

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

Key Words: Carnitine, Fat, Weanling pigs

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

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

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

Key Words: Carnitine, Weanling pigs, Accretion

ASAS/ADSA Animal Health: Dairy

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

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

Key Words: Mastitis, Linear Score, Genetics

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

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

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

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

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

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

each fore quarter and the rear quarters every .5 h for 2 h before and after each milking on all 9 d. A black body temperature standard was used to calibrate IR temperatures (IRT) before, amid, and after each series of images. Environmental conditions of temperature, humidity, and barometric pressure were recorded prior to collection of images to provide additional IR correction, if necessary. Rectal temperatures (RT) and bacteriological cultures were collected at scheduled days and times for mastitis detection using conventional methods. Challenged quarters were infused with cephaperine sodium for consecutive milkings upon observation of clinical mastitis, or on d 9. Three of four challenged cows developed clinical mastitis ($\chi^2=3$, $p=.08$, $DF=1$) although positive *S. aureus* cultures and elevated RT were noted only in two. Overall, patterns of IRT correlated to RT ($r=.58$, $t=52.5$, $p<.001$), but differences among quarters were apparent. IRT increases accompanied elevated somatic cell scores in challenged quarters ($r=.33$, $t=2.04$, $p<.05$), but not in other quarters ($r=-.33$, $t=-4.13$, $p<.001$). Adjustment of rolling average (12 and 24 h) RT and IRT for ambient temperatures accounted for diurnal variation. Results from this study show IRT can detect elevated temperatures associated with mastitis, but are unlikely to detect mastitis earlier or be more cost effective than existing methods.

Key Words: Mastitis, Infrared, Temperature

627 Effects of acidosis inducing diets on memory responses to viruses in Holstein steers. D. C. Donovan^{*1}, A. R. Hippen¹, and D.J. Hurley¹, ¹South Dakota State University, Brookings.

Cattle are more susceptible to infectious disease when acidotic. Susceptibility to disease is dependent on the level of infectious agent and the immune response to the agent. To evaluate the relationships between acidosis and immune responses, Holstein steers (220 +/- 43 kg) were used in a 4 x 4 Latin square examining the influence that acidosis inducing diets exert on memory responses to bovine viral diarrhea virus (BVDV), bovine respiratory syncytial virus (BRSV), parainfluenza type 3 (PI3), and bovine herpes virus (BHV-1) tested in vitro. Diets were designed to evaluate the effects of the metabolites, lactate and ketone bodies, or mineral salts in decreasing blood pH. Diets were defined as control (45% concentrate, C), high grain (100% concentrate, HG), supplemented with 1,3-butanediol (700 ml/d, BD), or anionic salts (dietary cation anion difference of -30 mEq/100 gm, AS). Data was collected on day 18 and 20 of each period. Blood pH was decreased in treated steers and the decrease was greatest in AS (7.38, 7.37, 7.32, and 7.36 for C, BD, AS, and HG, respectively; $P < 0.009$ for treatments; $P < 0.05$ for AS vs. C). Decreased T cell proliferation in response to *Staphylococcus aureus* exotoxin B was observed in treated steers (54816, 37654, 35226, and 29459 cpm for C, AS, BD, and HG; $P < 0.006$), but was not correlated to blood pH. Increased T cell memory response to BVDV stimulation was observed in treated animals (133, 2428, 1407, and 2429 cpm for C, AS, BD, and HG; $P = 0.11$), and was negatively correlated to blood pH ($r = 0.45$, $P < 0.01$). Increased T cell memory response to BRSV stimulation was observed in steers supplemented with BD (516, 244, 2051, and 336 cpm for C, AS, BD, and HG; $P = 0.06$), but was not correlated to blood pH. Memory response to PI3 tended to be increased in steers supplemented with AS (9, 174, 36, 25 for C, AS, BG, and HG; $P < 0.10$), and was strongly, negatively correlated with blood pH ($r = 0.51$, $P < 0.01$). Diets that induced an acidotic state, decreasing blood pH, had an effect on immunity. Memory of T cells was affected differentially in response to ketoacidosis and mineral acidosis. Therefore, acidosis may increase susceptibility to disease. The effects of acidosis on viral load remain to be evaluated.

