

Dairy Section of Veterinary Diagnostic and Production Animal Medicine (VDPAM)

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Summary and Implications

The College of Veterinary Medicine at Iowa State University has responded to the shortage of veterinarians in food animal practice by hiring new faculty in the Veterinary Diagnostics and Production Animal Medicine Department as well as expanding its curriculum offerings in large animal species that encompass species electives from freshman through senior year. In the past five years there has been the addition of full and part-time faculty members to address the needs to teach beef, dairy, small ruminant, and swine production medicine, embryo transfer, and animal welfare.

VDPAM Dairy Section: New Faculty

The Dairy Section of VDPAM includes Dr. Pat Gorden, Dr. Bruce Leuschen, Dr. Suzanne Millman, Dr. Paul Plummer, Dr. Jim West, Dr. Jesse Goff, and Dr. Jan Shearer. These appointments fulfill a variety of needs and their responsibilities include clinical work, extension, research, and teaching.

Dr. Jesse Goff is a Professor and Anderson Chair in Veterinary Medicine in the Department of Biomedical Sciences at the College of Veterinary Medicine. He received his DVM in 1984 from Iowa State University and PhD in Veterinary Physiology and Nutritional Physiology in 1986. He worked at the USDA-ARS National Animal Disease Center where he did research on metabolic and nutritional diseases in animals until 2007. He also worked with West Central Cooperative where he served as Director of Research & Development. Dr. Goff has a teaching and research assignment at Iowa State University.

Dr. Pat Gorden received his DVM in 1993 from Iowa State University and is a diplomat with the American Board of Veterinary Practitioners. He was in private practice in Wisconsin for seven years and then recently in Arizona for seven years. Dr. Gorden has developed several Dairy Production Medicine courses and has put together a team of instructors to teach them. He does field case investigations as well as ongoing clinical work on some dairies. He has established a Milk Quality Lab at the ISU Veterinary Diagnostic Lab, and is head of Food Animal Medicine.

Dr. Amanda Kreuder received her DVM in 2008 from Iowa State University. She was in private dairy and equine practice in Wisconsin following graduation. Dr. Kreuder is concurrently doing a PhD in Microbiology and a residency

in Large Animal Internal Medicine in the ISU Food Animal Hospital and Veterinary Field Services.

Dr. Adam Krull received his DVM in 2008 from Iowa State University and was in private dairy practice in Wisconsin following graduation. Dr. Krull is concurrently doing a PhD in Microbiology and a part time clinical work assisting with the ISU Food Animal Hospital and Veterinary Field Services.

Dr. Bruce Leuschen received his DVM in 1983 from Iowa State University. He was in private practice in NE Iowa for twenty-three years prior to coming to Iowa State. Dr. Leuschen does field case work on local farms in Central Iowa and serves as the Fair Veterinarian for the Iowa State Fair. Dr. Leuschen also coordinates the D-PIKE program that allows students to experience on farm dairy production and also some dairy medicine.

Dr. Suzanne Millman has a PhD in Applied Ethology from the University of Guelph. She serves as Associate Professor of Animal Welfare in the Veterinary Diagnostic and Production Animal Medicine and the Biomedical Sciences Departments. Dr. Millman leads an active research program in food animal welfare, coordinates animal welfare instruction within the DVM curriculum, and provides expertise in animal behavior and welfare for producers, veterinarians and the public.

Dr. Paul Plummer received his DVM in 2000 from the University of Tennessee and is board certified in large animal internal medicine with the ACVIM (American Academy of Veterinary Internal Medicine). He finished his PhD in Microbiology in 2009 and has a variety of research projects in place. Dr. Plummer is a guest lecturer in courses involving dairy medicine, co-instructor in a small ruminant medicine course, and conducts extensive molecular microbiology research.

Dr. Jan Shearer received his DVM in 1975 and MS in 1981 from The Ohio State University. He had been a Dairy Extension Veterinarian at the University of Florida for the past 27 years. He has earned national and international recognition for his expertise in bovine lameness and animal welfare. He co-created the Master Hoof Care Program where he has shared his expertise with many people in the dairy business. Dr. Shearer is hired as Dairy Extension Veterinarian at Iowa State and will have responsibility in teaching, research, and extension.

