

707 Strategies to reduce *Campylobacter*. Norman J. Stern^{*1}, E. A. Svetoch², B. V. Eruslanov², Y. N. Kovalev², L. I. Volodina², V. V. Perelygin², E. V. Mitsevich², I. P. Mitsevich², V. D. Pokhilenko², V. N. Borzenkov², V. P. Levchuk², O. E. Svetoch², and T. Y. Kudriavtseva², ¹USDA-ARS-Russell Research Center, Athens, GA, ²State Research Center for Applied Microbiology, Obolensk, Russia.

We evaluated anti-*Campylobacter* activity among 11,790 isolates of lactic acid bacteria from poultry production environments. We measured zones of *C. jejuni* inhibition surrounding the candidate strains and observed 279 isolates exhibiting antagonism. A *Lactobacillus salivarius* strain PVD32, was identified and deposited under provisions of the Budapest Treaty (NRRL B-30514). The cell-free, ammonium sulfate precipitate from the culture was termed the crude antimicrobial preparation (CAP). A zone of *C. jejuni* growth inhibition surrounding 10 ul of the CAP was observed. *C. jejuni* growth resumed when the CAP was pre-incubated with protease enzymes, thus demonstrating the peptide characteristic consistent with bacteriocin definition. The bacteriocin was further purified using a combination of ammonium sulfate precipitation, CM-Sepharose, Superose, and ion exchange chromatography. SDS-PAGE electrophoresis provided an estimated molecular weight of 6 KDa. MALDI-TOF analysis refined the molecular weight as 5,123 Da. The isoelectric point of the active fraction was determined at a pH of 9.0. The amino acid sequence of the bacteriocin was determined. The bacteriocin activity was stable following exposure to 90°C for 15 minutes. The moiety was purified and encapsulated in polyvinylpyrrolidone (PVP), and added to feed at levels of 250 mg/Kg feed. Day of hatch chicks were colonized with *C. jejuni*; log 10 cfu/gm feces mean levels in untreated, 7-day old control chicks was 6.21, while birds provided bacteriocin in feed 3 days prior to sampling was 1.98; untreated, 10-day old control chicks were colonized at a means of 8.99 and treated birds were colonized at 0.61. Among an additional 14 trials, comprised of 290 chickens, of varying ages, with varying amounts of bacteriocin administered, and challenge strains of *C. jejuni*, we consistently observed at least a one-million fold reduction in cecal levels among treated birds. The bacteriocin from this *L. salivarius* appears useful to control *C. jejuni* in poultry.

Key Words: *Campylobacter*, Poultry, Bacteriocin Therapy

708 Strategies to reduce *Clostridium perfringens*. G. R. Siragusa^{*}, Agricultural Research Service, USDA Russell Research Center, Athens, GA.

In the context of poultry production, *Clostridium perfringens* (*Cp*) represents both a potential food borne pathogen as well as a significant poultry disease. As a human food borne disease agent, this spore forming pathogen has accounted annually for over 248,000 total cases of food borne disease in the United States alone. As illnesses caused by this pathogen are not part of an active surveillance program in the U.S., the aforementioned figure is estimated to be a tenfold under reporting. Within the context of production, *C. perfringens* necrotic enteritis (NE) is a peracute disease associated with predisposing factors including coccidial infections, feed types and environmental stresses. Complete withdrawal of antibiotic growth promoters from feed is one factor strongly associated with NE. This presentation will present newly initiated research to both develop alternatives to antibiotics to control *Cp* in the live bird but also research into our current understanding of gut microbial ecology preceding this disorder. Our lab has been successful in isolating a number of bacteriophage lytic for *Cp*. These virions display a highly narrow spectrum of activity against different *Cp* strains however; it is noteworthy that they show a high level of variation in plaque morphology. Work is ongoing to isolate, purify and clone the phage lytic enzyme responsible for the lysis activity and for potential use as either a therapeutic or prophylactic agent in live production. Work is also underway to identify and characterize bacteriocins for the purposes of *Cp* control. This effort has so far resulted in strains of *Cp* which produce bacteriocins against other non-producing strains. The quantitative profiling of the gut flora during growout is a goal so far achievable only on a small sample basis. Work is underway to develop sets of tools based on non-cultural methodology that can be applied to large numbers of samples thereby enhancing the diagnostic and accuracy of a general gut microbial profile. Results from other antibiotic alternative strategies to control *Cp*, e.g. sodium chlorate, as well as a review of the potential role of quorum sensing in gut modulation of specific pathogens will be presented.

