to the parlor, cow handling systems, ability to manage heat stress and housing design (freestalls, bedded pack, and dry-lots). It is important that all the components of the dairy are compatible with each other. Local climatic and regulatory conditions will have a major impact on how dairy facilities will be designed and built in the future.

Key Words: Dairy facilities, Cow comfort

Animal Health: Immunophysiology of Host-Environment Interactions: Implications for Disease Pathogenesis and Health Management of Production Livestock

335 The effect of transport by road and sea on physiology, immunity, and behavior of beef cattle. B. Earley*, *Teagasc*, *Grange, Beef Research Centre, Dunsany, Co. Meath, Ireland.*

The overall objective of the studies was to investigate the physiological, hematological and immunological responses of weanling heifers transported to Spain, and of weanling bulls transported to Italy under EU legislation (91/628/EEC) and to evaluate the implications in terms of animal welfare. During these studies, appropriate physiological, hematological and immunological measurements were made on the animals which quantified the effect of transport (by road and sea) on the degree of stress imposed and the performance of the animals over a 38-day study period. Physiological, hematological and immunological parameters (including interferon-γ production, cortisol, protein, globulin, urea, white blood cell numbers and differentials, and haptoglobin) were used to determine the welfare status of animals, before, during and after the respective transport journeys. Age-matched control animals that were blood sampled for the same parameters at times corresponding to the transported animals were retained in Ireland as controls. Heifers transported to Spain, lost, 7.6% of their liveweight during the sea crossing to France. However, by the time of their arrival in Spain they had regained 3.3% of their liveweight and had fully recovered to their pre-transport liveweight values within six days of arriving in Spain. Weanling bulls lost 7.0% of their liveweight during the sea crossing from Ireland to France. The liveweight loss in control animals ranged from 1-2% during the same period. The percentage of time that bulls spent lying during the transport journey was 63.5% for the sea journey and 35.4% for the journey from the French lairage to the Italian feedlot. The performance (average daily gain kg/day) of all transported animals was greater ($P \leq 0.05$) than control animals from day 11 to day 38 of the studies. While transient changes in physiological, hematological and immunological parameters were found in the transported and control animals relative to baseline levels, the levels that were measured were within the normal physiological range for the age and weight of animals that were studied.

Key Words: Animal welfare, Transport, Immune function

336 Making sense about stress and immunity: Th1 and Th2 aspects of the immune system respond differently to stress. J. L. Salak-Johnson*, *University of Illinois*, *Urbana*.

Stress is generally considered to suppress the immune system which leads to an increase in disease occurrence in the face of a pathogen. The immune system serves as a primary defense against bacterial and viral challenges. The immune system is brought back to baseline levels after a challenge to homeostasis that involves the hypothalamic-pituitary-axis (HPA). Often, findings reported from various studies investigating the effects of stress on the immune system are conflicting and difficult to interpret. These discrepancies may be partly explained by the types and durations of the stressors and whether researchers measured Th1 or Th2 aspects of the immune system. Cytokines produced by the innate immune system lead to differentiation of the Th1/Th2 immune pathways. Activation of Th1 involves stimulation of cellular immunity and Th2 is associated with humoral immunity. When animals experience stress, it is possible that there is a shift toward either a Th1 or a Th2 response. For example, a certain stress may stimulate Th1 response while suppressing Th2, resulting in a shift toward a Th1. At any moment, animals have some certain balance between Th1 and Th2 immune arms, and stress can disrupt that balance by lowering Th2 and increasing Th1 cytokines and cell activity. How farm animals perceive the stressfulness of their environment depends not only on traditional environmental stressors (e.g., heat, cold, humidity, pollutants) but also on aspects of the social environment. Social status can interact with environments to cause unusual relationships. For example, dominant animals may have enhanced immune activation while subordinates have suppression of the same trait. This could help explain why individual animals in a group respond differently to stressors and disease challenges. A better understanding of the consequences and complex interactions between social and environmental stressors for both innate and adaptive immune traits must be developed so we can fully understand stress effects on immunity. Once these complex relationships are better understood, more effective interventions can be designed to improve animal health.