Key Words: Acidosis, T Cell Memory, Virus

628 Association between retained placenta and blood interleukin-8 concentration and lack of association of retained placenta with energy and calcium metabolic profiles. Kayoko Kimura^{*1}, Jesse Goff¹, Timothy Reinhardt¹, and Shigeru Sato², ¹National Animal Disease Center, USDA-ARS, ²NOSAI Miyagi, Japan.

We previously reported that neutrophil function (chemotaxis and myeloperoxidase activity) of cows that would develop retained placenta (RP) was significantly decreased compared to neutrophil function of cows that expelled the placenta normally (No RP) (J Dairy Sci 83, Suppl. 1:3) using 142 cows (20 RP, 122 No RP cows). Why neutrophil function of cows with RP is impaired remains unknown. We

hypothesized that the metabolic state of the cow prior to calving influences neutrophil function. Using plasma obtained during the cited study, we examined the relationship between energy or calcium status during the periparturient period and the development of RP. In addition an ELISA for interleukin-8 (IL-8), a cytokine critical to neutrophil chemotaxis and activation, was performed on a subset of 8 RP and 8 No RP cows. Plasma calcium and phosphorus concentrations decreased at calving to the same extent in both RP and No RP cows. Energy status at parturition, as assessed by plasma NEFA (0.53 ± 0.14 meq in RP and 0.67 ± 0.07 meq in No RP) and -hydroxybutyrate (8.76 ± 1.74 mg/dl in RP and 12.0 ± 1.90 mg/dl in No RP) concentrations were also essentially the same in both RP and No RP cows. IL-8 concentration at calving in plasma of No RP cows (125 ± 14 pg/ml) was significantly higher than in RP cows (61 ± 15 pg/ml). It remained higher throughout the first 2 weeks of lactation as well. Fetal cotyledons were collected within 4 h of calving in a subset of 3 RP cows and 15 No RP cows for histologic evaluation. Binucleate giant cells, thought to produce placental lactogen, are reported to be present in "retained" placenta and absent in placenta that are expelled normally. Binucleate giant cells comprised 14.7% of the total epithelial cells in retained placenta and 14.2% of epithelial cells in placenta expelled normally. We are unable to confirm previous reports suggesting retention of binucleate giant cells is a cause of RP. We also could not show an association between plasma calcium or energy status at calving and retained placenta. We did find further evidence that the immune system of the cow may be involved in RP as IL-8 concentration at calving was significantly lower in cows developing RP.

Key Words: Retained placenta, Interleukin-8, Binucleate giant cell

629 Impact of leptin on in vitro cytokine production during early and mid lactation. Gina M Pighetti^{*}, University of Tennessee, Knoxville, TN USA.

The ability of leptin to regulate energy stores within the body has allowed it to evolve and help regulate other energy-dense processes such as reproduction and immunity. However, very little if any information exists regarding the consequences of leptin on bovine immune function. Therefore, the objective of the current study is to compare the in vitro responses of peripheral blood mononuclear cells isolated from both mid-to-late (ML) and periparturient (PP; within 3 days after calving) dairy cows to leptin. Increasing doses of concanavalin A (0-2 ug/ml) and/or recombinant human leptin (0-50 ng/ml) were administered to the cells 12 hours prior to collection for RNA. Interferon (IFN)- γ and interleukin (IL)-4 mRNA were measured as indicators of cellular and humoral immunity, respectively. Preliminary evidence indicates that cells isolated from PP and ML cows respond in a similar fashion to leptin, but vary as to which concentrations they respond to. Leptin approximately doubled the relative expression of IFN γ mRNA in cells from ML cows, regardless of dose. In contrast, cells from PP cows only responded to the lowest leptin dose (1 ng/ml). Little, to no IL-4 mRNA was produced in stimulated cells collected from ML lactation cows. However, costimulation with a minimum of 5 ng/ml leptin increased IL-4 mRNA to levels comparable to IFN- γ . In contrast, it required 50 ng/ml to achieve the same effect in cells from PP dairy cows. These preliminary results indicate that immune cell populations are responsive to leptin and that this response can vary with the stage of lactation. Moreover, with the fluctuations in leptin that can occur with body condition and pregnancy, it is imperative to further investigate this link between leptin, energy metabolism/storage, and immune function in order to promote better animal health.