Key Words: *Clostridium perfringens*, Lytic Bacteriophage, Bacteriocins

Women and Minority Issues in Animal Agriculture Symposium

709 Gender and animal agriculture. C. Sachs^{*}, Rural Sociology and Women's Studies, Penn State University, University Park.

Women have become increasingly involved in agriculture in the U.S. in recent years. More women are farming on their own, while others are more involved in decision-making with their spouses or other agricultural partners. Women farmers are more likely to be involved in animal agriculture than in crop production. Also, women on farms extensively participate in farm tasks and decision-making related to livestock. This paper will use data from a national survey of 2,661 farm women collected in 2001 to understand the extent of women's involvement in farm tasks, farm decision-making, and off-farm work. This study will report differences in women's involvement in tasks and decision making in livestock production by type of farm, type of livestock, sociodemographic characteristics of farm women, and region.

710 A respect for the land. A. J. King^{*}, University of California - Davis.

Historically, Japanese, Chinese and Mexican Americans have made valuable contributions to farming in the West. Today, many Hmong families

have leased lots of a few acres in Washington and California to raise specialty crops that are sold at local farmers markets. There are also populations of East Indians growing several different types of row and fruit crops in Northern California. The number of African American farmers is significant when focusing on the West and the Midwest. Minority groups (African Americans, American Indians, Chinese, East Indians, Hispanics, Hmong, Japanese, Laotians and women) who choose farming as careers continue to face obstacles while contributing in several ways to the ample and diverse food supply produced in the Western United States. What are these obstacles, their similarities and differences? What unique contributions have been made to farming processes and distribution related specifically to animal agriculture? How are minority farmers redefining the profile of animal agriculture and engagement by grassroots organizations?

Key Words: Minority Farmers, Animal Agriculture, Obstacles and Contributions

Animal Health - Growth and Immunity

711 Preliminary evaluation of the efficacy of halofuginone lactate (Halocur[®]) as an aid in the prevention of cryptosporidiosis in Ontario dairy calves. B. D. Jarvie, K. E. Leslie^{*}, A. S. Peregrine, T. F. Duffield, and J. Scott Weese, University of Guelph, Guelph, ON, Canada.

Cryptosporidium parvum is a common cause of diarrhea in neonatal calves. The incidence of shedding of *C. parvum* and clinical disease is

high on many dairy farms. There are currently no approved products in North America for the prevention of cryptosporidiosis. In Europe, halofuginone lactate (Halocur[®]) is marketed for the prevention of cryptosporidiosis. The objective of this study is to evaluate the efficacy of halofuginone lactate as an aid in the prevention of cryptosporidiosis in dairy calves. Commercial dairy farms participated in this study from February to July 2003. A total of 509 replacement heifer calves from 24 farms were enrolled and randomly assigned to one of two groups.

The treatment group received 5 mg of halofuginone lactate orally once daily for the first seven days of life. The control group received an equal volume of 10 ml of a placebo solution, administered in an identical manner. Fecal samples were collected from 305 calves on a weekly basis for the first three weeks of life at 3 to 9 days, 10 to 16 days, and 17 to 23 days of age. Fecal samples were collected from another 202 calves once between 14 and 21 days of age. Feces were analyzed for the presence or absence of *C. parvum* oocysts using sucrose flotation and microscopy. The prevalence of isolation was significantly ($p < 0.05$) reduced in halofuginone lactate-treated calves (39%) as compared to placebo-treated calves (50%). In the subset of calves sampled for three consecutive weeks, there were significant ($p < 0.05$) differences between treatment groups in the incidence of *C. parvum* detection during the three weeks of the study. In the overall study population, halofuginone lactate treatment resulted in a significant decrease in mortality up to three weeks of age ($p < 0.05$). In summary, halofuginone lactate has considerable promise as an aid in the prevention of *C. parvum* isolation in Ontario dairy calves.