Dr. Jennifer Schleining received her DVM in 2001 from Iowa State University. She also received her Masters in Veterinary Clinical Sciences in Biomechanics. Dr. Schleining became Board Certified in 2010 with the American College of Veterinary Surgeons. Dr. Schleining helps teach surgery labs, Food Animal Medicine, and fourth year clinical courses.

Dr. James West received his DVM in 1971 from Iowa State University and his Masters in 1975. He practiced in NE Iowa. He has extensive expertise in the area of Veterinary Theriogenology and Embryo Transfer. Dr. West holds the **Scott and Nancy Armbrust Chair in Clinical Medicine**. He teaches a course in Embryo Transfer to senior veterinary students and is a guest lecturer in other courses. He has established an embryo transfer lab at Iowa State University where he does commercial embryo transfer work. His lab has the ability to determine the sex of an embryo prior to its transfer into a recipient cow.

VDPAM Expanded Role

VDPAM has expanded its role by taking over the operations of the Food Animal portion of the Large Animal Hospital. The services offered at the hospital have also been expanded to include Camelid medicine and surgery.

VDPAM also has expanded its role by restarting an ambulatory service called Veterinary Field Services for the Ames and surrounding area in food animal and Camelid medicine and surgery.

VDPAM Dairy Section: Courses

New course offerings have been put together to teach students dairy production medicine. These courses complement the bovine medicine and management courses already established at Iowa State University and currently being taught by Dr. Jim Thompson, Dr. Steve Hopkins, Dr. Leo Timms, other faculty in the College of Veterinary Medicine, and industry partners. These new courses include:

VDPAM 309- Informatics: This course provides an introduction to production records and spreadsheets, and gives the student information on how the data is collected and used. The course covers materials in swine, dairy, cow-calf, and feedlot.

VDPAM 340- Clinical Foundations: This course provides an opportunity for veterinary students to receive basic understandings of the domestic farm livestock species on an individual animal basis and the issues and industries that they are involved in.

VDPAM 402- Dairy Records: This new course is designed to give the veterinary student an in depth study of dairy records and their use. Dairy Comp 305 and PCDart are used in the course to look at the various production indices and how they impact production on the dairy farm.

VDPAM 310 – Intro to Production Animal Medicine: This new course focuses on developing and understanding principles and techniques that serve as a basis for food animal health management programs and the critical role of veterinarians in implementing these programs.

VDPAM 451- Clinical Embryo Transfer: This new course is designed to give the students clinical experience and understanding of embryo transfer in the ruminant animal (mainly bovine). Students are also instructed on caesarian section in the bovine and are allowed to do the surgery on a cow.

VDPAM 476- Field Service: This course involves ambulatory medicine to the university farms as well as some farms serviced by the department. Students are instructed in truck-side pharmacology, vaccination programs, and dystocia correction/fetotomy in the bovine.

VDPAM 484- Dairy Production Medicine: This is an established course (developed by Leo Timms) that is designed to give an in depth look at the dairy farm and study various production systems on the farm. Topics include biosecurity, milk quality, cow comfort, records, heifer development, nutrition, welfare, and reproduction. Several farm visits are conducted and trouble shooting on those farms is expected with a written report back to the farm.

VDPAM 491- Bovine Nutrition: This course is an applied course looking at both dairy and beef nutrition and ration balancing. Basic ruminant nutrition, physiology, and requirements as well as ration balancing are the focus. This is jointly taught between VDPAM and industry partners.

VDPAM 494- Advanced Dairy II, Dairy Nutrition and Milk Quality: This course gives students an indepth look at nutrition and udder health and milk quality issues. Students will collect data related and analyze and compare that data to benchmarks in the industry. Students will learn how to analyze a milking system based on current NMC protocols. Students will also balance rations and be able to make nutritional recommendations.

Programs and Research Projects

Dairy Lameness and Animal Welfare: Dr. Jan Shearer will implement the continuation of his programs at Iowa State University. **ISU Master Hoof Care Program:** Its objective will be to provide training in foot care and claw trimming for trimmers with an advanced version of this training program for veterinarians. The program will be presented in English and in Spanish in order to address the needs of Hispanic participants.

Programs to address issues related to welfare of dairy cattle are continuing to evolve. As with foot care, a primary objective at the present time is to improve awareness of the issue. This will be accomplished in part through the development of appropriate publications, the delivery of seminars at veterinary and producer meetings, and via other forms of media communications. Training programs in English and Spanish for on-farm workers are being considered as a possible mechanism for addressing some of the specific needs of dairymen relative to appropriate care and handling of animals.