Key Words: Immunity, Leptin, Stage of lactation

630 Serum antibody responses in Holstein cows immunized five times with J5 Bacterin. K. Smith^{*}, C. Phipps, J.L. Burton, and R.J. Erskine, Michigan State University, East Lansing, MI.

In a previous study of J5 bacterin-immunized dairy steers, we observed significantly higher and more sustained serum IgM, IgG1, and IgG2 antibody responses when animals were immunized 5 times than when they were immunized 3 times. We also showed that the hyperimmune steer serum was highly effective at promoting neutrophil phagocytosis of opsonized *E. coli in vitro*. Because of the implications of these results for improved resistance to coliform mastitis in vaccinated dairy cows, we were curious to know if five immunizations with J5 bacterin (Pharmacia

and Upjohn, Kalamazoo, MI) would elicit better antibody responses in lactating cows than the currently recommended 3-immunization protocol. Therefore, our objective was to monitor anti-J5 antibody response profiles in dry and lactating Holstein cows immunized either 3 times ($n = 5$) or 5 times ($n = 5$) with J5 bacterin. All cows received the first 3 immunizations according to manufacturer's recommendation (5 ml of bacterin administered subcutaneously at dry off, at 30 days dry, and within a few days of calving), and the 5-shot group received two additional immunizations (5 ml) at 30 and 60 days in milk. Antibody response profiles were monitored (ELISA) on the 7th day following each immunization. Results showed that 3 immunizations caused modest increases in serum anti-J5 IgM and IgG1 antibodies that persisted until 60 days in milk, but was not effective in eliciting an IgG2 antibody response. Five immunizations caused an approximately 2-fold higher IgG1 antibody response than the 3-shot protocol, and successfully elicited IgG2 isotype switching. Based on these results we conclude that 5 immunizations of J5 bacterin may be more effective than 3 immunizations in eliciting higher, more sustained humoral immunity against coliform bacteria that cause mastitis.

Key Words: Hyperimmunization, J5 Bacterin, Antibody Responses

631 Changes in the Amino Acid Ratio and Ammonia Concentration in Plasma and Cerebrospinal Fluid of Dairy Cows suffering from Hepatosteatosis and Liver Failure. J. Rehage*, C. Meier, M. Kaske, and H. Scholz, *Veterinary School of Hannover, Hannover, Germany.*

