converts to a pregnancy rate of 20% and 133 days open to a pregnancy rate of 25%.

Key Words: Genetic evaluation, Cow fertiltity, Pregnancy rate

521 Quality of data included in genetic evaluations for daughter pregnancy rate. P. M. VanRaden, M. E. Tooker*, A. H. Sanders, and G. R. Wiggans, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD.*

National genetic evaluations of daughter pregnancy rate are based on data from 40 million lactation records of 16 million cows that calved since 1960. Up to five lactations are included per cow. Date pregnant is determined from several data sources. The most accurate information is last insemination date verified by birth date of next calf within 15 d of expected birth date. For lactations with no reported inseminations, date pregnant is obtained by subtracting mean gestation length (280 d for Holsteins) from next calving date. For lactations without next calving date, date pregnant is assumed to be the last insemination date unless the cow was subsequently examined and verified not pregnant, or was still milking in the same lactation more than 295 d after the last insemination. Last reported breeding date is used if the next lactation is initiated by abortion. A final data source is an owner report that the cow was sold because of infertility. Such cows are assumed to be nonpregnant and the last insemination date is disregarded. Records for pregnancy rate are considered to be complete at 250 d in milk (DIM), and pregnancy status after 250 DIM is not used. Date pregnant is set equal to 50 DIM for cows that become pregnant before 50 DIM. Some early pregnancy dates calculated from next calving date are inaccurate because of short gestations or unreported abortions. Therefore, lower and upper limits of 50 and 250 DIM, respectively, were applied after adjusting days open for season effects; 5 and 14% of records were affected. For Holstein calvings during 1998 and 1999, 57% had breeding date verified by calving date; 6% had next calf born with no previously reported breeding date; 5% had breeding date inconsistent with birth date of next calf; and 5% had the cow reported as sold for reproductive reasons. Although 19% of reported final breeding dates could not be verified because the cow was sold for reasons other than fertility, comparisons with birth date indicate that most farms report accurate breeding dates.

Key Words: Genetic evaluation, Fertility, Pregnancy rate

522 Use of early lactation days open records for genetic evaluation of cow fertility. M. T. Kuhn* and P. M. VanRaden, *Animal Improvement Programs Laboratory, ARS, USDA, Beltsville, MD.*

National genetic evaluation for female fertility was implemented in February 2003. The evaluations are reported as daughter pregnancy rate. Pregnancy rate is calculated from days open (**DO**) as (233 – DO)/4. Currently, records must have a minimum of 250 days in milk (**DIM**) to be included for genetic evaluation. Furthermore, DO is set to 250 for records that go beyond that upper limit. This research examined the possibility of using DO records prior to 250 DIM by predicting unknown records. The prediction model included the fixed effects of lactation and calving ease and linear regressions on age at calving, average of first three test day milk yields, previous DO, previous number of services, and days to first breeding. Quadratic effects of age and milk yield were also included. To assess the utility of the predictions, 10 DO groups were formed by defining the first group as 70 days or less and subsequent groups in 20 day increments. The final group was defined as $\geq$ 250-d. Each record was included in each group. Within group, y-hat was defined as actual DO if actual DO was $\leq$ the upper limit for that group or projected DO otherwise. Bias, standard deviation of prediction errors, and phenotypic correlations between y-hat and actual DO were calculated for each group. Genetic correlations were estimated for the groups with 90, 130, and 170 day upper limits. Bias ranged from 30 d (70-d group) to 0 d and was close to 0 d starting with the 110-d group. Standard deviation of prediction errors ranged from 49 d to 14 d. Phenotypic correlations increased from .41 (70-d) to .98 (250-d). Estimates of genetic correlations were 1 in all 3 groups examined. These results suggest that DO records can be utilized prior to the current 250-d requirement. Projected records require a weight less than one in genetic evaluation. Weights can be determined from correlations between actual and predicted records. Pregnancy confirmation code, now being collected, will also contribute to determination of weights.

