrum and milk interact to promote neonatal development. Thus, better understanding of these components and their functions may lead to new

methods to manipulate their concentrations in mammary secretions and thereby improve calf health and growth.

535 Effects of dexamethasone on the somatotrophic axis in neonatal calves and dependence on colostrum intake. S. N. Sauter¹, E. Ontsouka¹, M. Pfaffl², J. W. Blum¹, and H. M. Hammon*¹, ¹University of Berne, Berne, Switzerland, ²Technical University of Munich, Freising, Germany.

Glucocorticoids and colostrum (C) feeding influence postnatal maturation of the somatotrophic axis. We have tested the hypothesis that the somatotrophic axis in neonatal calves is modulated by a high glucocorticoid status and by C feeding. Calves ($n=7$ per group) of GrFD⁻ and GrFD⁺ were fed a milk-based formula (F), whereas calves of GrCD⁻ and GrCD⁺ received C. Dexamethasone (DEXA; 30 $\mu\text{g}/[\text{kg body weight} \times \text{d}]$) was injected to calves of GrFD⁺ and GrCD⁺. Calves were fed C or F for the first 3 d, milk replacer on d 4, and were euthanized on d 5 of life. On d 1, 2, 4, and 5 plasma concentrations of growth hormone (GH), insulin-like growth factor (IGF)-I and IGF bindings proteins (IGFBP)-2 and -3 were measured, and on d 5, mRNA concentrations of IGF-I, IGFBP-2 and -3, IGF type 1, IGF type 2, and insulin receptors (IGF1R, IGF2R, and IR, respectively) and GH receptor (GHR) were measured in liver. Concentrations of hepatic GH binding sites were measured by radioreceptor assay. Plasma GH concentrations on d 4 were lower ($P < 0.05$) in DEXA-treated groups than in non-treated groups. On d 4 and 5, DEXA increased ($P < 0.05$) plasma IGF-I concentrations. Plasma concentrations of IGFBP-2 on d 4 were lower ($P < 0.05$) in DEXA-treated than in non-treated calves and were lower ($P < 0.05$) in C-fed than in F-fed calves. Concentrations of IGF-I mRNA were higher ($P < 0.1$) in DEXA-treated than in non-treated calves and were higher ($P < 0.05$) in GrFD⁺ than in GrFD⁻ and in GrCD⁺. IGFBP-2 and -3 mRNAs were higher ($P < 0.01$) in F-fed than in C-fed calves. GHR mRNA was higher ($P < 0.01$) in DEXA treated than in non-treated calves. IGF1R, IGF2R, and IR mRNAs were higher ($P < 0.05$) in F-fed than in C-fed calves and were higher ($P < 0.05$) in DEXA-treated than in non-treated calves. GH binding sites were higher ($P < 0.05$) in GrCD⁺ than GrCD⁻. DEXA affected the maturation of the somatotrophic axis in neonatal calves and these effects were partly modified by C feeding.

Key Words: neonatal calf, somatotrophic axis, dexamethasone

536 Effects of plasma IgG concentration and milk replacer feeding on hormone and growth responses in stressed calves. J. D. Quigley, III*^{1,2}, T. A. Wolfe², and T. H. Elsasser³, ¹APC, Inc., Ames, IA, ²Iowa State University, Ames, ³USDA-ARS, BARC-East, Beltsville, MD.

This study was conducted to determine if milk replacer (MR) feeding program or plasma IgG concentration on d 0 were related to hormone concentrations, growth, and health in young calves. Holstein bull calves ($n = 120$) were purchased from sale barns, transported to the research facility and fed 454 g/d of MR powder (20% CP, 20% fat) to 28 d (CON), or varying amounts of MR (28% CP, 16% fat; 454 to 908 g/d; total = 27.9 kg/calf) to 41 d (ACC), or ACC + Gammulin (APC, Inc.) at 30 to 60 g/d to 15 (GAM). Calf starter (CS) and water were available to 56 d. Calves were stressed by adding soiled bedding to each hutch prior to arrival. Calves were blocked by plasma IgG on d 0 (>10, 5-10, and <5 g/L). Blood was collected on d 7, 14, 28, 42 and 56 and samples were analyzed for IGF-1, TNF- α and growth hormone (GH) concentrations. Mean BW at 56 d, intake of MR, fecal scores, d scouring, d treated with antibiotics (AB) and plasma IGF-1 concentrations were lower in CON. Mortality was lowest in CON and tended to be lower in GAM. Intake of CS was higher in CON. Plasma GH was unaffected by treatment and declined from 7 to 56 d. Plasma IgG on d 0 had no effect on parameters measured, except TNF- α which was affected by a day by plasma IgG interaction. Calves with high IgG on d 0 had higher TNF- α from d 7 to 42. Calves fed increased amounts of MR grew faster, but experienced greater morbidity and mortality. Feeding GAM tended to reduce mortality in calves fed increased MR.