Cows with liver failure develop clinical signs of a hepatic encephalopathy (HE), such as loss of appetite, general depression, ataxia, recumbency or even coma. The pathogenesis is still unclear. The objective was to study the amino acid ratio and ammonia concentrations in plasma and cerebrospinal fluid (CSF) in German HF cows with fatty liver and HE. The study included healthy controls ($N = 19$; age: 5.8 ± 1.2 years, liver triglyceride: 19.5 ± 3.2 mg/g FW [mean \pm s]; dry), uncomplicated fatty liver cows (group FL; $N = 12$; age: 5.1 ± 1.2 years; 14.3 ± 3.2 days p.p.; liver triglyceride: 57.2 ± 19.7 mg/g FW) and 31 cows with HE (age: 5.3 ± 1.2 years; 12.3 ± 3.9 days p.p.). Mild signs of HE showed 17 cows (group HE1; no appetite, general depression, ataxia; liver triglyceride: 65.3 ± 18.9 mg/g FW) and 14 severe HE (group HE2; recumbency, coma; liver triglyceride: 78.5 ± 23.5 mg/g FW). CSF was obtained lumbally, blood samples were taken from the jugular vein for amino acids (AA) and from the auricular artery for ammonia determinations. The amino acid pattern was measured by HPLC and the amino acid ratio was calculated from the concentrations [μ mol/L] of (VAL + LEU + ILE / (PHE + TYR)), ammonia was determined on an automated analyzing system. Compared to controls and FL cows in HE cows plasma levels of branched chain amino acids (VAL, ILE, LEU) decreased considerably and those of aromatic AA (PHE, TYR) increased slightly, whereas in CSF the increase in aromatic AA levels was most prominent. The mean amino acid ratio in plasma of controls, FL cows, HE1 and in HE2 was 6.4 ± 0.5 , 6.1 ± 0.5 , 3.5 ± 0.3 , 2.9 ± 0.4 ($p < 0.01$), and in CSF 6.2 ± 0.3 , 5.5 ± 0.4 , 2.8 ± 1.0 , 3.3 ± 0.6 ($p < 0.01$), respectively. Mean ammonia concentrations [μ mol/L] in controls, FL, HE1 and HE2 in plasma were 18.9 ± 8.7 , 20.5 ± 9.5 , 50.3 ± 12.8 , 65.8 ± 14.1 ($p < 0.01$), and in CSF 7.4 ± 3.8 , 11.1 ± 6.4 , 26.8 ± 10.7 , 33.5 ± 13.2 ($p < 0.01$), respectively. Results revealed that liver function in dairy cows has as in monogastric species a substantial impact on the plasma and CSF amino acid pattern as shown by the amino acid ratio and that the occurrence of HE is correlated to ammonia concentrations in plasma and CSF.

Key Words: Dairy cows, Ammonia, Amino acids

632 Growth Responses of *Escherichia coli* to Purified Immunoglobulin G from Cows Immunized with Ferric Citrate Receptor FecA. K. Takemura*, J. S. Hogan, and K. L. Smith, *Ohio Agricultural Research and Development Center, The Ohio State University.*

The effect of purified immunoglobulin (Ig) G from cows immunized with FecA on growth of *Escherichia coli* was investigated in an in vitro assay. Twenty-one cows were assigned to one of 3 treatments: 1) FecA immunized cows, 2) *E. coli* J5 immunized cows, and 3) unimmunized control cows. Immunizations were: 1) subcutaneous injection at 14 d prior to drying off, 2) intramammary infusion at 7d after drying off, and

3) subcutaneous injection at 28 d after drying off. FecA used to immunize cows was purified from *E. coli* UT5600/pSV66 by ion exchange chromatography. Protein G affinity chromatography was used to purify IgG from pooled colostrum whey from each treatment group. The whey from FecA immunized cows had significantly higher IgG titers against FecA compared with whey from *E. coli* J5 immunized cows and control cows. Fourteen isolates of *E. coli* from the cases of naturally occurring mastitis were cultured at 37°C for 6 h under iron restricted conditions in a chemically defined medium containing $200 \mu\text{M}$ α - α' -dipyridyl and 1 mM citrate. Bacterial cells were washed and resuspended in PBS to approximately 10^3 cfu/ml. The bacterial cells were mixed with purified IgG at concentrations of 0, 2, and 4 mg/ml and incubated at 37°C . Fifty μM FeCl_3 was added to the assay containing 4 mg/ml IgG to determine the effects of exogenous iron on bacterial growth. At 0, 6, 12, and 24h incubations, samples were taken and serially diluted to culture on MacConkey agar plates. Iron restriction decreased rates of the growth, but did not reduce peak bacterial counts. The presence of IgG decreased the growth of *E. coli* under iron restricted conditions; however, the growth did not differ among IgG sources nor between IgG concentrations. The addition of exogenous iron overrode the inhibitory effects of the iron depletion and the presence of IgG, but did not restore growth of *E. coli* to that comparable in iron replete control medium.