Toxicology: Dr Steve Ensley received his DVM from Kansas State University in 1981. He was in private practice for fourteen years. After practice he completed a MS and PhD in toxicology at Iowa State University. As a clinician in the Veterinary Diagnostic Laboratory he is responsible for toxicology cases submitted through the laboratory. Dr Ensley has been active in research with high sulfur corn co-product diets, drinking water quality for livestock, trace minerals and mycotoxins.

Development of a Metagenomics Tool Box and Application of Metagenomics to Address Culture Negative Clinical Mastitis Samples.

Investigators: Patrick J. Gorden, DVM, Paul J. Plummer, DVM and Chong Wang, MS, PhD from VDPAM and Gregory Phillips, MA, PhD from VMPPM, College of Veterinary Medicine, Iowa State University.

This project is funded by the Iowa Healthy Livestock Competitive Grant Program. Metagenomic analysis involves using culture independent techniques to identify genome sequences of a community of organisms inhabiting a common environment. Metagenomic analysis will be done using the Roche Genome Sequencer FLX (454) System available at DNA Facility at the University of Iowa.

Project Summary: Polymicrobial diseases like bovine mastitis cost the dairy industry millions of dollars annually. Of the diagnostic mastitis cultures performed, approximately 10-40% are culture negative. This limitation reveals a need for the application of culture-independent methods that facilitate the characterization of entire microbial communities. Culture independent bacterial identification methods using 16S ribosomal RNA signatures and new DNA sequencing technologies can now provide “metagenomic” data of complex microbial communities, including culture negative clinical mastitis samples. Metagenomic approaches have significant implications for animal health as polymicrobial diseases can now be studied in unprecedented detail. *Identifying the microorganisms responsible for mastitis, as well as assessing changes in pathogen populations throughout infection, are necessary prerequisites to better understand the disease process and to identifying more effective intervention strategies.*

Our hypothesis is that the microbiota of clinical mastitis samples that are “culture negative” differ significantly from normal mammary gland microbiota.

The experimental plan involves the utilization of culture negative mastitis milk samples compared to normal milk from the same cow. These samples will undergo metagenomic analysis using PCR amplification and sequencing of DNA using Roche/454 pyrosequencing and subsequent bioinformatic analysis to identify and quantify the microbiota present that are non-culturable.

Our *long term goal* is to develop a multi-disciplinary team to master metagenomic techniques, and the associated bioinformatic analysis, in order to better characterize the microbiota associated with multiple animal and environmental systems. This study will provide new insight into bovine mastitis, provide proof of concept of the technique and demonstrate our team’s ability to successfully generate and analyze metagenomic data for application to improved animal health.

Prevention of Metritis in Dairy Cows

Investigators: Jesse Goff, Bruce Leuschen, Kayoko Kimura, Patrick Gorden

Metritis continues to cause disease in the dairy cow; 15-30% of post-parturient dairy cows have clinical cases of metritis that costs the dairy industry about \$106/metritis case in drugs, veterinary services, and lost production costs. If just 15% of the 8.5 million dairy cows in the US develop metritis this year, the disease will cost US dairy producers \$135 million. A major cause of metritis in the post-parturient period is reduced neutrophil function. This decreases the ability to eliminate bacteria attempting to invade the uterus. Once bacteria become established they induce a prolonged inflammatory reaction (metritis) in the cow.

An investigation into novel chemicals that will prevent metritis has begun. These chemicals are known chemo-attractants of neutrophils. The hypothesis is that when placed into the uterus of the immediate post-parturient cow they will recruit neutrophils into the uterus in large numbers right after calving. That way, even if neutrophil function is compromised, there will still be ample cells to kill the bacteria early in the battle and therefore prevent the costly metritis disease in that cow. Initial studies to investigate that the chemicals are not harmful to the cow when placed into the post-parturient uterus has been completed.

Detection of Immune Responses to Bovine Paratuberculosis (Johne’s Disease) using a Removable Implant

Jesse Hostetter, Doug Jones, and Brandon Plattner in the Department of Veterinary Pathology are developing a diagnostic tool with potential to detect cattle in the early stages of Johne’s disease. Their strategy is to modify a skin test in order to detect cell mediated immune responses against this pathogen.