Key Words: *Cryptosporidium parvum*, Halofuginone Lactate (Halocur[®]), calf Diarrhea

712 A yeast cell-wall derivative and ascorbic acid fed to neonatal dairy calves is protective against enteric challenge with *Salmonella dublin*. D. C. Cary¹, S. D. Eicher², J. A. Patterson¹, and T. A. Johnson¹, ¹Purdue University, West Lafayette, IN, ²USDA-ARS, West Lafayette, IN.

Salmonella dublin frequently causes morbidity and mortality in dairy calves during the first weeks of life. The objective of this study was to examine the efficacy of beta-glucan and ascorbic acid for protection against a *S. dublin* challenge. Thirty-eight bull calves, 3 to 10 days of age, were transported for 4 h, then placed into one of three treatment groups: Immuno-gain, a product containing 2% beta-glucan and ascorbic acid (IG); a purified beta-glucan plus ascorbic acid (BG); and a control (CTL). On day 21, all calves received an oral challenge of 4.28×10^8 CFU *S. dublin*. BW were recorded post-d 0 transport, pre-challenge (d 21), and pre-d 42 transport. Weekly wither heights, feed intake, temperature, average fecal scores, and fecal shedding of *Salmonella* were recorded. Temperatures were taken twice daily, for one week after the challenge. All calves began the study positive for *Salmonella* (non-*S. dublin*). By day 14, shedding of *Salmonella* by BG calves had decreased compared to IG ($P < .05$) and CTL ($P = .15$). Shedding was negligible at the time of *S. dublin* challenge. All groups increased shedding after challenge, with no difference among groups. All calves were negative for fecal *Salmonella* by d 42. BG temperatures peaked at 96 h through 120 h, IG temperatures peaked at 72 h, and CTL temperatures showed a bimodal peak, at 48 and 96 h. At 48 h, the CTL with temperatures higher than 40C (normal=39C) tended to be more than IG ($P = .12$). Mortality tended to be lower ($P < .10$) in IG than BG prior to challenge (8%,36%), and lower ($P < .10$) than BG and CTL after challenge (8%,36%,17%, respectively). There were no significant differences in growth measures of weight or height. Feed efficiency (weight gain/feed intake) was significantly higher in IG than BG ($P < .01$) and CTL ($P < .01$) prior to *S. dublin* challenge on d 21. There was no difference in final feed efficiency. Results indicate that ascorbic acid plus yeast cell wall derivatives containing beta-glucan may provide protection during enteric challenge.

Key Words: *Salmonella dublin*, Beta-Glucan, Ascorbic Acid

713 Dietary protein and energy and the adaptive immune response of milk replacer-fed dairy calves. M. R. Foote¹, B. J. Nonnecke², W. R. Waters², M. V. Palmer², M. A. Fowler³, B. L. Miller⁴, and D. C. Beitz¹, ¹Iowa State University, Ames, IA, ²National Animal Disease Center, ARS, USDA, Ames, IA, ³Land O'Lakes, Inc., St. Paul, MN, ⁴Land O'Lakes, Inc., Webster City, IA.

We have shown previously that increased protein and energy affect specific aspects of immune function. Effects of enhanced nutrient availability on adaptive immune responses, however, have not been studied. Using a *Mycobacterium bovis*, Bacille Calmette-Guerin (BCG) sensitization/purified protein derivative (PPD) challenge model, we have shown that neonatal calves, relative to adult cattle, have robust cell-mediated immune responses and weak antibody responses to antigen. The present study examined the effects of increased protein and energy provided by a commercial, intensified milk replacer on the adaptive (i.e. antigen-specific) immune response of the calf. Holstein bull calves were fed a