Key Words: Genetic evaluation, Cow fertility, Prediction

Food Safety: On farm food safety: Assessment of costs, tools and management

523 Economic assessment of food safety in the dairy chain. N. Valeeva*, M. Meuwissen, and R. Huirne, *Wageningen University, Wageningen, the Netherlands.*

As a result of the increased demand for food safety, a number of quality assurance regulations have been introduced all over the world. However, little is known about the costs and efficiency of implementing such regulations, especially with regard to the entire chain. The objective of this research was to develop a mathematical programming model to identify measures for increasing the level of food safety in the dairy production chain in a cost-effective manner. The chain included compound feed production and its transport, the dairy farm itself, transport of raw milk, processing, delivery of (pasteurized) milk, and the retailer and catering sectors. The model focused on two main groups of hazards: microbial (*Salmonella, E. coli, M. paratuberculosis* and *S. aureus*) and chemical (antibiotics and dioxin). In collecting input data for the model, special attention was given to the costs of the various measures and the effectiveness of these measures in increasing the food safety level. Costs included implementation and maintenance of these measures (including interest and depreciation costs). Effectiveness was measured by adaptive conjoint analysis as the relative contribution of each measure to the food safety level. An electronic questionnaire was completed by 67 experts from industry, research, extension and farming who evaluated the measures in four steps. Linear regression analysis was then performed to determine the relative contribution (i.e. so-called utility level) of each measure. Respondents were consistent (R-squared $>$ 0.8) with respect to their individual responses. Relative contributions and cost estimates were used in the mathematical model to determine the optimal set of measures for various food safety levels. Results showed that the dairy farm (42%) and dairy processing (24%) stages are most important for reducing microbial hazards. In contrast, the compound feed (43%) and dairy farm (39%) stages are most important for reducing chemical hazards. Overall, an increase in the higher levels of food safety was associated with a steep non-linear increase in costs.

Key Words: Food safety, Dairy chain, Economics

524 Bactericidal efficacy of quaternary ammonium compounds against species of bacteria isolated from feces of dairy cattle. A. A. Sawant*, N. V. Hegde, S. C. Donaldson, K. B. Buck, and B. M. Jayarao, *Pennsylvania State University, University Park, PA.*

Quaternary ammonium compounds (QAC) are widely used as disinfectants in dairy, meat-packing, and food processing industry. QACs have been shown to be more effective against gram-positive than gram-negative bacteria. In a dairy setting, gram-negative organisms are the major microflora in the environment. There is very little information on the MIC_{90}values of gram-negative bacteria of dairy origin to QACs. A study was conducted to assess the susceptibility of gram-negative bacteria isolated from feces of lactating cattle to QACs. Gram-negative bacteria including *Escherichia coli* (n=186), *Citrobacter koseri* (n=14), *Enterobacter aerogenes* (n=3), *Klebsiella oxytoca* (n=3), and *Pseudomonas* spp. (n=6) were examined for their susceptibility to cetyltrimethylammonium bromide (CTAB), benzalkonium chloride (BKC), and benzyldimethylhexadecyl ammonium chloride (BDAC). The MIC_{90} modal values for *E. coli* were 60μg/ml for BKC (range 30 - $>$80), 60μg/ml for CTAB (range 50-700), and 400μg/ml for BDAC (range 100 - $>$800). *Pseudomonas* spp. showed high MIC_{90} values for BKC ($\geq$80μg/ml), CTAB ($\geq$700μg/ml), and BDAC ($\geq$700μg/ml). *Citrobacter koseri*, *E. aerogenes*, and *K. oxytoca* showed MIC_{90} $\geq$30μg/ml for BKC, $\geq$300μg/ml for CTAB, and $\geq$600μg/ml for BDAC, respectively. The presence of *qacE* gene in *E. coli* was detected in 80 of 186 (43%) of the *E. coli* isolates. The *qacE* gene was also detected in other species except *E. aerogenes*. Results of the study suggested that: (1)

there was no correlation between the high MIC_{90} values and the presence of the *qacE* gene, and (2) the MIC_{90} values varied considerably within and between species of gram-negative bacteria.

Key Words: Quaternary ammonium compounds, Gram negative bacteria, Dairy cattle

525 Antimicrobial effect of alpha-linolenic acid against *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Salmonella* spp. in ground beef from finishing cattle fed flaxseed. M. A. Greenquist*, J. S. Drouillard, R. K. Phebus, L. J. Franken, B. E. Depenbusch, E. J. Good, C. M. Gordon, S. P. Montgomery, and J. J. Sindt, *Kansas State University, Manhattan, KS*.