Key Words: Mastitis, FecA, IgG

633 Opsonic activity of serum and whey from cows immunized with the *Escherichia coli* ferric citrate receptor. A.J. Wise*, J.S. Hogan¹, and K.L. Smith¹, ¹*Ohio State University, OARDC-Wooster.*

The effect of immunizing dairy cows with the ferric citrate receptor (FecA) on the opsonic activity of serum and whey was measured in a phagocytosis assay. Fifteen cows were assigned to five blocks of three cows based on date of expected parturition. Cows within a block were randomly assigned to one of three treatments: 1) FecA immunization, 2) immunization with a commercially available *Escherichia coli* J5 bacterin, and 3) unimmunized controls. Immunizations were 1) subcutaneous injections fourteen days prior to the end of lactation, 2) intramammary infusion seven days after the end of lactation, and 3) subcutaneous injection twenty-eight days after the end of lactation. Cows were challenged approximately twenty-one days after parturition by intramammary infusion of *Escherichia coli* 727, a strain previously isolated from bovine mastitis. The phagocytosis assays included opsonizing *E. coli* 727 with either 10% heat-inactivated serum or 50% heat-inactivated whey from each cow. Immunization with FecA and the commercial bacterin increased antibody titers against *E. coli* 727 compared with control cows. Cows immunized with FecA had reduced clinical signs of mastitis following challenge compared with either cows immunized with *E. coli* J5 or unimmunized controls. However, sera and whey collected from cows immunized with FecA did not enhance opsonization of *E. coli* 727 compared with sera and whey from control cows. Immunization with the commercial bacterin increased opsonization of both sera and whey greater than immunization with FecA. Results of the current trial suggest that the protective effects of immunizing cows with FecA against bacterial challenge with *E. coli* 727 does not relate to enhanced opsonization and in vitro phagocytosis.

Key Words: Mastitis, *Escherichia coli*, Ferric Citrate Receptor

634 Opsonization of *Escherichia coli* cultured in iron-replete and iron-deplete media. A.J. Wise*, J.S. Hogan¹, and K.L. Smith¹, ¹*The Ohio State University, OARDC-Wooster.*

The effects of iron availability in culture medium on the opsonization of *Escherichia coli* by bovine sera were tested in an in vitro phagocytosis assay. Fourteen isolates of *E. coli* from bovine intramammary infections were tested. Isolates were cultured 16 h in trypticase soy broth as an iron-replete environment. Isolates were cultured 16 h in trypticase soy broth plus .2 mM dipyridyl and 1 mM citrate as an iron-deplete environment. Cultures were centrifuged and cells opsonized by 5% pooled bovine serum in HBSS. Opsonized bacteria were added to neutrophils at a 2:1 bacteria:neutrophil ratio and incubated 1.5 h at 37°C . Phagocytic indices were measured by direct microscopic count of neutrophils stained with acridine orange and crystal violet. A portion of bacterial cells cultured in both iron-replete and iron-deplete media was suspended separately in 6% dextrose and stained to determine the presence of a

capsule. Phagocytic index, percentage of neutrophils containing intracellular bacteria, and average number of intracellular bacteria per positive neutrophil were each greater for bacterial cells cultured in iron-replete medium compared with bacterial cells cultured in iron-deplete medium. Bacterial isolates positive for capsule were more resistant to phagocytosis than isolates that were capsule-negative. Iron availability in culture did not affect expression of a bacterial capsule. Culturing *E. coli* in iron-deplete medium increased resistance to phagocytosis by bovine neutrophils compared with culture in iron-replete medium.