standard (ST, 0.57 kg/d of a 22% CP, 20% F milk replacer, n=11) or intensified (IN, 1.14 kg/d of a 28% CP, 20% F milk replacer, n=11) diet from 1 to 7 wk of age. Calves were vaccinated with BCG at the initiation of the study (i.e. approximately 1 wk of age). Average daily gain was greater ($P < 0.0001$) for IN (0.62 kg) than ST (0.29 kg) calves. Liver, thymus, and subcervical lymph nodes from IN calves were heavier ($P < 0.05$) than ST calves. Total leukocyte numbers, serum IgG, IgM, and IgA levels and cutaneous reactions to antigen were affected by age but not by nutrition. Mitogen-stimulated blood mononuclear cells (PBMC) from IN calves produced less ($P < 0.05$) IFN- γ and more ($P < 0.05$) NO than PBMC from ST calves 5 wk after vaccination, as reported previously. Antigen-induced IFN- γ and NO production by PBMC, however, were unaffected ($P > 0.05$) by nutritional plane. TNF- α production of non-stimulated and PPD-stimulated PBMC from IN calves was decreased ($P < 0.05$) relative to responses of cells from ST calves 5 wk after vaccination. These results suggest that antigen-specific responses of vaccinated calves are affected minimally by feeding an intensified milk replacer that is available commercially.

Key Words: Calf, Nutrition, Immune Function

714 Pro- and anti-inflammatory cytokine responses in endotoxin challenged bovine macrophages. J. A. Mills^{*}, J. E. Campanicki, and R. M. Dyer, Department of Animal and Food Sciences, University of Delaware, Newark.

Endotoxin (LPS) induced inflammatory responses are a complex process mediated by a number of cytokines. A balance of pro-inflammatory and anti-inflammatory cytokines during endotoxin exposure avoids over production of pro-inflammatory cytokines and the resultant widespread tissue damage and dysfunction of the microcirculation. Accordingly, we proposed bovine macrophages respond to LPS by expressing both pro- and anti-inflammatory cytokines. Bovine alveolar macrophages (n=3) were challenged with LPS (1mg/ml) (*E. coli*: O111:B4) and mRNA expression for IL-1 α , IL-1 β , TNF α , IL-10, IL-12, IL-18, TGF β and iNOS was determined by real time QPCR at 1.5, 12, 24 and 36h. Expression of all cytokines and iNOS increased post LPS challenge ($P < 0.05$). IL-1 α , IL-1 β , TNF α and iNOS expression peaked in LPS exposed cells at levels 11.3, 19.7, 6.5 and 11.3 fold higher ($P < 0.05$) than unexposed cells after 24h. By 36h, levels of TNF α and iNOS expression in LPS exposed cells decreased 6.5 and 3.5 fold below ($P < 0.05$) unexposed cells while IL-1 α and IL-1 β remained elevated 2.5 and 9.8 fold above unexposed cells ($P < 0.07$). IL-10 and IL-12 expression peaked to levels 6.1 and 24.3 fold higher ($P < 0.05$) in LPS exposed cells compared to levels in unchallenged cells after 1.5h. By 36h, IL-10 expression significantly decreased to a level 2.8 fold lower ($P < 0.05$) than unexposed cells. TGF β expression peaked ($P < 0.05$) at levels 2.6 fold above those in unexposed cells after 12h; however, decreased 2.1 fold below levels in unexposed cells by 36h. The data indicated LPS activated expression of a mixed pro- and anti-inflammatory cytokine response in bovine macrophages. The early mixed response entailed expression of the pro-inflammatory cytokines IL-1 α , IL-1 β and IL-12 and the anti-inflammatory cytokine IL-10. Later, the mixed responses lead to expression of the pro-inflammatory cytokines IL-1 α , IL-1 β and TNF α and the anti-inflammatory cytokine, TGF β . Expression of IL-1 α and IL-1 β was sustained throughout the LPS challenge while expression of all other cytokines and iNOS was depressed below levels in unexposed cells by 36h.

Key Words: Cytokines, Endotoxin, Alveolar Macrophages

715 Are polymorphisms within the interleukin-8 receptor (CXCR2) gene linked to altered neutrophil function? G. M. Pighetti^{*}, M. Rambeaud, S. M. Youngerman, and A. M. Saxton, The University of Tennessee, Knoxville.