Item	Treatment				Contrast*	
	CON	ACC	GAM	SEM	1	2
BW, kg						
d 0	45.5	45.4	45.9	0.6	NS	NS
d 56	72.3	79.5	79.0	1.9	0.003	NS
DM intake, g/d						
MR	218	473	475	1	0.001	NS
CS	929	748	702	42	0.001	NS
Total	1148	1221	1188	45	NS	NS
TNF- α , ng/ml	0.137	0.133	0.136	0.003	NS	NS
GH, ng/ml	3.918	3.626	3.468	0.199	NS	NS
IGF-1, ng/ml	145.8	170.5	161.4	6.4	0.01	NS
Mortality, %	2.8	22.1	10.1	5.2	0.05	0.10
Fecal score**	1.37	1.59	1.53	0.04	0.002	NS
Scours, d	1.61	2.62	2.51	0.33	0.02	NS
AB, d	1.79	2.97	3.19	0.51	0.05	NS

*Contrasts: 1 = CON vs. (ACC+GAM/2); 2 = ACC vs. GAM; NS = $P > 0.10$.

**Fecal score: 1 = normal consistency to 4 = severe scours.

Key Words: Calves, Milk replacer, Health

537 Effects of intestinal development on calf growth. R. L. Baldwin, VI*¹, J. Klotz², R. N. Heitmann², and K. R. McLeod³, ¹USDA, ARS, ²Univ. of Tennessee, ³Univ of Kentucky.

The role of intestinal development and the process of transitioning calves from their neonatal reliance on nutrients supplied by milk to nutrients supplied from grain are of substantial economic importance to the producer. Improvements to the calf nutritional regime can decrease mortality and disease susceptibility, increase post-weaning rate of gain, and ultimately, enhance the rate of herd genetic improvement (due to increased capacity for voluntary culling). Current feeding practices result in weaning from milk by 3 to 4 weeks of age by daily encouragement to eat grain diets. Although the mechanisms are not yet completely understood, development of a viable fermentation within the rumen is required to initiate the maturation of the rumen epithelia. The metabolic ramifications of this transition to calf growth rate are great, as tissues must convert from reliance on glucose supplied from milk to the metabolism of volatile fatty acids as primary energy substrates. This transition is the result of differential expression of numerous genes regulating both physical and metabolic characteristics of the tissue. While the most dramatic physical changes occurring during development are associated with the rumen epithelium, changes in intestinal mass and metabolism are also realized in response to dietary changes. Amino acid use by the intestinal tissues is high and may affect amino acid availability in support of growth. Moreover, because the metabolic and protein synthetic activities of the digestive tract are high, accounting for up to 30% of both whole animal energy use and whole animal protein synthesis, understanding their regulation is vital to the continued improvement in calf management. Specific nutrient-gene interactions have been identified across the digestive tract which serve to increase visceral organ mass and directly change nutrient metabolism by the epithelia. Similarly, humoral factors have been identified as having regulatory function over gastrointestinal tissue mass and metabolism. These and continuing efforts to better understand the factors affecting intestinal development will improve weaning strategies and foster better post weaning calf growth performance.

538 Influence of dietary nucleotides on calf health. C. E. Oliver*, M. L. Bauer, C. M. De Jesus Arias, W. L. Keller, and C. S. Park, *North Dakota State University, Fargo, North Dakota.*

To determine the effect of dietary nucleotides on calf health, performance, and immune function, 20 newborn Holstein bull calves (41.9 \pm 1.1 kg initial body weight [BW]) were assigned to either standard milk replacer or milk replacer supplemented with purified nucleotides in the proportion found in cow milk, but at 5 times the level (AMP = 0.04 μ mol/kg BW per d, CMP = 1.14 μ mol/kg BW per d, GMP = 0.48 μ mol/kg BW per d, IMP = 0.64 μ mol/kg BW per d, and UMP = 10.3 μ mol/kg BW per d). Calves were fed milk replacer by dry powder weight at 1.4 % of BW/d divided into two equal portions and fed by bucket in 1.9 L water at h 0630 and 1600. No other feed was offered during the trial. Calves were housed indoors in individual pens on an expanded metal floor with a vinyl coating. Rectal temperature and fecal score (1 = normal, 4 = watery) were recorded daily in the morning,

