3-carbon pool contributed to 70.7% (± 7.2) of acetyl-CoA and to 2.2% (± 0.8) of oxaloacetate fluxes, with only 20.2% (± 1.5) and 0.7% (± 0.3) of these respective fluxes derived from glucose catabolism in muscle. In this study, despite high rates of dietary glucose absorption, gluconeogenesis (from AA) was maintained, and at rates similar to glucose absorption. In liver and muscle, glucose catabolism made a minor contribution to overall Krebs cycle metabolism, and thus fatty acids and (or) AA were the largest contributors to energy generation in these fish tissues.

Key Words: Striped Bass, Glucose, Stable Isotope

Nonruminant Nutrition: Minerals

W144 Genetic background and phosphorus nutrition affect bone strength and gene expression in young pigs. L. Hittmeier, R. Lensing, L. Grapes, M. Rothschild, and C. Stahl*, *Iowa State University*, *Ames.*

Phosphorus (P) is essential to bone growth and turnover; however, little research has focused on the genetic mechanisms controlling P utilization. In this study, 36 gilts (6.63 ± 0.78 kg) from six litters (three gilts/litter) were sired by two lines known differ in bone structure [one considered heavier-boned (HB) and the other lighter-boned (LB)]. Pigs were assigned to three dietary treatments: P adequate (0.41% available P for 2 wk), repletion (0.14% available P for wk 1, 0.41% available P for 2 wk), or P deficient (0.14% available P for 2 wk). After 14 d, pigs were harvested and bone marrow was collected for analysis of gene expression by real-time PCR, and radial bones were collected for breaking strength analysis. In HB, but not LB pigs, the P deficient diet caused a decrease in ADG ($P < 0.01$) compared to the other treatments. In the LB line, repletion pigs had higher ADG ($P < 0.01$) than the other treatments. For both lines, P deficiency caused a reduction in radial bone strength ($P < 0.01$). The LB and HB lines responded similarly to P deficiency in the expression of *OXTR* and *IGF1*. In HB, but not LB pigs, diet affected the expression of *VDR* ($P < 0.04$), *CALCR* ($P < 0.05$), and *IGFBP3* ($P < 0.06$), and there was a trend of increased *IL6*, *Sox-9*, and *TFIIB* expression with P deficiency. Expression of *BGLAP*, *OPG*, *RANKL A-Raf-1* and *IGFBP5* was not affected by sire line or diet. Data were analyzed using a mixed model with line, diet, and line × diet fit as fixed effects. Based on this study, the HB pigs were more responsive to dietary P than LB pigs. Differences in growth and gene expression within the bone marrow suggest a difference in the homeorhetic control of P utilization between these genetic lines. In addition, a better understanding of the role genetics plays in P homeorhesis will enable selection for pigs that will require and excrete less P, as well as allow for the recommendation of specific genetic lines for producers with different waste management strategies.

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Key Words: Bone, Gene Expression, Phosphorus

W145 Effect of dietary phosphorus on the gene expression related to energy metabolism in porcine muscle. A. Qu*, L. Grapes, M. Rothschild, and C. Stahl, *Iowa State University*, *Ames.*

Phosphorus (P) plays a vital role in growth and development, however little research has focused on the genetic mechanisms controlling P utilization. We examined the influence of two sire lines, selected primarily for either meat quality (MQ) or growth performance (GP), and dietary P on the expression of a variety of genes related to energy metabolism in muscle. These genes were identified in a previous oligonucleotide microarray study. Thirty-six gilts (21 d of age, 6.63 ± 0.78 kg) from six litters (three pigs/litter) for each sire line were allotted into three dietary treatment groups: P adequate (+P, 0.41% available P), P repletion (RP, 0.14% available P for wk 1, 0.41% available P for wk 2), or P deficient (-P, 0.14% available P) for 2 wk. Using real-time PCR, we quantified the gene expression of glycogen synthase, succinate dehyrdrogenase, and the succinate dehydrogenase iron-sulfur protein in porcine muscle. The relative gene expression levels in muscle samples from all gilts were analyzed using a mixed-model which included the fixed effects of sire line, diet and sire line by diet interaction. Phosphorus deficiency caused an increase ($P < 0.05$) in the expression of glycogen synthase regardless of genetic background. However, the increase tended to be greater in the GP sired pigs. In MQ, but not GP, sired pigs fed the -P diet had lowered ($P < 0.05$) and those fed the RP diet tended ($P < 0.06$) to have lowered expression of the succinate dehydrogenase iron-sulfur protein. Also the MQ sired pigs in the -P group had higher ($P < 0.05$) levels of succinate dehydrogenase mRNA, while dietary P did not effect its expression in GP sired animals. Our results demonstrated that there are significant nutrition × genetic interactions that affect gene expression in porcine muscle. Elucidating these interactions may enable selection for pigs that will require and excrete less P, as well as allow for the recommendation of specific genetic lines for producers with different waste management strategies.