Recent work within our lab has identified three single nucleotide polymorphisms (SNP 1, 3, and 5) within the CXCR2 gene that are associated with subclinical mastitis. However, mechanisms contributing to this change in susceptibility are unknown. As neutrophils express high levels of CXCR2 and are necessary for resolving infections, the objective of this study was to determine the association between neutrophil functional activity and CXCR2 polymorphisms. Neutrophils from 20 lactating Jersey cows were evaluated for adhesion molecule expression and chemotaxis. Baseline expression of CD11 and CD18 tended to be lower for cows with the less common SNP3 (GC) genotype when compared to the more common GG genotype. This same trend was evident

following activation with interleukin (IL)-8. Whereas stimulation with zymosan-activated sera (ZAS) resulted in significantly elevated CD11 and CD18 expression by neutrophils with GC genotypes when compared to GG genotypes ($P < 0.05$). In contrast to CD11 and CD18, baseline expression of CD62 was significantly greater in neutrophils with the GC genotype when compared to the GG genotype ($P < 0.02$). This difference was still apparent after downregulation of CD62 induced by IL-8, but not ZAS. Not only were differences observed with respect to adhesion molecule expression, neutrophil migration also was significantly reduced with the GC genotype at SNP3 when compared to the GG genotype following stimulation with ZAS ($P < 0.04$). A similar trend was observed following stimulation with IL-8 ($P = 0.17$). Neutrophils from cows with AG genotype at SNP5 performed similarly to those with genotype GC at SNP3 in all measured parameters. However, only CD62 expression was comparable between neutrophils from cows with the AG genotype at SNP1 relative to those with the GC genotype at SNP3. This work provides preliminary evidence of an association between neutrophil function and CXCR2 polymorphisms and suggests a potential mechanism for increased rates of mastitis observed in cows with specific genotypes.

Key Words: Neutrophil, Polymorphism, Mastitis

716 Restoration of normal innate immune function in immunosuppressed sheep with OmniGen-AF: a nutritional product. Y. Wang, S. B. Puntney, and N. E. Forsberg*, Department of Animal Sciences, Oregon State University, Corvallis, OR.

The goal of this research was to investigate effects of a nutritional product (OmniGen-AF) on innate immune function in immunosuppressed sheep. Sixty growing sheep were allotted to five treatments consisting of 1: Control, 2: immunosuppressed via daily injection of Dexamethasone ([Azium] 0.1 mg/kg BW/head, twice/day), 3: immunosuppressed plus OmniGen-AF (0.5% of dry matter intake), 4: immunosuppressed plus a challenge of feed-borne mold (*Aspergillus fumigatus*) and 5: immunosuppressed plus addition of moldy feed and OmniGen-AF. Sheep were provided a "dairy diet" consisting of alfalfa, corn and soybean meal for 28 days. On Day 28, blood samples were taken from six sheep on each treatment and neutrophils were purified using a Ficoll gradient. Neutrophil proteins were processed on SDS-PAGE after which concentrations of L-selectin (a neutrophil adhesion molecule which serves as a marker for innate immune function) and interleukin-1beta (IL-1B: a pro-inflammatory cytokine) were assessed using Western blot analysis. L-selectin and IL-1B concentrations were markedly reduced ($P < 0.05$) in dexamethasone-treated sheep. These observations indicate that dexamethasone effectively repressed immune function and that we had an adequate model of immunosuppression to study effects of the nutritional product. Addition of the nutritional product to Treatment 3 increased L-selectin concentration but had no effect on IL-1B. Addition of *A. fumigatus* to Treatment 4 had no effect on either L-selectin or IL-1B. However, the presence of the nutritional product (OmniGen-AF) in Treatment 5 restored ($P < 0.05$) normal concentrations of both L-selectin and IL-1B. These observations demonstrate efficacy of dexamethasone in immunosuppression and of OmniGen-AF in restoring immune function in immunosuppressed/stressed animals. The presence of a pathogen potentiated the actions of OmniGen-AF on immune function.

Key Words: Immunity, L-Selectin, Interleukin-Lbeta

717 Dietary supplementation of lipoic acid and its effect on circulating metabolic hormones and acute phase proteins of virus-challenged beef steers. T. B. Schmidt*, E. P. Berg¹, E. M. Cochran², J. J. Garcia², S. B. Kleiboeker¹, R. Larson¹, C. W. Morgan², C. D. Grager², J. A. Carroll³, D. H. Keisler¹, K. C. Olson¹, G. Rentfrow¹, and M. S. Brown², ¹University of Missouri-Columbia, ²West Texas A&M University, Canyon, TX, ³Animal Physiology Research Unit, Agricultural Research Service.