The antimicrobial effect of long-chain fatty acids in culture medium is known to reduce some pathogenic microorganisms by inhibiting membrane transport systems. Feeding flaxseed to finishing cattle increases the alpha-linolenic acid (18:3n3) composition of adipose and muscle tissues. We conducted an experiment to determine if feeding flaxseed to enrich carcass tissues with alpha-linolenic acid could be used to inhibit growth of pathogenic organisms in ground beef. Individually fed steers (n=70; 338 kg initial BW) were fed steam-flaked corn-based diets containing (DM basis) 0, 5, 10, or 15% ground flaxseed with or without the addition of 220 IU/kg DM of vitamin E for 120 d. Three 10-g composites of 80% lean ground beef were obtained from each carcass and separately inoculated (3.0 log colony forming units/gram of meat) with a five-stain mixture of *Escherichia coli* O157:H7, *Listeria monocytogenes*, or *Salmonella* spp. Each pathogen was enumerated on d 0, 3, and 10. No interactions were detected among flax and vitamin E treatments ($P>0.75$). The addition of flaxseed to finishing diets did not affect the antimicrobial activity in ground beef against *E. coli* O157:H7 ($P=0.14$), *L. monocytogenes* ($P=0.24$), or *Salmonella* spp. ($P=0.63$). In addition, vitamin E did not affect antimicrobial activity in ground beef against *E. coli* O157:H7 ($P=0.36$), *L. monocytogenes* ($P=0.44$), or *Salmonella* spp. ($P=0.30$). Fatty acid enriched ground beef from cattle fed flaxseed does not elicit antimicrobial activity against *E. coli* O157:H7, *L. monocytogenes*, and *Salmonella* spp.

Key Words: Alpha-linolenic acid, Antimicrobial, Ground beef

526 Effects of diet and monensin on ruminal persistence and fecal shedding of *Escherichia coli* O157:H7 in cattle. M. J. VanBaale*[1], J. M. Sargeant[1], D. P. Gnad[1], B. M. Debey[1], K. F. Lechtenberg[2], and T. G. Nagaraja[1], [1]*Kansas State University, Manhattan, KS,* [2]*Midwest Veterinary Services, Oakland, NE*.

Twelve ruminally-cannulated cattle, adapted to high-forage (85% forage; HF) or high-grain diet (85% grain; HG) with or without monensin (1.32 mg/kg of diet), were used in a 2 x 2 factorial design, to investigate the effects of diet and monensin on level and duration of ruminal persistence and fecal shedding of *E. coli* O157:H7. Cattle were ruminally inoculated with a strain of *E. coli* O157:H7 (10^{10} CFU/animal) adapted to nalidixic acid (Nal^r). Ruminal and fecal samples were collected for 11 wk, and then cattle were euthanized, necropsied, and contents from different gut locations were collected. Samples were cultured for enumeration or detection of Nal^r *E. coli* O157:H7. Fecal and ruminal pH were recorded immediately after collection and an aliquot of ruminal sample was acidified and frozen for VFA analysis. Cattle fed the HF diet shed higher ($P<0.05$) concentrations of Nal^r *E. coli* O157:H7 in the feces and for a longer duration compared to cattle fed the HG diet. In HF fed cattle, the duration of shedding decreased for monensin compared to no monensin group. Generally, ruminal persistence of Nal^r *E. coli* O157:H7 was not affected by diet or monensin. Fecal pH was higher ($P<0.05$) in cattle fed HF diet compared to cattle fed HG diet. Monensin had no effect on fecal pH in cattle fed either of the two diets. Cattle fed HF diet had higher ruminal pH ($P<0.05$) and lower VFA concentrations than the cattle fed the HG diet. At necropsy, Nal^r *E. coli* O157:H7 was detected in hind gut (rumen and cecum) contents more often than from any other gut location, including the rumen. Our study suggests that cattle on a HF diet shed higher concentrations and for longer duration than cattle on a HG diet. Monensin supplementation decreased the duration of shedding with HF diet, and the hind gut, not the rumen, appears to be the site of persistence of *E. coli* O157:H7 in cattle.

Key Words: *Escherichia coli* O157, Monensin, Cattle

527 Bactericidal effect of 2-nitropropanol against selected foodborne pathogens *in vitro*. Y. S. Jung*, R. C. Anderson, T. R. Callaway, T. S. Edrington, K. J. Genovese, R. B. Harvey, T. L. Poole, and D. J. Nisbet, *USDA-ARS, Food and Feed Safety Research Unit, College Station, TX*.