Key Words: Stress, Immune, Health

337 Nutritional modulation of innate immunity: Practical approaches. N. Forsberg*[1], S. Puntenney[1], Y. Wang[1], and J. Burton[2], [1]*Oregon State University*, *Corvallis*, [2]*Michigan State University*, *East Lansing*.

The immune system may be divided into the innate and antibody systems. The innate system provides a first line-of-defense and time for antibodies to develop. Included in the innate system are neutrophils. Neutrophils roll along the vascular wall via an adhesion molecule (L-selectin). In response to local production of IL8, neutrophils migrate toward pathogen and kill it. A third molecule links the innate with the antibody system. Specifically, activation of the innate system via pathogen up-regulates the antibody system via secretion of interleukin-1-beta (IL1B). The rate-limiting enzyme to IL1B synthesis is IL1-converting enzyme (ICE). We have used a variety of models to study effects of nutritional supplements on markers of innate immunity (L-selectin, IL1B, IL8R and ICE). Models included: 1) dexamethasone (DEX)-induced immunosuppression of sheep, 2) parturition-associated stress in dairy cattle and 3) shipping stress in sheep and beef cattle. Injection of DEX into sheep reduced L-selectin and IL1B ($P < 0.05$). Administration of the supplement restored normal levels of both markers ($P < 0.05$). Ability of the supplement to elicit this effect was enhanced ($P < 0.05$) by fungal pathogen. In dairy, parturition is a normal stress which brings about immunosuppression. We determined, using microarray analysis (BoTL-5 arrays) and quantitative RT-PCR, that supplementation of dry cows for 28 days prior to parturition causes up-regulation ($P < 0.05$) of over twenty neutrophil genes including ICE.

Ability of the supplementation protocol to augment ICE expression may, in part, explain ability of the product to stimulate neutrophil IL1B synthesis in immunosuppressed sheep. The microarray study also revealed up-regulation ($P < 0.05$) of IL8R. This implies that the product may sensitize neutrophils to pathogen signaling during the peri-parturient period. Finally, we examined ability of a nutritional product to affect immune function during shipping. Shipping is a stressful event and methods to augment immunity during this time are needed. The nutritional product augmented ($P < 0.05$) indexes of innate immunity (neutrophil IL8R and L-selectin) in neutrophils of cattle and sheep during shipping stress.

Key Words: Immunity, Nutrition, OmniGen-AF

338 Cumulative physiological events influence the inflammatory response of the bovine udder to E.coli infections during the transition period. C. Burvenich*[1], M. Kehrli[2], M. Paape[3], D. Bannerman[2], and J. Lippolis[2], [1]*Ghent University, Faculty of Veterinary Medicine, Milk secretion and mastitis research center*, *Merelbeke, Belgium*, [2]*Periparturient Diseases of Cattle Research Unit, USDA, ARS*, *Ames, IA*, [3]*Bovine Functional Genomics Laboratory, U.S. Department of Agriculture, Agricultural Research Service*, *Beltsville, MD*.

A high proportion of cows with intramammary coliform infections at parturition display signs of severe inflammation and develop systemic complications and sepsis during the first 60-70 days of lactation. In the lactating bovine mammary gland, the innate immune system plays a critical role in the host response to infection and the eventual outcome of mastitis. Since the beginning of the 1990's, research on bovine mammary innate defense mechanisms in connection with the pathogenesis of coliform mastitis has increased significantly. There is no doubt that the viable neutrophil in the cisterns and ducts is a key factor in the protection of the mammary gland. However, in the bovine udder the protective role by the neutrophil seems to be influenced by a cumulation of physiological events occurring during the transition period. During the last 30 years most efforts have been focused on diapedesis, phagocytosis and killing by neutrophils, one of the most important components of the efferent innate arm. How these functions modulate the clinical outcome of coliform mastitis and how they are influenced by hormones and metabolism have also been the subject of intensive research. The study of the afferent (sensing) arm of innate immunity that enables host recognition of a diverse array of pathogens is a new area of interest and differences in the ability of the immune system to detect the presence of a pathogen may vary depending on stage of lactation and influence the inflammatory response.