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Key Words: Phosphorus, Energy Metabolism, Gene Expression

W146 Phosphorus utilization is improved in the growing Enviropig™(Cassie line). A. Ajakaiye*, R. G. Meidinger, M. Z. Fan, D. A. Murray, J. Zhang, M. Mundia, J. P. Phillips, S. P. Golovan, J. M. Kelly, R. R. Hacker, and C. W. Forsberg, *University of Guelph*, *Guelph, Ontario, Canada.*

The objectives of this study were to determine phosphorus (P) utilization by the Enviropig™ (EP) during the growing phase and to compare the values obtained with that derived from the Yorkshire pigs (YK). Six of each EP and YK growing barrows, with average initial BW of 24 and 20 kg, respectively, were fed three diets according to a cross-over (split-plot design). The main plot was the breed and diet was the subplot. There were three diets, six pigs and three periods, with two pigs/diet/period for a total of six replicates/diet. The diets were formulated on the basis of available P with Ca:P maintained at 2:1. The diets consisted of diet A, a control diet with supplemental PO_4^{3-}; diet B, no supplemental PO_4^{3-}; and diet C, no supplemental PO_4^{3-} and 2% lower CP. Each experimental period consisted of 14 d with 10-d adaptation and 4-d collection of urine and representative fecal samples. Data collected were subjected to analysis of covariance using the mixed models procedure with initial BW as a covariate. Fecal P values were significantly reduced ($P < 0.05$) in EP by up to 39% on diet A, 70 % with the diet B, and 68% with the diet C compared to the YK. Apparent P digestibility was increased ($P < 0.05$) in EP than in the YK. Also, the total manure P excretion was reduced when EP was fed the diet with low P and low CP compared with YK (2.82 ± 0.99 vs. 4.56 ± 0.96 g/pig/day; 3.37 ± 1.05 vs. 4.28 ± 0.94 g/pig/day), respectively. The increase ($P < 0.10$) in urine P observed in the EP (4.13 ± 0.84 g/pig/day) vs. YK (-2.0 ± 0.96 g/pig/day) fed diet A is due to the supplemental inorganic P in the diet since the EP does not require supplemental inorganic P in their feed. These data support that the Enviropig™ breed would cost less to feed because neither supplemental P nor phytase enzyme needs to be included in the diet. Furthermore, the reduced P in the manure from the Enviropig™ is more compatible with stringent nutrient management legislation.

Key Words: Enviropig™, Yorkshire, Phosphorus

W147 Phosphorus and calcium utilization by the G1 generation Enviropig™ lines fed a diet without supplemental inorganic phosphorus. A. Ajakaiye*, R. G. Meidinger, M. Z. Fan, S. P. Golovan, J. P. Phillips, R. R. Hacker, and C. W. Forsberg, *University of Gulph*, *Guelph, Ontario, Canada.*

