

however DMD, OMD and DE were not affected ($P > 0.10$). Treatment did not affect N retention ($P > 0.10$; 49.46 vs. 5.22 g/d) but there was a trend for more digested N to be retained. Blood urea nitrogen (BUN) increased after feeding ($P < 0.05$; 14.15 vs. 16.3 mg/dl) and tended to be negatively related to RUP. In a 63-d 2×2 factorial feedlot trial, British and Brahman \times British steers ($n = 48$; 556 kg initial BW; age 9 mo.) were ranked by BW, randomly allocated to one of 8 pens and fed two levels of RUP (26.5 vs. 44 % of CP) and two types of supplement form (meal and pressed blocks). Bermudagrass Hay (13.1% CP) was offered free choice and supplements were fed at 1.5 kg DM/hd/d. Blood samples were collected on d 21 and 63. Intake was not affected by treatments. Steer ADG (0.67 vs. 0.05 kg) did not respond to RUP or form. BUN was lowered with RUP (14.1 vs. 12.1 mg/dl; $P < 0.01$). A trend for interaction between RUP levels and form was also observed. Despite indications that RUP improved nutrient metabolism of cattle fed high fiber hay, animal performance was not affected.

Key Words: Protein supplementation, Fiber, Growing steers

98 Effects of ammonia load on methionine utilization in growing steers limit-fed soybean hull-based diets. M. S. Awawdeh*, E. C. Titgemeyer, K. C. Candler, and D. P. Gnad, *Kansas State University, Manhattan.*

Six ruminally cannulated Holstein steers (203 kg BW) housed in metabolism crates were used in a 6x6 Latin square to study effects of rumen ammonia load on methionine (Met) utilization. Steers were fed the basal diet (83% soybean hulls, 8% wheat straw, and 0.3% urea) twice

daily at 2.5 kg DM/d. Periods were 6 d, with 2 d for adaptation and 4 d for fecal and urine collection to determine N retention. Treatments were arranged as a 3×2 factorial and were continuously infused into the rumen (0, 40, or 80 g/d urea to supply ammonia load) and into the abomasum (2 or 5 g/d Met). Basal ruminal infusions contained 200 g/d acetate, 200 g/d propionate, and 50 g/d butyrate to provide energy without increasing microbial protein supply. Basal abomasal infusions contained: a mixture (255 g/d) of all essential amino acids except Met, 10 mg/d vitamin B-6, 10 mg/d folate, 0.1 mg/d vitamin B-12, and 300 g/d glucose. Rumen ammonia concentrations were 4.5, 21.5, and 19.7 mM when 0, 40, and 80 g/d urea were infused, respectively. Urea infusions linearly increased plasma urea ($P < 0.01$) from 4.5 to 7.8 mM for 0 and 80 g/d urea, respectively. Fecal N was similar among treatments. There was no urea \times Met interaction for fecal, urine, or retained N. Urea infusions did not ($P = 0.2$) affect retained N (25.2, 23.4, and 25.7 g/d for 0, 40, and 80 g/d urea, respectively), but increased ($P < 0.01$) urine N excretion (48.5, 67.3, and 84.6 g/d for 0, 40, and 80 g/d urea, respectively). Increasing Met from 2 to 5 g/d decreased ($P < 0.01$) urinary N excretion and increased ($P < 0.01$) N retention from 22.0 to 27.5 g/d. Serum insulin and IGF-1 concentrations were similar among all treatments. The efficiencies of deposition of supplemented Met between 2 and 5 g/d were 22.5% and 18.4% when steers received 0 or 80 g/d urea, respectively. In our model, regardless of whether Met was limiting, increasing ammonia load did not impact whole body protein deposition in growing steers. (Supported by NRI Competitive Grants Program/CSREES/USDA, Award No. 2003-35206-12837.)

Key Words: Methionine, Ammonia, Amino acids

Teaching/Undergraduate & Graduate Education

99 A partnership of universities and agri-business for an effective dairy herd management learning experience for undergraduates: the Dairy Challenge. M. Tomaszewski*¹, M. S. Weber Nielsen², D. K. Beede², D. Thorbahn³, M. Budine⁴, and D. Selner⁵, ¹Texas A&M University, College Station, ²Michigan State University, East Lansing, ³Select Sires, Plain City, OH, ⁴Cargill Animal Nutrition, Mentone, IN, ⁵Shawano, WI.