The bactericidal effect of 2-nitropropanol (2NPOH), a nitroalkane, on several pathogenic bacteria including *Salmonella enterica* serovar Typhimurium, *Escherichia coli* O157:H7, *Listeria innocua*, and *Enterococcus faecalis* was determined *in vitro*. The test compound was added to tryptic soy broth (TSB) medium in amounts to give 0, 2.5, 5, and 10 mM final concentration. Specific growth rates (h^{-1}) (n=3) were calculated by measuring optical density (A_{600}). The growth of gram negative (Typhimurium and *E. coli* O157:H7) and positive (*L. innocua* and *E. faecalis*) was largely prohibited at $\geq$ 2.5 mM 2NPOH and was completely inhibited at 10 mM 2NPOH. To determine if pH affected the bactericidal activity of 2NPOH, approximately 10^5 to 10^6 CFU per ml of Typhimurium were inoculated into TSB medium containing 0, 2.5, and 10 mM of 2NPOH and adjusted to pH 5.6, 7.2, and 8.0. After 24 h incubation at 37°C, cell numbers were reduced approximately 3 log (from 10^5 to 10^2 CFU/ml) at 2.5 mM 2NPOH at pH 5.6 but not at pH 7.2 or 8.0. However, Typhimurium was completely inactivated (>5 log reductions) at 10 mM 2NPOH regardless of pH. To evaluate the bactericidal effect of 2NPOH against Typhimurium in buffered rumen and fecal fluid (pH 6.8), a novobiocin and nalidixic acid resistant Typhimurium strain was inoculated into these mixtures supplemented with 0, 2.5, 10 mM 2NPOH and incubated at 37°C under CO_2. The populations were monitored at different times (0, 3, 6, and 24 h). After 24 h, mean $\pm$ SD populations (log CFU/ml) of Typhimurium were reduced significantly ($P<0.05$) in both ruminal and fecal fluid containing 2NPOH at 10 mM concentration compared to controls (0.55 $\pm$ 0.64 vs 2.65 $\pm$ 0.06 and 0.1 $\pm$ 0.00 vs 2.80 $\pm$ 0.28, respectively). The results obtained in this study indicate that 2NPOH has bactericidal activity against *Salmonella*, *E. coli* O157:H7, *L. innocua*, and *E. faecalis*, and potentially could be developed as an antimicrobial supplement.

Key Words: 2-Nitropropanol, Bactericidal, Foodborne pathogens

528 Origanox as a natural ingredient to inhibit the growth of foodborne pathogens. S. A. Ibrahim*, *North Carolina A&T State University, Greensboro, NC*.

The Pathogen Reduction Program of the U.S. Department of Agriculture Food Safety and Inspection Service recommends that natural antimicrobial treatments such as herb extracts be included to reduce or inactivate food borne pathogens. Origanox (OX) is a common herb extract that has been used as a functional ingredient in foods, but has not been extensively examined as a possible antimicrobial agent. The objective of this study was to evaluate the effect of OX on the survival and growth of *Escherichia coli* O157:H7, *Salmonella typhimurium* (ATCC 14208) and *Salmonella agona* (H 6115 and F 5567). *E. coli* O157:H7 and *Salmonella* grown separately in Tryptic soy broth (TSB) at 37C for 24 h, were inoculated (final inoculum level of 2 log/ml) into TSB containing OX with different concentrations of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0%. Samples were then incubated at 37°C for eight h. Samples were withdrawn every two h during the incubation period and surface plated on EMB agar and XLD agar for conducting enumeration counts of *E. coli* and *Salmonella*, respectively. Results showed that the addition of 0.2% OX significantly inhibited the growth of pathogenic bacteria when compared to control samples. During the eight h storage period, populations of bacteria increased by 7.0 log CFU/ml in control samples while bacterial populations in samples with the addition of 0.1% OX increased by 2.2 log CFU/ml. When appropriate dilution of microbial suspension was surface plated on Tryptic soy agar supplemented with 0.1% OX, at least 2-log reduction in the microbial population was observed. These results indicated the potential applicability of OX as antimicrobial agent for increasing the biosafety of many consumable food products.

Key Words: Origanox, *Escherichia coli* O157:H7, *Salmonella typhimurium*

529 Experimental chlorate product treatment reduces *Salmonella* populations in swine during lairage. T. R. Callaway*[1], R. C. Anderson[1], T. S. Edrington[1], K. J. Genovese[1], C. H. Stahl[2], Y. S. Jung[1], K. M. Bischoff[1], T. L. Poole[1], R. B. Harvey[1], and D. J. Nisbet[1], [1]*USDA-ARS, Food and Feed Safety Research Unit, College Station, TX,* [2]*Iowa 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 10^3 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

530 Vermont Cattle Health Improvement Project. C.A. Rossiter-Burhans*[1], J.W. Barlow[2], and T.E. Johnson[3], [1]*Poulin Grain Inc., Newport, VT,* [2]*University of Vermont, Burlington, VT,* [3]*Vermont 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

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 a-lactalbumin (a-LA) gene were developed. The a-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 a-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 overal piglet body weight, or intestinal weight and length was observed. However, piglets suckling IGF-I transgenic sows had greater intestinal mucosal weight 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