Our previous research has shown that there were differences in the capabilities of different lines of phytase Enviropig™ (EP) in the utilization of phosphorus (P) and calcium (Ca) during the finishing phase. Therefore, the objective of this study was to examine the effects of lines and genders on salivary phytase activities, total fecal P and Ca contents in the growing EP pigs in comparison with results of the Yorkshire pigs (YK) fed a corn and soybean meal-based low-P diet. Thirty EP (15 boars and 15 gilts) derived from three G1 generation founder lines of Jacques (JA), Wayne (WA) and Gordie (GO) and 19 YK (eight boars and 11 gilts) were fed a conventional corn and soybean meal-based grower diet with no supplemental PO_4^{3-} while meeting other nutrient requirements according to the 1998 NRC. All the pigs were fed ad libitum with free access to water. During the trial, three replicate fresh fecal samples were collected from each pig daily over a 3-d period. Saliva samples were also collected from each of the EP pigs during this period. There were differences ($P < 0.10$) between boars and gilts in salivary phytase activity (303.57 ± 63.77 vs. 144.96 ± 63.77 umol/mL/min). The total fecal Ca was also different (0.89 ± 0.05 vs. 1.03 ± 0.04% on DM basis; $P < 0.05$). However, the total fecal P was not different (0.81 ± 0.05 vs. 0.92 ± 0.05% on DM basis). Variations in salivary phytase activity (JA, 46; WA, 460; and GO, 167 umol/mL/min), total fecal P (JA, 0.63; WA, 0.46; and GO, 0.82% on DM basis) and fecal Ca (JA, 1.02; WA, 0.66; and GO, 1.17%, on DM basis) contents were observed among the lines. The Enviropig™ lines had lower ($P < 0.05$) fecal P (0.64 ± 0.08 vs. 1.60 ± 0.05% on DM basis) than the YK pigs. The Enviropig™ are more effective and efficient in reducing total fecal P contents than the YK pigs. Enviropig™ are thus substantially more environmentally friendly than the Yorkshire pigs.

Key Words: Enviropig™, Phytase Activity, Genders

W148 Dietary selenium sources in swine: maternal transfer to embryos. M.-È. Fortier[1], H. Quesnel[2], J.-F. Bilodeau[1], A. GiguÈre[3], J.-P. Laforest[1], and J. J. Matte*[3], [1]*UniversitÈ Laval*, *QuÈbec, Canada*, [2]*Institut de la Recherche Agronomique*, *St-Gilles, France*, [3]*Agriculture et Agroalimentaire Canada*, *Lennoxville, QuÈbec, Canada*.

This project aimed to determine the effect of selenium (Se) as inorganic Na-selenite (MSe) or organic Se-yeast (OSe) on maternal Se transfer to embryos, embryonic antioxidant status [Ferric Reducing Antioxidant Power (FRAP) and glutathione peroxidase activity (GSH-Px)] and litter performance. Forty-nine gilts received one of the three dietary treatments, starting at first pubertal estrus and lasted up to 30 days post-AI (AI at the fourth estrus): control (C: basal diet (Se = 0.2 ppm) without added Se) (n = 16), MSe (C + 0.3 ppm Na-Se) (n = 16) and OSe (C + 0.3 ppm Se-yeast) (n = 17). Sows had received, on days 14 and 15 of third estrus, a hormonal challenge to synchronise and stimulate ovulation. At slaughter, embryos and corpora lutea (CL) from 35 gravid sows (C = 12, MSe = 13 and OSe = 10) were weighed and measured. There was no treatment effect on mean litter size and embryonic survival, as well as on embryonic antioxidant status ($P > 0.23$). Se content of individual embryo was higher for Se treated sows than for C ($P < 0.04$). Total litter and individual Se content of embryos were, respectively, 62.6% and 44.7% higher for OSe than MSe ($P < 0.01$). The within-litter variation of Se in embryos tended to be lower ($P = 0.07$) when Se was supplied to sows. Embryonic FRAP was more uniform within OSe than MSe litters ($P = 0.01$). The length, weight and protein content of embryo were, respectively, higher by 5.5%, 11.5% and 11.6% in OSe than MSe sows ($P < 0.05$). The within-litter variation of embryonic lengths was in general low but better ($P = 0.06$) in MSe (4.8%) than in C and OSe sows (6.1%). There was no treatment effect ($P > 0.18$) on weight, diameter, total number, Se content, FRAP and total GSH-Px of CL. However, Se-GSH-Px in CL was higher for Se than for C sows ($P = 0.02$). The protein content of CL tended to be higher for OSe than MSe ($P = 0.06$). It appears therefore that the uterine transfer of selenium to embryos was improved with OSe as compared to MSe and this was concomitant with a better development of embryos. The results on CL deserve more studies in order to better understand the OSe effects on embryonic development and/or ovulation.

Key Words: Selenium, Embryos, Sow's Gestation

W149 The comparative effects of organic and inorganic selenium on selenium transfer from sows to nursing pigs. I. Yoon*[1] and E. McMillan[2], [1]*Diamond V Mills, Inc.*, *Cedar Rapids, IA*, [2]*MapleLeaf Foods Agresearch*, *Burford, Ontario, Canada*.