Key Words: *Escherichia coli*, Opsonization, Iron

635 Oral glycerol as an aid in the treatment of ketosis/fatty liver complex. J.P. Goff* and R.L. Horst, *USDA-ARS, National Animal Disease Center, Ames, IA.*

Glycerol can be converted to glucose in the liver of cattle. Glycerol enters the gluconeogenic pathway at the level of dihydroxyacetone phosphate and 3-phosphoglyceric aldehyde. This is several biochemical steps closer to glucose than the traditional gluconeogenic precursors, propionate and propylene glycol. Use of glycerol as an aid in the treatment of ketosis was suggested during the 1960s but not adopted due to high costs. New sources of glycerol have reduced the cost. We examined the effect of glycerol administration on blood glucose in dry cows and did a dose titration to determine the maximal tolerable dose. Treatment groups consisted of 3 cows (one of which had a rumen fistula) which were given 1, 2 or 3 L of glycerol via esophageal pump. Blood samples were taken hourly for the next 8 hrs and also at 24 hrs. At 0.5 hr after treatment mean blood glucose increased 16, 20, and 25% respectively over pretreatment values. They remained elevated for the next 8 hrs. All cows had returned to baseline glucose values at 24 hrs. Two of three cows given 3 L glycerol exhibited staggering and depression; from which they recovered from within 4 hrs. Rumen pH was unaffected by treatment with glycerol. Two lactating cows with clinical ketosis, which had been previously treated for 2 or 3 d with IV glucose with little response suggesting fatty liver involvement, were treated with 1 L glycerol. In both cases ketone level in urine was reduced to trace amounts by 24 h and milk production increased 4-6 lb. In the first cow blood glucose increased from 48 mg/dl to 75 mg/dl 0.5 hr after treatment and was 109 mg/dl 5 hr after treatment. In the second cow blood glucose did not increase until about 4 hr after treatment when it increased from 48 mg/dl to 74 mg/dl and was just 64 mg/dl 8 hr after treatment. Glycerol offers another means of treating cows for ketosis which may have less toxic effects than propylene glycol.

Key Words: glycerol, ketosis, gluconeogenic

636 Economic consequences of Johne's disease control programs on dairy herds in Pennsylvania. H. Groenendaal* and D.T. Galligan, *University of Pennsylvania, School of Veterinary Medicine, Kennett Square, PA, USA.*

A stochastic simulation model called JohneSSim has been developed to evaluate different Johne's disease control programs on their epidemiological and economic consequences. The model was applied to infected farms in the Pennsylvania dairy industry. Input data were collected from literature or obtained from experts. The results showed that none of the 'test-and-cull' strategies alone are effective in reducing the Johne's disease prevalence. 'Test-and-cull' strategies have an average benefit-costs ratio of around 0.85 (5% and 95% percentiles are respectively 0.00

and 1.30) and are therefore economically not attractive. However, improved management and hygiene for calves until 12 months of age, is much more effective in reducing the prevalence. This reduction will gradually start after 3-5 years because of the long sub-clinical period, but will result in a prevalence close to 0, after 15-20 years. In addition, the 'management improvement' strategies result in significant economic benefits. On average, the benefits increase from none (in year 1) to US dollar 11,000 in year 20 for a 100 cow dairy herd. Furthermore, 'heifer contract rearing' appeared to be an effective, simple, cheap and therefore attractive way of reducing the Johne's disease prevalence under Pennsylvania conditions with economical benefits, similar to 'management improvement strategies'. It was concluded that only a complete improvement of the calf management can reduce the prevalence effectively, and is therefore critical in any Johne's disease control program.

Key Words: Johne's disease, Simulation, Economics

637 Using *Solanum glaucophyllum* as a source of 1,25-dihydroxyvitamin D to prevent hypocalcemia in dairy cows. R.L. Horst*¹, J.P. Goff¹, S. Gill², E. Pawlak², and M.E. Dallorso³, ¹*National Animal Disease Center, USDA-ARS, Ames, IA*, ²*CAE, Buenos Aires, Argentina*, ³*Universidad Nacional de Lomas de Zamora, Buenos Aires, Argentina.*