Thirty-two, virus-challenged crossbred steers were used to determine if dietary supplementation of lipoic acid (LA) modulates circulating metabolic hormones and acute phase proteins. Steers (BW=308+27kg) were randomly assigned to control (CON), 16mg of LA/kg of BW (LA16), 32 mg of LA/kg of BW (LA32), and negative control (NEG) treatments. Steers were adapted to treatment and environment for 21 d. On d 22, blood samples, nasal swabs, BW, DMI, and rectal temperature were recorded. Control, LA16, and LA32 steers received an intranasal dose of 2 mL/nostril of infectious bovine respiratory virus (Cooper stain, 1 X 10⁶-7 PFU); NEG received 2mL of saline/nostril. Blood samples,

nasal swabs, BW, DMI, and rectal temperatures were collected on 23, 25, 27, 29, 36, and 43 d. Serum samples were analyzed for haptoglobin, amyloid-A, leptin, insulin, and serum-neutralization titer levels. Prior to challenge, DMI (% of BW) was similar among treatments. Seven and 14 d post-challenge, DMI was higher ($P < 0.05$) for LA32 than CON and LA16 (1.35%-7 d; 1.88%-14 d vs. 0.95%-7 d; 1.77%-14 d, and 0.95%-7 d; 1.67%-14 d, respectively), but all treatment groups experienced BW loss during this time. However, LA32 began gaining BW by d 29 (+5.15 kg from previous BW; $P < 0.001$), while NEG, CON, and LA16 to decline (-3.45, -1.59, and -1.42 kg from previous BW, respectively). Haptoglobin concentrations were similar before the challenge (0.147, 0.133, 0.121, and 0.128 ng/mL for CON, LA16, LA32, and NEG, respectively). On d 27, LA32 had lower ($P < 0.04$) serum haptoglobin than CON (0.311 vs. 0.592 ng/mL), and lower than both CON and LA16 on d 29. Haptoglobin concentrations were at or below pre-challenge concentrations by d 36. Serum-neutralization titers for 30/32 steers were negative on d 22. However, all animals were positive for IBRV antibodies by d 43. The geometric mean titer for CON, LA16, LA32, and NEG were similar ($2^{4.29}$, $2^{5.13}$, $2^{5.13}$, and $2^{4.50}$, respectively). Supplementation of LA at 32 mg/kg of BW provides additional protection to steers facing a viral challenge associated with respiratory disease.

Key Words: Immune Response, Antioxidants, Lipoic Acid

718 Colicins E1 and N are effective against *Escherichia coli* strains responsible for post-weaning diarrhea and edema disease in swine. C. H. Stahl*, T. R. Callaway², L. M. Lincoln¹, S. M. Lonergan¹, and K. J. Genovese², ¹Department of Animal Sciences, Iowa State University, Ames, ²USDA-ARS Food and Feed Safety Research Unit, College Station, TX.

Escherichia coli infections causing post-weaning diarrhea and edema disease are one of the most prevalent disease problems in swine in the U.S. More than 43% of the large swine facilities in the U.S. reported *E. coli* infections among weaned pigs in 2000 and in an attempt to prevent the spread of these infections more than 78% of these facilities reported using prophylactic antibiotic treatments. The strains considered primarily responsible for these infections, F4 (K88) and F18, are not well controlled by traditional prophylactic antibiotic treatments, and with worldwide concern over the use of prophylactic antibiotics in animal agriculture, the development of alternatives to conventional antibiotics is urgently needed to protect swine from these *E. coli* infections. Colicins have been shown effective against other pathogenic *E. coli* strains, but their efficacy against the *E. coli* strains responsible for post-weaning diarrhea and edema disease has not been examined. The efficacy of two pore-forming colicins, E1 and N, against *E. coli* F4 (K88) and F18 were determined quantitatively in vitro. Colicin E1 and N were expressed by native producers and purified by ion exchange chromatography. The purified colicins were quantified and used in growth inhibition dose-response studies against *E. coli* F4 (K88) and F18. Both colicins were effective against both strains of *E. coli*, however their efficacy varied greatly. Colicin E1 was more effective against F18 than F4 (K88) ($P < .01$), requiring approximately 1 $\mu\text{g/mL}$ of culture to completely inhibit the growth of F18 and an approximately 50 $\mu\text{g/mL}$ to inhibit the growth of F4 (K88). Colicin N was less effective than Colicin E1 against *E. coli* F18 ($P < .01$), requiring fifty fold higher concentrations in order to achieve the same level of growth inhibition, but more effective against the F4 (K88) strain ($P < .01$), requiring only half the concentration of Colicin E1 to obtain the same growth inhibition. These antimicrobial peptides may provide an effective and environmentally sound method to prevent post-weaning diarrhea and edema disease in swine.