The effects of dietary Se sources on the transfer of Se to the sow's milk and nursing pigs were examined by feeding sows with diets containing no supplemental selenium (Se) or supplemental Se from either inorganic (sodium selenite) or organic (Se-enriched yeast, SelenoSource™ AF) sources. Both inorganic and organic Se sources were added to the diet at 0.3 ppm Se. A non-Se fortified corn-soybean meal basal diet served as a negative control (approximately 0.2 ppm Se). Sows were fed their treatment diets from 60 d prepartum to parturition and through a 14-d lactation period. Six sows from each treatment were bled at 60 and 30 d prepartum, at farrowing and at 14 d postpartum to measure serum Se concentration. Colostrum was collected within 12 h postpartum and milk at 14 d of lactation. Piglets from twelve litters on each treatment were bled at birth and at weaning and serum was analyzed for Se concentration, IgG and glutathione peroxidase (GSH-Px) activity. Sow serum Se concentration declined throughout gestation and gradually increased during lactation period. Sows fed organic Se maintained numerically higher serum Se than sows fed non-supplemented diet. The effect was close to a significant ($P < 0.06$) at farrowing. Colostrum Se content was increased ($P < 0.01$) when the organic source was provided but was not increased when inorganic Se was supplemented. The effect was maintained ($P < 0.01$) throughout lactation. Serum Se was increased ($P < 0.01$) by organic Se but not by inorganic Se in newborn piglets. The supplemental Se effect disappeared by 14 d of age in piglets. Pig serum IgG and GSH-Px activity were not affected by dietary Se source. The results demonstrated that organic Se is more effective than inorganic Se in maintaining higher serum Se level of sows until farrowing and in increasing colostrum and milk Se and serum Se of nursing pigs.

Key Words: Selenium Yeast, Sodium Selenite, Sow and Piglet

W150 Supplementation of potassium-diformate (Formi®), as an alternative to antibiotics, on growth performance, morphological changes of small intestine and immune responses in weanling Pig. M. S. Yun, W. S. Joo*, H. F. Long, W. G. Park, and Y. Y. Kim, *Seoul National University*, *Seoul, South Korea*.

This experiment was conducted to investigate the effect of potassium-diformate (KDF), as an alternative to antibiotics, on growth performance, morphological changes of small intestine, and immune response in weanling pig. A total of 120 weanling pigs [(Landrace x Yorkshire) x Duroc; weaned at 25 d of age] were allotted to six treatments in a randomized complete block (RCB) design with five replicates and four pigs per pen. Treatments were: 1) N-CON (basal diet), 2) P-CON (basal diet + 0.1% antibiotics), 3) F0.3 (basal diet + 0.3% Formi®), 4) F0.6 (basal diet + 0.6% Formi®), 5) F0.9 (basal diet + 0.9% Formi®) and 6) F1.2 (basal diet + 1.2% Formi®). Diets were formulated with corn-soy and all nutrients were met or exceeded the 1998 NRC requirements. Eighteen pigs (three pigs per treatment) with 7.90 kg body weight were housed in an individual metabolic crate for digestibility trial. After 7 days of adaptation period, pigs were subjected to a 5-day collection period for nutrient digestibility. A total of 36 weanling pigs were sacrificed to measure morphological changes, GI-tract pH and microbial alteration. During the 5-week feeding trial, growth performance was not significantly affected by treatments, but positive control, F0.3 and F0.9 groups showed improved ADG, and consequently, heavier final BW was observed. Potassium diformate supplementation had influence on the pH of stomach digesta, and it decreased linearly as dosage levels increased ($P < 0.01$). In blood assay, all pigs had similar blood urea nitrogen (BUN) concentration patterns, while F0.3 and F0.9 had significantly lower serum IgA concentration compared to the other treatments ($P < 0.05$). Potassium-diformate supplementation had no effect on the small intestinal morphological changes for villus height and crypt depth. Nutrient digestibility tended to increase as KDF was provided although there was no significant difference. These results showed that the addition of KDF to the weanling diet was not differed from antibiotics supplementation group in growth but improved humoral immune responses and tended to improve nutrient digestibility.

Key Words: Weanling Pig, Antibiotic Alternative, Potassium-Diformate

W151 Diet acidity fails to match zinc oxide in improving weaner pig performance. H. Miller*[1], P. Blanchard[2], and P. Toplis[3], [1]*University of Leeds*, *Leeds, West Yorkshire, UK*, [2]*Frank Wright Ltd*, *Ashbourne, Derbyshire, UK*, [3]*Primary Diets Ltd*, *Ripon, North Yorkshire, UK*.

