

include transportation, handling, facility management and euthanasia. After each module is completed, students can assess a question set that can be used to evaluate their comprehension. In addition a list of discussion points is also provided. Within each species module, a sample scenario is included to allow students to practice evaluating welfare. After each scenario, an example of an oral presentation of welfare assessment "reasons" is provided using quick time video. Students are also given a set of seminal papers on animal welfare and behavior as well as a reference bibliography and a glossary of terms. As a final educational activity students visit the Purdue research farm and assess the welfare all major farm animal species.

**Key Words:** Animal welfare, Judging team, Behavior

**106 Performance and cognitive level of questions asked by rural and urban students in a beginning Animal Science course.** E. A. Buescher\* and D. R. Brink, *University of Nebraska-Lincoln.*

Animal Science departments are seeing an increase in urban student and a decrease in rural student enrollment. This provides a challenge for educators to reach students at both levels of animal agriculture knowledge. For two months (24 class periods) we have observed and evaluated the questions students (n=67) asked in Animal Management 250. We were interested in the cognitive level and performance on the final examination as related to student's background and experience in the animal industry. Each class period students were chosen at random to ask a question and it was recorded and evaluated using Blooms Taxonomy. Cognitive level of the questions was then compared with individual performance in the class and how it related to their peers from urban or rural backgrounds. A survey was distributed to obtain the demographics of the students along with the extent of their agriculture background. Rural students (n=45) and urban students (n=22) received approximately the same grade on the short answer part of the final exam. The average level of question asked was 2.6, indicating student's questions were between the comprehension and application levels of Blooms Taxonomy. No difference in the cognitive level of questions asked by urban or rural students was observed. Students indicated knowing they may be asked a question helped them stay more alert in class (average = 4.0) on a scale where 5=strongly agree, 3=no opinion, and 1=strongly disagree. Students that asked higher level questions scored higher on the final exam (r=.56). Sixty-six percent of the students said they prepared more for class, because they may be asked a question. In conclusion, students that asked higher level questions scored higher on the final exam. Students indicated they prepared more for class, because they may be asked to provide a question. Animal agriculture background did

**Animal Health Symposium: Laminitis in dairy cattle**

**108 Subclinical laminitis, or not? The aetiology and early pathogenesis of sole and white line lesions in dairy heifers.** A. J. F. Webster\* and J. F. Tarlton, *University of Bristol, Langford, Bristol BS405DU, UK.*

The existence of the condition known as acute laminitis in cattle, and associated with improper feeding, especially of starchy concentrates, is not in dispute. The chronic condition variously called aseptic pododermatitis or subclinical laminitis, featuring haemorrhagic lesions of the sole and white line (SWLL), has a more complex aetiology. The major risk factors are phenotype, physical environment, diet, season and stage of lactation. The main predisposing factors may be described mechanistically as direct strains and stresses within the foot, disorders of rumen function, and physiological changes inherently associated with parturition and the onset of lactation.

At this conference, Bill Stone will review the importance of disorders of rumen function. Christoph Lischer will present anatomical evidence to describe the changes within the internal structures of the foot that accompany and precede the superficial sole lesions of aseptic pododermatitis. Our paper will describe the pathogenesis of SWLL in dairy heifers around the time of parturition and the first 6 months of lactation, and review the extent to which these are determined by housing type, nutritional changes accompanying the onset of lactation, and/or the physiological consequences of parturition and lactation per se.

In our studies SWLL appeared in nearly all heifers within 4 weeks of calving. Their subsequent development and severity were influenced both by diet and housing. The incidence of severe SWLL (i.e. sole ul-

cers) was greatly reduced by housing heifers in straw yards rather than cubicles for 12 weeks following calving. Movement into cubicles thereafter did not cause foot damage. This is consistent with the hypothesis that physiological events associated with parturition and the onset of lactation are an inevitable but transitory high risk factor for SWLL.

**Key Words:** Cognitive, Question, Background

**107 Heptachlor contamination of Oahu's fluid milk supply: A case study to teach contemporary ethical issues to undergraduate animal science majors.** D. Vincent\*, *University of Hawaii, Honolulu.*