and calves were weighed and blood was drawn weekly and analyzed for glucose, insulin, non-esterified fatty acids (NEFA), and immunoglobulin G (IgG) and M (IgM). Calves were challenged with lipopolysaccharide (LPS) or saline at 3 to 4 wk of age; rectal temperature and blood were taken at h -24, 0, 1, 2, 3, 4, 6, 8, 12, and 24. Nucleotide supplementation did not affect weight, fecal score, rectal temperature, or serum glucose, insulin, NEFA, or IgM over the course of the trial. Nucleotide-fed calves tended to have higher mean IgG levels ($P = 0.16$) than controls (859.6 \pm 98.9 vs 670.5 \pm 85.4 mg/dl). During the LPS challenge, there was a treatment by challenge interaction in IgG level ($P = 0.01$). Dietary nucleotides do not affect metabolic status, but may enhance immunity in neonatal calves.

Key Words: Nucleotide, Immune, Calf

539 Effect of various levels of crude fiber and form of diet on rumen development in calves. J.A. Booth*¹, H.D. Tyler¹, and J.D. Quigley III², ¹Iowa State University, ²APC Company, Inc..

Consumption of solid feed is essential for making the transition from a preruminant animal to a functioning ruminant. The optimal amount of roughage for inclusion in the diet of young calves is still unclear. The objective of this study was to determine the effect of form of diet (coarse vs. ground) and the inclusion of various levels of hay on rumen development in calves. Holstein bull calves ($n = 50$) were randomly assigned to one of four treatments. Diets consisted of commercial coarse starter (C), a ground starter (G), coarse starter with 7.5% grass hay of consistent particle size (H1), and coarse starter with 15% hay (H2). All diets were formulated to be isocaloric and isonitrogenous. Total ADF in diets were 6.39, 6.44, 6.47, and 7.43%, respectively. Intake was held constant across treatments until weaning when feed was given ad libitum. Jugular blood samples were obtained weekly and analyzed for BHBA. Body weight and rumen fluid samples were also obtained weekly. Daily scour scores and days receiving antibiotics and electrolytes did not differ with treatment. Calves receiving the H1 and H2 diets tended ($P < 0.07$) to be heavier prior to weaning and were heavier postweaning ($P < 0.01$) than the calves receiving C. Calves receiving the H1 and H2 diets also had higher BW gain (ADG) and feed efficiency (GF) postweaning than calves fed C. Calves fed H1 diet tended to have higher ADG and GF postweaning than the calves fed H2 ($P < 0.07$ and $P < 0.12$ respectively). There were no differences in intake. Total VFA concentrations were higher for calves fed G diet versus C diet ($P < 0.01$) and tended to be higher for calves fed H1 versus H2 ($P < 0.10$). Calves fed H2 had greater acetate to propionate ratio ($P < 0.03$) than calves consuming the H1 diet. Calves receiving the G diet had lower proportions of acetate ($P < 0.06$) than calves fed C. Addition of hay to diets of young calves appears to favorably alter the rumen environment causing more efficient gain of body weight.

Key Words: Dairy calves, Rumen development, Forage

540 Influence of ratio of dietary fat to protein on body composition of Jersey bull calves. S. Bascom*¹, R. James¹, E. Hovingh¹, M. VanAmburgh², and M. McGilliard¹, ¹Virginia Tech, ²Cornell University.

Calves were fed either milk or milk replacer (MR) at one of three ratios of CP:fat to determine effect on growth, feed efficiency, and body composition. Week-old calves ($n=39$) were assigned to one of four diets. Six calves were randomly selected and sacrificed to establish baseline body composition. Nine calves were fed a 28.5% CP, 16.4% fat MR (29/16). Eight calves were fed a 27.3% CP, 33.4% fat MR (27/33), and eight calves were fed a 20.6% CP, 20.6% fat MR (21/21). Calves fed 27/33, 29/16, and milk received 180 g/d CP, whereas calves fed 21/21 received 90 g/d CP. Weight, hip height, wither height, heart girth, and body length, were measured weekly for 4 wk. Weekly plasma samples were analyzed for PUN, NEFA, and glucose. A subset of calves [29/16 ($n=7$), 27/33 ($n=6$), 21/21 ($n=6$), and milk ($n=5$)] was sacrificed for body composition analysis. Feed efficiency and ADG were largest for calves fed milk and least for calves fed 21/21. Calves fed 27/33 or milk had the largest body fat percentage ($>7.0\%$) in the empty body. Calves fed 29/16 or 21/21 had similar fat percentage (4.9, 3.7%) in EB as baseline (2.9%), whereas calves fed milk and 27/33 had the largest fat percentage (6.8, 8.2%) in the EB and gains of fat (169, 238g/d). Calves fed 27/33 had a trend toward higher NEFA in wk 1 and 2. Overall, ADG of calves fed 27/33 and 29/16 was similar except that calves fed 29/16 were

leaner than calves fed 27/33. Feeding 180g of CP in the MR improved calf performance when compared to 90 g/d in the 21/21 diet.