Key Words: Colicin, Antibiotic Alternatives, Post-Weaning Diarrhea

719 Infectious dose of young pigs experimentally inoculated with PRRS virus by oral and intranasal routes. J. R. Hermann*, M. Kaiser¹, M. Roof², K. Burkhardt², and J. J. Zimmerman¹, ¹Iowa State University, Ames, IA, ²Boehringer Ingelheim, Ames, IA.

Prevention and control of PRRS virus requires an understanding of transmission in the field. Current reports in the literature suggest that swine are susceptible to PRRS virus by several exposure routes, including intranasal, intramuscular, and oral. The infectious dose by either intranasal or intramuscular routes is known to be very low. Infection of swine via oral exposure has been reported, but the minimum infectious dose has not been estimated. Thus, data on the specific exposure dose

necessary for infection is needed to assess the likelihood of transmission by oral exposure in the field. This study was designed to estimate the probability that a specific oral dose of PRRS virus would result in infection. The experiment was conducted as a randomized block design in which individually housed 19 - 24 day old pigs were orally exposed to a specific dose (titer) of PRRS virus (2 to 7 logs TCID₅₀). Each replicate consisted of 10 animals: 4 treatment levels of PRRS virus (run in duplicate), plus positive and negative control animals. To test a volume effect, treatment doses were administered in either 10 ml or 100 ml volumes. Animals were bled on days -7, 0, 7, 14, 21 and serum samples tested for evidence of PRRS virus infection by virological and serological assays to determine whether exposure resulted in infection. The pig was considered the experimental unit. The primary outcome for this study is binary, i.e., pigs become infected or not. The resulting probabilities at each dose were used to construct and infectious dose curve using a single hit model based formula. The estimated infectious dose₅₀ (ID₅₀) of young healthy pigs is 10⁵ TCID₅₀. However an oral treatment dose of 10³ TCID₅₀ were sufficient to cause infection in young swine. No differences existed between antibody levels by route or dose of exposure.

Key Words: PRRS Virus, Swine, Oral

Beef Species: Enhancing Energetic Efficiency

721 Growing program effects on efficiency of energy use by feedlot cattle. C. R. Krehbiel*, M. P. McCurdy, and G. W. Horn, *Oklahoma State University, Stillwater.*

Maintenance energy requirements can account for more than half of the ME intake by beef cattle. It is generally accepted that ADG and efficiency during finishing are directly related to plane of nutrition and energy density of the diet during the growing phase. Steers that are fed for high ADG during the growing phase accrete a greater percentage of their BW gain as fat than restricted steers, and contain more fat upon feedlot entry. Restricted steers have greater protein content as a percentage of BW, and are generally considered to have a lower NE_g requirement. Cattle that have had greater rates of BW gain during the growing phase are generally assumed to be less efficient and have decreased gains during the finishing phase. This concept is consistent with the 1996 Beef Cattle NRC Level 1 Model, which shows a negative correlation between predicted ME allowable ADG and initial body fat content. In contrast, recent literature has reported that cattle subjected to greater ADG during the growing phase might not always experience lower ADG or gain efficiency during the finishing phase. Reasons for discrepancies are not fully understood. Changes in visceral organ mass might change the amount of nutrients available for growth. Several authors have observed that when ME intake was restricted, mass of the gastrointestinal tract (GIT) was similar or decreased compared with animals fed above maintenance or ad libitum. In contrast, ruminants restricted by energy density of the diet have greater GIT mass as a percentage of BW. The GIT appears to respond to physical form of the diet and fiber content, which could increase NE_m requirements during finishing. Investigation into gain and efficiency of feedlot cattle must provide a complete picture of nutritional management through all production segments due to the number of potential factors that may determine performance in the feedlot. A comprehensive understanding of animal biology will allow us to enhance efficiency of beef production systems, and improve end-product quality.