A course with a focus on contemporary ethical issues is a new requirement for all undergraduates at the University of Hawaii. Use of case study methods is encouraged to expose students to these issues. Cases can be used in discussion, in small groups and in role-playing to expose students to current issues in animal agriculture and assist in developing critical thinking skills. The 1982 contamination of the Oahu fluid milk supply with the PCB pesticide, heptachlor is an excellent case for introductory students. In 1981, ensiled pineapple "green chop" (tops of the pineapple plants after fruit were harvested), contaminated with heptachlor, was fed to Oahu's dairy cattle as a low cost alternative feed. Feeding green chop resulted in contaminated milk being sold to consumers from both of Oahu's milk processors. The Hawaii State Department of Health (HDOH), in routine screening of milk in January 1982, discovered Heptachlor epoxide (HE) contamination of the milk supply. HDOH continued to permit sale of dairy products while waiting for verification of results and internal efforts to reduce the HE levels until March 1982, when homogenized milk supplies were pulled from grocery shelves. This was the first of many recalls of dairy products from store shelves and a near complete loss of confidence in the HDOH's ability to protect the public health. Cows could not be slaughtered and dairy farmers were forced to "milk" the HE out of the cows in order to reach EPA action levels. On some dairies, it took over 12 months before processors would accept milk. Following the contamination, high levels of HE were discovered in human breast milk. The contamination resulted in political scandal, a large class-action lawsuit, dairy bankruptcies and a continuing concern about the long-term health effects of exposure to HE in Oahu's population. The case illustrates a situation where animal scientists were called upon to assist the local dairy industry to find alternative feeds. However, when problems arose, unethical behavior on the part of several critical individuals resulted in the compounding of the problem to the detriment and distrust of a "wholesome" product and created public health fears and uncertainty among Oahu's milk drinking consumers.

**Key Words:** Heptachlor epoxide contamination, Case study, Dairy

cers) was greatly reduced by housing heifers in straw yards rather than cubicles for 12 weeks following calving. Movement into cubicles thereafter did not cause foot damage. This is consistent with the hypothesis that physiological events associated with parturition and the onset of lactation are an inevitable but transitory high risk factor for SWLL.

We have measured biochemical and biomechanical properties of the connective tissue attaching the third phalanx (P3) to the laminated wall of the hoof. Biomechanical changes occurring in early lactation include an increase in laxity permitting increased movement of P3.

**109 Environmental influences on laminitis and Sub-Acute Ruminant Acidosis (SARA) in dairy cows.** N. B Cook\* and K. Nordlund, *University of Wisconsin-Madison, School of Veterinary Medicine.*

Sub-acute ruminal acidosis (SARA), and hormonal changes occurring around parturition, have been suggested as trigger factors for bovine laminitis. This paper will review the environmental risk factors present on North American dairy herds, which may influence the onset of SARA, contribute to the changes in claw architecture observed around parturition, and significantly impact cow behavior and resultant claw lesions and lameness.

The mean prevalence of lameness measured on 30 well managed Wisconsin dairy herds using a system of locomotion scoring was 22.5%. The lameness treatment rate for a sub-sample of 10 herds averaged 69.1 foot

treatments per 100 cows per year, with a range from 15.1 to 132.7. Lesions typically associated with laminitis were responsible for 34% of foot treatments, with the remainder due to infectious causes.

Existing data regarding the significance of risk factors such as over-crowding, limited access to feed, heat stress, exposure to concrete, stall usage and pen design will be reviewed. New data from two surveys of lameness on well managed Wisconsin dairy farms will be presented, demonstrating significant differences in lameness prevalence between different housing systems and different stall surfaces.

Preliminary cow behavior and locomotion scoring data from current research conducted on herds utilizing freestall housing, using 2 or 3 row pen designs, and either sand or a rubber crumb filled mattress stall surface will be presented, which will test the working hypothesis that the environment in which we place the cow is the final determinant of the prevalence of lameness and laminitis on the farm.

**Key Words:** Lameness, Laminitis, Environment

### **110 Nutritional approaches to minimize subacute ruminal acidosis in dairy cattle.** W. C. Stone\*, <sup>1</sup>*Cornell University Ithaca, NY.*

Subacute ruminal acidosis (SARA) is very costly to the United States dairy industry. Reduced ruminal efficiency, liver and lung abscesses, and laminitis are all thought to be related to SARA. Both the nutritionist and the dairy's management are responsible for the delivery and consumption of a ration that is likely to be ruminally pH healthy. Nutritionists should consider the expected amount of physically effective NDF provided by ration ingredients, along with their expected ruminal fermentabilities and resultant microbial acid production. Environmental conditions, such as heat stress, over-crowding, and uncomfortable stalls, which may alter feed intake patterns and animal behavior should also be considered in ration formulation. Additional physically effective NDF, and/or a reduction in ruminal NSC availability, may well be warranted during times of increased animal stress. Higher levels of intake may also predispose the rumen to SARA, since buffer production may not adequately compensate for additional acid production. The addition of dietary buffers, biotin, and organic zinc may also aid in reducing acidosis and laminitis. Dairy managers and feeders are responsible for delivering the formulated ration. Forage dry matters should be taken biweekly, or more frequently if results vary by more than five percent of the DM value. Ration variability can be further reduced by premixing individual forages, or at least attempting to make each loader bucket of feed a uniform mix obtained from the entire height of the silo. Dairies should consider investing in electronic feed recording systems. These systems record the precision of ration manufacture by the feeder, and foster the development of healthy competition among feeders, resulting in enhanced mixing accuracy. Ingredient sequencing and mixing time should be standardized on a given dairy. Techniques to minimize sorting, including frequent feed pushups, the addition of water or a low dry matter byproduct, and appropriate forage processing, should be adopted by managers.