The new modified skin test will directly measure local cellular infiltrates and cytokines within the skin test site. This is accomplished by using an implant to serve as a “removable skin test”. This implant consists of a 5mm x 3mm detection platform that is coated with Mycobacterium avium ss paratuberculosis (Map) antigen. It is inserted into the subcutis of the animal using a 14 gauge needle, removed after 24 hours, and read in the laboratory. Currently the implant is removed via biopsy, however in the future a thin wire will be attached to the end of the device, which will remain on the skin surface. Gently pulling this wire will allow for rapid removal of the implant. Currently, the prototype detects one cytokine - Interferon Gamma, however multiple parameters tests (cytokines, cells, and antibody) are now being developed to be housed within a single assay. The implant has been successfully tested in mice and is now being tested in calves experimentally infected with Map. The goal of the project is to identify an “immune signature” based on multiple immune parameters that will be highly diagnostic for Map infection.

Efficacy of Formic Acid as a Means of Controlling *Mycoplasma bovis* and *Mycobacterium avium* subsp *paratuberculosis* in Dairy Cattle

Investigators: Drs. West, Plummer, Gorden, Leuschen, Griffith

Purpose: The purpose of this study was twofold: 1) To evaluate the bacteriocidal efficacy of formic acid acidification of milk for the control of *Mycoplasma bovis* and *Mycobacterium avium* subsp *paratuberculosis* (MAP) and 2) To evaluate the effect of formic acid acidification of colostrum on passive transfer of immunity to newborn calves. At the time of this report the data has been collected and is being analyzed and prepared for publication.

Summary of findings: The first objective focused on the ability of formic acid to kill or prevent replication of two important pathogens of dairy cattle. Transmission of these organisms from an infected dam to the calves often involves milk/colostrum containing the bacteria. The data demonstrated that formic acid acidification rapidly decreases the number of viable *Mycoplasma bovis* organisms in the milk sample and that the organism drops below the limit of detection by 2 hours at the lower pH ranges used in the study. In contrast, MAP appears to be much more stable in the acidic environments and demonstrates minimal killing of the organism over the first 48 hours of incubation. Longer periods of time started to show some inhibition however use of these longer time periods would be prohibitive in clinical practice. MAP studies were performed using both a rapid read fluorescent staining test for viable organisms as well as a standard solid media culture method with similar results observed in both experiments.

The experimental data demonstrated that there was no effect of formic acid acidification on the passive transfer and absorption of immunoglobulins from bovine colostrum. Immunoglobulin levels as measured by radial immunodiffusion, total serum protein and turbidity were identical between the treated (formic acid acidified) and untreated (non-acidified) groups at both 12 and 24 hours of age. Furthermore, serum inhibition testing using the samples demonstrated identical results from both groups. Collectively these data show that the immunoglobulins are absorbed in equal levels in both groups and that their activity remains unchanged despite the long-term exposure to acidic conditions.

Conclusions and applications: The use of formic acid acidified colostrum will not negatively impact the passive transfer of immunoglobulins to calves. Since cellular immunity was not accessed in this study we cannot make any statements regarding to role of acidification on transfer of cellular immunity. Formic acid acidification does appear to be an effective tool for limiting the transmission of *Mycoplasma bovis* in milk and provides an additional option for on-farm control of this organism in dairy calves. Formic acid acidification of milk and colostrum appears to have limited effect on MAP and thus may not be as useful in the

control of Johne's disease. Given the previously demonstrated efficacy of formic acid in controlling many other gram-positive and gram-negative organisms combined with the efficacy against *Mycoplasma* and the lack of negative impact on passive transfer of antibodies we suggest that this tool may be effectively implemented to improve dairy calve health in situations where Johne's disease is not the top priority. The technique provides financial advantages over other management tools currently available and unlike pasteurization it provides the residual protection post-treatment afforded by the maintained acidic environment.

Papillomatous Digital Dermatitis

Investigators: Gorden, Krull, Plummer, Shearer, Leuschen

Purpose: The purpose of this trial is to study the epidemiology of PDD, the lesion development and the immune response. Further development and discovery of the variety of bacterial agents involved during the stages of lesion development are also being investigated.

Mastitis Therapy Investigation

Investigators: Gorden

Purpose: The purpose of the study is to investigate the long term use of approved intramammary therapy during extended use. The results of this study will provide veterinary practioners necessary information in the prevention of milk residues when using extended intramammary therapies.