Reducing cation-anion difference of diets (DCAD) fed just before parturition can prevent milk fever. However this dietary regimen does not entirely eliminate hypocalcemia. Milk fever can also be prevented by exogenous administration of the calcium regulating hormone 1,25-dihydroxyvitamin D. Unfortunately 1,25-dihydroxyvitamin D treatment remains expensive and the pre-parturient diets used in most trials would be classified today as high in cations. *Solanum glaucophyllum* (SG) is a plant which contains high levels of a glycoside form of 1,25-dihydroxyvitamin D. Could administration of SG leaves to cows that were already being fed a low DCAD pre-parturient diet further improve calcium status at calving? Nine multiparous Jersey cows were fed a low DCAD diet prior to calving. Urine pH of cows was maintained below 7.0 in all cows the week prior to parturition. Five cows were daily given 2 or 3 g SG leaves in gelatin boluses beginning 6 days (on average) before calving and continuing for the first 14 days of lactation. None of the four cows fed the low DCAD diet developed milk fever. Their blood calcium concentrations were 7.6, 7.0 and 8.0 mg/dl the day of calving and d 1 and 2 after calving respectively. Cows receiving SG in addition to low DCAD diet had significantly higher blood calcium concentration during the periparturient period with blood calcium concentrations of 7.8, 8.8 and 9.3 mg/dl the day of calving and d 1 and 2 after calving respectively. Control cows suffered an average of 3 days of subclinical hypocalcemia (blood calcium < 7.5 mg/dl) and the SG treated cows suffered 0.8 d of subclinical hypocalcemia the first 2 wk of lactation. Thus SG treatment improved calcium status in animals that were also being fed a low DCAD diet. Unfortunately, all cows receiving SG suffered 1-2 days of hypocalcemia (1 cow developed milk fever) between 6 and 8 days after SG treatment was ended. Mean blood calcium on d 22 of lactation of SG cows was 6.9 mg/dl compared with 9.2 mg/dl in untreated cows. It appears that SG treatment supplanted calcium homeostasis mechanisms in cows so that withdrawal of treatment left the cows temporarily unable to control blood calcium concentration.

Key Words: milk fever, *Solanum glaucophyllum*, hypocalcemia

ASAS/ADSA Forages and Pastures: Silages

638 Corn plant and silage nutritive value in different stages of maturity. Jorgelina Ferrero*¹, Oscar DiMarco², Enrique Rossi², and Daniel Valle², ¹*Fac. Cs. Agrarias U.N.L.*, ²*Fac. Cs. Agrarias UNMdP-INTA Balcarce.*

The nutritive value of corn "fresh cut" (FC) and ensiled (S) whole plant, stalk and leaf blade was evaluated in three stages of maturity: milking (A), half milk line (B) and physiological maturity (C). Chemical composition, *in vitro* DM digestibility (IVDMD) and *in situ* DM and NDF degradability (48 h) of whole plant, stalk and leaf blade, before and after ensiling, were evaluated. Three silos of each fraction were made in each stage of maturity in plastic containers (5 liters), which were stored for 45 days. In addition, samples of stalk and leaf blade were ensiled

in each container by placing them in nylon mesh bags inside the whole plant silage. Data from each plant fraction were analyzed by a two factorial analysis of variance (stage of maturity and ensiling). Whole plant (FC) chemical composition was: 52.2 % NDF, 3.2 % starch and 17.3 % soluble sugars (CNES) in A, and 43.9 % NDF, 21.6 % starch and 20.9 % CNES in C. The concentration of CNES diminished in stalk with maturity from 27.4 in A to 18.2 % in C. The IVDMD of whole plant did not differ between stages of maturity (average: 66.8 %). IVDMD of stalk diminished between B and C (50.6 to 48.8 %, $P < 0.01$), due to a lower concentration of CNES, and in leaf blade IVDMD decreased between A and B (65.2 to 56.7 %, $P < 0.01$), due to a decrease in NDF quality. The *in situ* NDF degradability decreased ($P < 0.01$) with maturity (A and