Key Words: Mastitis, Escherichia coli, Innate immunity

Breeding and Genetics: Genetic Fitness

339 Stillbirth (co)variance components for a sire-maternal grandsire threshold model. J. Cole*, G. Wiggans, P. VanRaden, and R. Miller, *Animal Improvement Programs Laboratory, Agricultural Research Service, USDA*, *Beltsville, MD*.

(Co)variance components for stillbirth in US Holsteins were estimated under a sire-maternal grandsire threshold model using subsets of data from the national calving ease database, which includes over 7 million calving records with associated stillbirth scores. Stillbirth was coded as a binomial trait indicating whether or not the calf was alive 48 h postpartum; 10.8% of calves born to heifers were stillborn, versus 4.8% of calves born to cows. Records were selected from calves with sire and maternal grandsire (MGS) among the 2600 most-frequently appearing bulls (2578 distinct sires and 2586 distinct MGS). Herd-years were required to contain at least 20 records and only single births were used. After edits, the dataset included 2,083,979 calving records from 5765 herds and 33,304 herd-years. Six sample datasets of approximately 250,000 records each were created by randomly selecting herd codes. Quasi-REML and Gibbs sampling approaches were used to estimate (co)variance components from each sample. The model included fixed year-season, parity-sex, birth year group of sire, and birth year group of MGS effects and random herd-year, sire, MGS, and residual effects. Quasi-REML point estimates fell within the corresponding Gibbs sampling 95% confidence intervals for all samples, indicating good agreement between the two estimation procedures. Marginal posterior means (and standard deviations) averaged 0.0085 (0.0015), 0.0181 (0.0020), 0.0872 (0.0538), and 0.00410 (0.0001) for sire, MGS, and herd-year variances and the sire- MGS covariance, respectively. Mean direct and MGS heritabilities were 0.030 (0.003) and 0.058 (0.003), respectively, and the genetic correlation between direct and MGS effects was 0.331 (0.079). Heritability estimates were lower than some literature results, but the genetic correlation between direct and MGS effects was larger than previous estimated correlations of direct with pure maternal effects. Economic values of sire and MGS effects for stillbirth are less than for calving ease, and all four traits may be combined into a calving index.

Key Words: Stillbirth, (Co)variance components, Threshold model

340 Genetic parameters for calf vigor in the Montana Line 4 inbred Hereford herd. J. M. Rumph*[1], D. D. Kress[1], K. C. Davis[1], D. C. Anderson[1,2], H. C. Van Wagoner[3], and D. L. Boss[2], [1]*Montana State University, Bozeman*, [2]*Montana State University, Northern Agricultural Experiment Station*, *Havre*, [3]*Montana State University, Bair Ranch*, *Martinsdale*.

Records for 510 Hereford calves produced in the Line 4 Hereford herd at the Northern Agricultural Research Center (NARC) in Havre, Montana from 1997 to 2004 were analyzed to determine the genetic parameters associated with calf vigor. This herd is descended from the Miles City Line 1 Hereford herd and has been a closed herd in Havre since 1963. Inbreeding is increasing in this herd at an average rate of 0.7% per year and animals born in 2004 had an average inbreeding coefficient of 36.5%. Since 1995, selection in this herd has been based on single trait selection for yearling scrotal circumference adjusted for age of dam. For calf vigor, the model included fixed effects of year, age of dam, sex, calving ease score, and the linear and quadratic covariates of day of birth and birth weight. Random effects included were direct genetic, maternal genetic, direct-maternal correlation, and the proportion of variance attributed to maternal permanent environmental effects. Estimates of the genetic parameters were 0.14, -0.23, 0.06, and 0.00 for direct heritability, direct-maternal correlation, maternal heritability, and proportion of variance attributed to maternal permanent environmental effects, respectively. Genetic trends in this data for both direct and maternal breeding values are not significant for animals born from 1993 through 2004 which includes many of