Key Words: Cattle, Energetic Efficiency, Gastrointestinal Tract

720 A deterministic risk assessment of macrolide use in swine. A. G Mathew*¹, H. S. Hurd², S. Doores³, D. Hayes⁴, J. Maurer⁵, P. Silley⁶, R. N. Jones⁷, and R. Singer⁸, ¹University of Tennessee, Knoxville, ²Hurd-Health Consulting, Roland, IA, ³Pennsylvania State University, University Park, ⁴Iowa State University, Ames, ⁵University of Georgia, Athens, ⁶MB Consult Limited, Bingley, West Yorkshire, UK, ⁷The JONES Group/JMI Laboratories, North Liberty, IA, ⁸University of Minnesota, St. Paul.

To quantify risks stemming from antibiotic-resistant bacteria as a possible consequence of macrolide antibiotic use in swine, a farm-to-patient deterministic risk assessment was formulated using extensive scientific and government numerical data. The model was developed based on the US FDA Center for Veterinary Medicine Guidance Document 152, which advises veterinary drug sponsors of one potential process for conducting a qualitative risk assessment of drug use in food animals. The scope of modeling included all label claim uses of both antibiotics in U.S. swine production, including therapeutic, disease prevention, disease control, and growth promotion, as indicated by CVM-approved label claims for swine. The defined hazard was illness caused by a food-borne bacterium with a resistance genetic element(s), attributed to pork, and treated with a human-use macrolide drug. Risk was defined as the probability of this hazard combined with the consequence of treatment failure due to resistant *Campylobacter spp.* or *Enterococcus faecium*. A binomial fault tree model was applied to estimate this annual risk for the general US population. This risk assessment demonstrated that use of tylosin and tilmicosin in swine present a very low risk, with an approximate annual probability of less than 1 in 53 million *Campylobacter spp.*-derived and less than 1 in 27 billion *Enterococcus faecium*-derived risks.

Key Words: Macrolide, Antibiotic Resistance, Risk Assessment

722 Nutrition *in utero* and pre-weaning has long-term consequences for growth and size of Piedmontese- and Wagyu-sired steers. P. L. Greenwood*^{1,2}, H. Hearnshaw^{1,3}, L. M. Cafe^{1,3}, D. W. Hennessy^{1,3}, and G. S. Harper^{1,4}, ¹CRC for Cattle and Beef Quality, Armidale, NSW, Australia, ²NSW Agriculture, Armidale, NSW, Australia, ³NSW Agriculture, Grafton, NSW, Australia, ⁴CSIRO Livestock Industries, St. Lucia, QLD, Australia.

Piedmontese (PxH) and Wagyu (WxH) x Hereford steers were selected for divergence in birth weight (PxH, Low mean±SEM 31.4±0.8 and High 42.1±0.9 kg; WxH, Low 27.4±0.7 and High 36.7±0.6 kg) and pre-weaning growth following high (irrigated improved temperate pastures) or low (sub-tropical native pastures) nutrition during pregnancy and either high or low nutrition from birth to weaning. Steers were weaned at 7 months of age and grown on improved temperate pastures, with supplementation as required to maintain growth, to 26 months of age when they entered a feedlot for 105 days prior to slaughter. Steers from dams nutritionally restricted during gestation and/or steers nutritionally restricted from birth to weaning had lower live and carcass weights compared to their high birth weight plus high pre-weaning nutrition (HH) counterparts at 30 months of age, this being most evident in the low birth weight plus low pre-weaning nutrition (LL) steers. These results support the notion that nutritional restriction early in life limits capacity to compensate when adequate nutriment is restored. However, retail yield on a carcass weight-specific basis was greater in the LL steers compared to their HH counterparts. This finding, and the lack of nutritional effects on indices of carcass fatness beyond those attributable to differences in body weight of these animals, does not support the notion that increased fatness later in life is a consequence of nutritional restriction early in life. We conclude that nutrition early in life has long-term consequences for growth and size of steers at any given age to 30 months.

Table. Performance of Piedmontese (PxH) and Wagyu (WxH) x Hereford steers with divergent birth weight and pre-weaning growth as a result of high or low nutrition *in utero* and pre-weaning (HH, LH, HL, LL).