**Key Words:** SARA, Laminitis, Dairy cattle

### **111 Biomechanical aspects of the pathogenesis of claw horn disruptions in dairy cattle.** C. Lischer\*<sup>1</sup>, K. Nuss<sup>2</sup>, S. Nacambo<sup>2</sup>, S. Meyer<sup>2</sup>, and P. Ossent<sup>3</sup>, <sup>1</sup>*Equine Clinic, University of Zurich*, <sup>2</sup>*Farm Animal Clinic, University of Zurich*, <sup>3</sup>*Institute of Veterinary Pathology, University of Zurich.*

Despite intensive study, knowledge of the precise aetiology and pathogenesis of bovine laminitis is still incomplete. It is often hypothesized that changes in the microcirculation of the corium (dermis) of the bovine claw contribute significantly to the development of laminitis. The cause

of laminitis should be considered as a combination of predisposing factors leading to vascular reactivity and inhibition of normal horn synthesis. Nutrition, disease, management and behaviour appear to be closely involved in the pathogenesis of bovine laminitis. The only consistent feature in chronic laminitis is the sinkage of the pedal bone that compresses the corium in the sole and heel. However, the relationship between the development of these lesions and the anatomical structures of the distal phalanx or the supportive heel cushion under the bone are unclear. These structures were therefore examined in 19 cows with an ulcer at the typical site. There was a direct relationship between displacement of the third phalanx and ulceration of the sole or heel; the third phalanx had dropped in all the ulcerated claws and the corium and the subcutis under the bone were thinner than in the controls. The supportive cushions of the ulcer group contained less fat tissue. There was no histological evidence of damage to the epidermis or the corio-epidermal junction in the ulcerated claws nor were the lamellae elongated. Similarly, there were no morphological alterations in the connective tissue layer (sub-mural dermis). The lack of support for the theory that the separation of tissue layers at the laminar interface is an essential requirement for the third phalanx to sink leaves the only alternative explanation; the properties of the connective tissue of the suspensory apparatus must have undergone a change that resulted in excessive flexibility of the dermal segment. Details on the biochemistry of the connective tissue of the suspensory apparatus are presented by Webster and Tarlton at this conference.

**Key Words:** Laminitis, Dairy cattle, Claw horn disruption

### **112 Monitoring techniques to minimize laminitis.** K. V. Nordlund\* and N. B. Cook, *University of Wisconsin-Madison, School of Veterinary Medicine.*

Lameness in dairy cows includes many disease conditions caused by a wide variety of infectious, nutritional, traumatic, genetic, housing, and behavioral factors. Laminitis and its sequelae are the most common conditions in several surveys of dairy cow lameness. While laminitis is a multi-factorial disease, many dairy operators and advisors focus prematurely on ruminal acidosis as a primary cause. Accordingly, nutritionists frequently find themselves in a default defensive position while servicing herds with lameness problems. In the last decade, a variety of practical field tools have been developed that can differentiate lameness conditions in a specific herd and identify primary risk factors.

Lameness prevalence can be quantified using a modification of a published lameness scoring system. Entire herds can be scored quite easily as they walk access lanes. Hoof health record systems have improved and are used by many professional hoof trimmers, which has made it easier to monitor the prevalence of digital dermatitis, laminitis, and other conditions. If laminitis is a herd problem, the primary risk factors of subacute ruminal acidosis (SARA), excess standing time on concrete, and replacement heifer management should be evaluated. Stall usage indexes are being developed to estimate time spent lying down in stalls. Recent research is providing information on factors related to freestall design which influence lying time. Time in holding areas and parlors can be assessed, with an emphasis on the longest times for the last individual cows to come through the parlor.

Field tests for ruminal acidosis have emerged to compliment ration analyses. Rumenocentesis is a direct measure that provides diagnostic information when adequate samples are collected. Visual evaluations of washed screened feces provide useful information about rumen passage rates. Production records, combined with clinical signs of SARA such as diarrhea, irregular and reduced dry matter intake, laminitis, multifocal hepatic and pulmonary abscess, and hemoptysis or epistaxis, can provide useful diagnostic information.

**Key Words:** Laminitis, Ruminal, Acidosis

## **Food Safety Symposium: Emergence of antimicrobial resistance and implications to animal agriculture**

### **113 Epidemiological principles relating to the study of antimicrobial resistance in animal agriculture.** Randall Singer\*, *University of Illinois, Urbana, IL.*

The emergence and spread of antimicrobial resistance among bacterial populations has major health and economic consequences in both human and animal populations. Of particular concern is the impact of animal agricultural antimicrobial use on human health. Understanding the epi-

demiology and ecology of antimicrobial resistance and finding solutions to counter this problem will be difficult, primarily due to the complexity of the issue. The purpose of this presentation is to highlight key epidemiological principles that are often overlooked and always problematic in antimicrobial resistance studies. One key epidemiological principle that must be considered is the background level of antimicrobial resistance. For example, to state that a certain antimicrobial use causes changes in