Newly weaned piglets fed zinc oxide (ZnO) in their diet have better performance and reduced incidence of diarrhoea. We hypothesised that similar effects could be achieved by feeding diets that created more acidic stomach conditions, either by adding acid to the diet or by reducing inorganic phosphate and replacing it with phytase. We therefore compared a diet containing ZnO with those containing either formic acid or phytase, or both. Two hundred forty eight pigs (62.5% Large White, 25% Landrace, and 12.5% Duroc) were weaned at 27 ± 0.2 d and 8.2 ± 0.13 kg liveweight into 32 slatted floor pens each of seven or eight pigs balanced for liveweight, sex and litter across treatments. Piglets were offered ad libitum access to diets (16 MJ DE/kg, 1.5% lysine) containing 0.2% ZnO (Z), 0.6% formic acid (A), 500 FTU/kg phytase (P) or 0.6% formic acid and 500 FTU/kg phytase (C) for 18 d following weaning. Thereafter all pigs received standard commercial diets through to slaughter. During the 18 d trial period, Z pigs grew more rapidly, ate more and converted feed more efficiently than all other treatments, and C pigs were next followed by A and finally P. Daily gains were 343, 302, 282, and 227 g (± 12.8, $P \leq 0.001$), daily feed intakes were 409, 362, 350 and 302 g (± 15.4, $P \leq 0.001$) and feed conversion ratios were 1.19, 1.20, 1.25 and 1.35 (± 0.029, $P \leq 0.01$) for Z, C, A and P, respectively. This performance advantage was maintained through to slaughter at 101 ± 7.7 kg liveweight with Z pigs killed 3.4 d earlier than C and 7.4 d earlier than A or P pigs ($P < 0.05$). The results indicate that ZnO gave a clear advantage to weaner pigs when provided in the diet for the first 18 days post weaning. The combination of formic acid plus phytase, whilst not as good as ZnO, provided a better start than either product alone indicating a synergism between the two additives. Improvements in immediate post weaning performance were maintained through to slaughter indicating the importance of the early weaner diet.

Key Words: Zinc Oxide, Acid, Phytase

W152 The effect of dietary natural mineral liquid complex on growth performance and blood characteristics in broilers. B. J. Min*, O. S. Kwon, K. S. Son, J. H. Cho, Y. J. Chen, H. J. Kim, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Korea*.

This experiment was conducted to investigate the effect of dietary natural mineral liquid complex on growth performance and blood characteristics in broilers. The natural mineral liquid complex was extracted from *Artemisia princes, Pinus densiflora* Sieb. and biotite. A total of six hundred forty eight broilers were randomly allocated into four treatments with six replications and fed for five weeks. Dietary treatments included: 1) CON (basal diet), 2) Min0.2 (basal diet + 0.2% mineral liquid complex), 3) Min0.4 (basal diet + 0.4% mineral liquid complex) and 4) Min0.6 (basal diet + 0.6% mineral liquid complex). Through the whole period, weight gain, feed intake and feed conversion ratio were not affected by mineral complex. In liver weight measured at the end of experiment, Min0.4 and Min0.6 treatments were heavier than Min0.2 treatment ($P < 0.05$). There were no significant differences in total protein, albumin and iron level in serum among the treatments ($P > 0.05$). Hemoglobin concentration in serum was increased in Min0.4 and Min0.6 treatments compared with Min0.2 ($P < 0.05$). GOT and GPT level in serum was decreased in Min0.4 and Min0.6 treatments compared with CON ($P < 0.05$). Broilers fed Min0.4 diet had the highest Mg concentration in serum compared with broilers fed other diets ($P < 0.05$). Mg concentration in breast muscle was higher in broilers fed Min0.4 diet than that fed CON or Min0.2 diets ($P < 0.05$). Also, in Fe concentration, Min0.4 treatment was the highest among the treatments ($P < 0.05$). In leg muscle, K concentration was increased in Min0.6 compared with other treatments ($P < 0.05$). In conclusion, 0.4% of natural mineral liquid complex supplementation in broilers diet increased liver weight and some mineral concentration in blood and muscle.

Key Words: Natural Mineral Liquid Complex, Broiler, Blood Characteristic

W153 Magnesium absorption from drinking water in rats. A. Ohata*, H. Ohmori, T. Matsui, and H. Yano, *Kyoto University*, *Kitashirakawa-oiwake, Sakyo-ku, Kyoto, Japan*.