Key Words: Jersey calves, Milk replacer, Body composition

Meat Science & Muscle Biology: Genetics and management of meat quality

541 Effect of sire line and slaughter weight on pork quality. M. A. Latorre¹, M. D. García-Cachín², A. Fuentetaja³, R. Lazaro^{*1}, and G. G. Mateos¹, ¹Universidad Politécnica de Madrid, Spain, ²Estación Tecnológica de la Carne, Salamanca, Spain, ³Copese S.A. Segovia, Spain.

A trial was conducted to study the influence of sex (barrows; gilts), sire line (Danish Duroc, DD; Dutch Duroc x Large White, DHxLW; Pietrain x Large White, PxLW), and slaughter weight (120 kg; 135 kg) on meat quality. Dam line was Landrace x Large White in all cases. Each treatment was replicated four times and the experimental unit was formed by five samples of muscle *longissimus* (150 ± 15 g), obtained at the last rib level from five pigs penned together during the growth period. Carcasses were obtained from pigs that had a common feeding program with free access to diets based on corn and soybean meal. Meat from castrates had more intramuscular fat (2.8 vs 2.5%) and higher a* value (4.63 vs 4.34) than meat from gilts (P < 0.05), but gender did not modify tenderness or cooking or thawing losses. Loins from DD had less protein (23.8 vs 24.0% and 24.1%; P < 0.01) and more intramuscular fat (3.0 vs 2.4%, and 2.5%; P < 0.001) than loins from DHxLW or PxLW. Also, meat from DD crossbreds had less moisture than meat from DHxLW crossbreds, with meat from PxLW crossbreds in an intermediate position (73.5, 73.9, and 73.7%; P < 0.01). The PxLW sired-pigs had higher b* value than DD or DHxLW sired-pigs (9.89 vs 9.46 and 9.19; P < 0.01). No influence of boar line on resistance to cutting or water holding capacity was observed. An increase in slaughter weight increased intramuscular fat (2.8 vs 2.5%; P < 0.01) and tended to decrease moisture content of the meat (73.6 vs 73.8%; P < 0.10). Loins from heavier pigs were redder (4.75 vs 4.21; P < 0.001) and had more intense color (10.7 vs 10.3; P < 0.01) and less thawing losses (6.4 vs 8.7%; P < 0.001) than loins from lighter pigs. We conclude that DD is an attractive sire line that can be used as an alternative to DHxLW or PxLW for production of dry-cured products from heavy pigs. Also, an increase of slaughter weight improved some aspects of meat quality that might be of benefit for quality of dry-cured products.

Key Words: Sire line, Slaughter weight, Pork quality

542 The effect of lorry on meat quality. Cs. Abrahám*, J. Seenger, and E. Szűcs, *Szent István University, Gödöllő-Hungary.*

The aim of this research was to establish effects of two different lorry types on meat quality traits. In addition, the objective was to establish relationships between meat quality parameters. A further question was whether there are differences in various parts of the same muscle in terms of meat quality traits measured at the cut surface of the medial and lateral sides of *M. longissimus dorsi* (LD). For transport of pigs two different lorry types were compared: (A) single-decker lorry and (B) double-decker one. Pigs (n=100) were transported from the pig farm to the abattoir (130 km distance). The animals were slaughtered according to commercial procedure. After slaughter and/or chilling for 24 h meat quality traits were recorded as follows: pH₄₅ and temperature in LD, as well as pH_u. Meat color was measured using MINOLTA CR 300 Chromameter (Minolta GmbH, Germany) at two anatomical (medial and lateral) parts of the LD cut surfaces. Data were processed and analyzed using software of SPSS 10.0 statistical program package. Significant differences were found between distributions of meat quality traits, which were assigned to PSE, normal and DFD categories. Lorry type A proved to be superior to lorry B showing a lower amount of PSE (18 vs. 34 %). The reason for the adverse phenomenon might be due to loading and unloading which was rather complicated with lorry B, and in this case frequent use of different tools for driving of animals was needed. It resulted in higher level of stress. Comparing the medial and lateral sides of the LD revealed significant differences for L* and a*. Coefficients of correlation between meat quality traits reveal close, negative relationship of L* with pH_u (r = -0.76). No association was established between L* and LD temperature and surface reflectance. A relatively

low coefficient of correlation was calculated for the relationship of LD temperature with surface reflectance (r=0.36).