Magnesium (Mg) is an essential mineral for animals and plays important roles in many biological processes. Livestocks and humans obtain minerals from drinking water. However, mineral bioavailability in drinking water has not been clarified. We compared the fractional absorption of Mg in water with that in diet using stable isotopes of Mg in rats. Male Wistar rats were given the AIN93G-based diet (control diet) for 12 h and fasted for 12 h in a day. Experiment 1: Rats were orally administered a solution containing 1 mg ^{26}Mg and dysprosium (Dy) 2 h after the initiation of feeding period and a solution containing 1 mg ^{25}Mg and ytterbium 4 h after the initiation of fasting period. Experiment 2: Rats were divided into two groups that obtained isotopic Mg from diet or water. One group was given the diet containing 1 mg ^{26}Mg and Dy in the first 4 h of feeding period and was given the control diet in the following 8 h. The other group was orally administered a solution containing 1 mg ^{26}Mg and Dy 2 h before feeding period. This group was given a low Mg diet in the first 2 h of feeding period then given the control diet. Thus, the daily intake of Mg was adjusted. Feces were collected for 5 d after the administration of isotopic Mg in each experiment. Fecal Mg was determined by an atomic absorption spectrometer after wet digestion. Mg isotope ratio and the unabsorbable markers were determined by an ICP/MS. The absorption of ^{25}Mg and ^{26}Mg was calculated from the unabsorbable markers, total Mg and isotopic Mg in feces. The absorption of ^{26}Mg was 69.8 ± 3.0% in the solution administered in the feeding period, which did not differ from the absorption of ^{25}Mg in the solution administered in the fasting period (65.6 ± 4.3%). The absorption of dietary ^{26}Mg was 71.9 ± 4.4% that was similar to the absorption of ^{26}Mg administered as the solution in the fasting period (72.8 ± 4.0%).

Key Words: Magnesium, Stable Isotope, Absorption

W154 Developmental regulation of brush border hydrolase and iron transporter gene expression in pig small intestine. X. Xiao*, E. A. Wong, and K. E. Webb, Jr., *Virginia Tech*, *Blacksburg*.

Piglets from each of seven sows were killed at birth (d 0), during lactation (d 1, 3, 7, 14, 21) and post-weaning (d 22, 24, 28, 35). Duodenum, jejunum and ileum were collected for RNA isolation. The abundance of mRNA was determined by Northern blotting for three protein hydrolases, aminopeptidase A (APA) and N (APN) and dipeptidyl peptidase IV (DPP IV), three carbohydrate hydrolases, lactase-phlorizin hydrolase (LPH), sucrase-isomaltase (SI) and maltase-glucoamylase (MGA), and two iron transporters, divalent metal ion transporter 1 (DMT1), and iron-regulated transporter 1 (IREG1). During lactation, APA, APN, and DPP IV mRNA abundance increased then decreased (quadratic, $P < 0.001$) with age, being highest at d 3 or 7. Post-weaning, abundance of these mRNA transiently increased then declined, followed by a slight increase to d 35. Abundance of APA, APN, and DPP IV mRNA was not different among segments during lactation, and was highest ($P < 0.05$) in the jejunum and/or ileum post-weaning. During lactation, LPH mRNA abundance increased then decreased (quadratic, $P < 0.001$) with age, being highest at d 14, and SI mRNA abundance increased linearly ($P < 0.001$) with age, whereas MGA mRNA abundance remained unchanged. Post-weaning, LPH and SI mRNA abundance initially increased and then declined, followed by an increase to d 35, and MGA mRNA abundance increased with age. During lactation, LPH and MGA mRNA abundance was higher ($P < 0.05$) in the jejunum and ileum than the duodenum, and SI mRNA abundance was higher ($P < 0.05$) in the duodenum and jejunum than the ileum. Post-weaning, LPH, MGA, and SI mRNA abundance was higher ($P < 0.05$) in the jejunum and ileum than the duodenum. The mRNA of DMT1 and IREG1 was predominantly distributed in the duodenum from d 0 through 35. In the duodenum, DMT1 and IREG1 mRNA abundance increased with age during lactation and then rapidly decreased after weaning. These results indicate a differential spatial and developmental regulation of these genes along the small intestine.

Key Words: Transporter, Hydrolyase, Gene Expression