Key Words: Pigs, Animal transport, Meat quality

543 Effects of available dietary carbohydrate and pre-slaughter stress on glycolytic potential and quality traits of pig muscles. G. Bee*, *Swiss Federal Research Station for Animal Production, Posieux Switzerland.*

The objective of the study was to evaluate the effects of pre-slaughter stress and dietary treatments known to affect post mortem muscle metabolism on the glycolytic potential (GP) and quality traits of the longissimus (LM) and semitendinosus muscles (light: STL; dark: STD portion). A total of 48 Swiss Large White pigs (24 gilts, 24 barrows) were selected at 88 kg and individually fed 2.6 kg of a diet either high (H) or low (L) in available carbohydrate up to 107 kg. In order to simulate pre-slaughter stress, 6 gilts and 6 barrows from each dietary treatment were subjected to a transporting stress for 3 h prior to slaughter. The remaining pigs were walked from the pen to the abattoir avoiding all unnecessary stress. In the samples collected 24 h post mortem of the LM, STL and STD the GP was determined. Measurements of the pH were carried out in the LM 30 min and 24 h post mortem and in the STD and STL 24 post mortem. Minolta L*, a*, b* values were assessed the day after dissection. In addition, muscles aged for 1 d and stored at -20C were thawed overnight at 4C (thawing loss) and then cooked to an internal temperature of 69C (cooking loss). Compared to the H-pigs, muscles of L-pigs had a lower GP (LM: 144 vs. 154 μmol/g; STL: 116 vs. 104 μmol/g; STD: 101 vs. 88 μmol/g; P < 0.02 for each). Regardless of the diet, pre-slaughter stress reduced the GP in the STD (90 vs. 99 μmol/g; P < 0.05), but not in the LM and STL. Neither diets nor pre-slaughter stress affected pH, but stress decreased meat temperature in the LM 30 min post-mortem (39.6 vs. 40.4C; P < 0.01). In the STL, L* (51.6 vs. 54.1) and b* values (3.4 vs. 4.2) were lower in pigs fed diet L (P < 0.03). Unexpectedly, pre-slaughter stress further accentuated the differences within diets (P < 0.01). Diet L reduced cooking losses of the STD (14.5 vs. 16.0%) and STL (12.8 vs. 13.6%; P < 0.04). Pre-slaughter stress increased thawing (7.5 vs. 6.4%) and cooking losses (13.6 vs. 12.8%; P < 0.02 for each) only in the STL. The present data revealed that the diet induced decrease of the GP positively affected meat colour and reduced thawing and cooking losses, whereas pre-slaughter stress accentuated the negative effects only in the STL.

Key Words: Feeding, Pre-slaughter stress, Pork quality

544 Growth parameters and carcass merit of market hogs supplemented creatine monohydrate in conjunction with ractopamine hydrochloride (Paylean) and a high glycemic carbohydrate. C. A. Stahl*¹, M. S. Carlson¹, D. L. McNamara¹, T. B. Schmidt¹, D. J. Newman¹, C. M. Schultz Kaster², and E. P. Berg¹, ¹University of Missouri, Columbia, MO, ²Premium Standard Farms, Milan, MO.

Crossbred barrows (n=128; 85kg) were blocked by weight and allotted to one of 16 pens (eight pigs/pen; four reps/treatment) using a completely randomized design. Treatments consisted of diets A (pelleted corn-soybean base formulated to meet or exceed all NRC requirements), B (diet A supplemented with 0.92% creatine monohydrate (CMH) and 2.75% dextrose), C (Diet B supplemented with 4.5 g/ton Paylean) and D (diet A supplemented with 4.5 g/ton Paylean). Animal weight and feed disappearance was recorded at 9d intervals throughout the 27d testing duration to determine ADG and feed efficiency. In addition, real-time ultrasound was used to establish 10th rib fat depth (FD) and loin muscle area (LMA) on d1 and 27. No treatment differences were noted when comparing ADG (P=0.66) and cold carcass weight (P=0.51). Over the 27d test, diets C and D expressed the greatest improvement in LMA growth (A: 6.84; B: 7.61; C: 9.35; D: 9.03 +/-0.58cm², P<0.01). Additionally, diet affected d27 FD (A: 2.21; B: 1.90; C: 1.93; D: 1.85 +/-0.08cm, P<0.05) and total fat accumulation (A: 0.69; B: 0.48; C: 0.46; D: 0.36 +/- 0.05cm, P<0.001). Moreover, boneless loin chops of animals