The North American Intercollegiate Dairy Challenge contest allows undergraduate students to apply knowledge gained in the classroom in an evaluation of the management practices of commercial dairy farms. University faculty partnered with industry representatives to develop the competition. Participants in the Dairy Challenge do the following: 1) visit local dairy farms and gain knowledge of different farms' management practices; 2) evaluate herd records, and utilize knowledge of dairy herd management software and computer presentation tools; 3) critically evaluate dairy herd management practices and make recommendations for improvements; 4) test their speaking, presentation, and problem-solving skills; 5) work as a team to build consensus and tag-team speaking formats; and 6) meet and interact with potential employers from the dairy industry during the contest. Teams of four undergraduate students critically evaluate a commercial dairy farm using herd records, a description of farm operations, and tour of the farm facilities. The farmer answers questions pertaining to management of the farm in a group interview with all teams and in a separate interview with each individual team. Teams give a 20-minute presentation that is scored on the description and assessment of the management practices and recommendations for improvements in management and facilities. Additionally, scoring is based on apparent level of preparation, speaking, presentation skills, and responses to judges' questions. The judges are university specialists and dairy industry professionals. This capstone experience allows students to interact with dairy farmers and representatives from the dairy industry, and expands their knowledge and skills gained during their academic career.

Key Words: Undergraduate, Dairy herd management, Industry

100 Undergraduate research: a win-win proposition. C. M. Wood*, *Virginia Tech.*

Experiential learning is an important component of the undergraduate program in the Animal and Poultry Sciences (APSC) Department at Virginia Tech. Undergraduate research has become an increasingly important facet of that learning. Reasons include: many students are interested in the sciences, specifically veterinary medicine, and they are

encouraged to gain such experience; faculty have become more aware of the valuable resource these students represent; and students can earn credit toward their degrees. Undergraduate APSC students become involved in research projects on and off campus via several routes: volunteering in research labs and at the animal units; interning at branch stations throughout Virginia; participating in programs at other universities and institutions; and studying abroad. To earn direct credit for undergraduate research, students must have junior standing and at least a 2.75 GPA. They must take ownership of their project, from planning the design, to conducting the research, to final write up and presentation. Students that do not meet those criteria, but put substantial effort into on-going research projects, can earn independent study credit. All such proposals must meet quality standards before they are approved. In five years (Fall 1998 - Spring 2003), 81 students working with 18 APSC faculty will have earned 157 credits for undergraduate research. Of those students, 18 were non-majors. Projects have ranged from botanicals in poultry feed to conformation analysis in horses. Students have presented the results of their research projects at regional and national meetings. One student will present results in Europe this summer. At least 40 of the 81 have continued on to graduate or professional school. Involving undergraduates in research conducted by faculty members can be beneficial to both parties. Faculty gain help in conducting research, and can recruit outstanding students into graduate programs. Students learn to apply principles learned in the classroom, gain valuable work experience, obtain a wider exposure to career possibilities; and often get a jump start in graduate school.

Key Words: Research, Undergraduate education

101 Biotechnology for the animal science classroom - Development of an inquiry-based curricula for undergraduate and graduate students. S. T. Willard*, T. R. Smith, and P. L. Ryan, *Mississippi State University, Mississippi State, MS.*

The objective of this educational program was to develop a pilot course to instruct graduate and undergraduate students on the theories and practices behind laboratory-based biotechnological procedures. A course was created under the "Special Topics" option to accommodate both graduate ($n = 6$) and junior/senior level undergraduate ($n = 6$) students as a split-level course. Graduate students were randomly paired with an undergraduate student as laboratory partners. The six laboratories consisted of (I) Restriction Digest of DNA, (II) DNA Fingerprinting, (III) PCR, (IV) Protein Fingerprinting, (V) Bacterial Transformation and (VI) an Immunocytochemistry laboratory. After each module,

students were asked to complete a laboratory report and an evaluation form to assess usefulness of the lecture and laboratory material, and to evaluate the working relationship between graduate and undergraduate students. Evaluations were conducted based on a 1 to 5 scale (1 = Strongly Disagree and 5 = Strongly Agree), and were analyzed to ascertain differences between modules and graduate versus undergraduate student respondents. At the conclusion of the course, a final overall course evaluation was conducted to assess student perceptions of the course as a whole. The overall course evaluation revealed that the students felt the course was relevant to the animal sciences (4.3 ± 0.14), the lecture and laboratory materials complimented one another (4.3 ± 0.13), that they learned a lot from the course (4.1 ± 0.23), and that what they learned would be useful later in life (4.2 ± 0.17). There were no cases where undergraduate students and graduate students differed across scoring categories (Agree vs. Disagree) on the individual modules or the overall course evaluations. Students agreed that pairing graduate with undergraduate students was beneficial (3.9 ± 0.26), and agreed that they worked well with their laboratory partner (3.8 ± 0.33). However, most disagreed that this type of course should be mandatory at the undergraduate level (2.8 ± 0.31). In summary, both undergraduate and graduate students agreed that this type of course was beneficial and complimented their current academic programs. [This study was supported, in part, by a William White Special Projects grant].

Key Words: Teaching, Biotechnology, Science education

102 Adding value to education: an undergraduate animal sciences internship program. K. E. Fike* and A. K. Lahmers, *The Ohio State University*.

Internship experiences became a required component of the undergraduate curriculum in the College of Food, Agricultural and Environmental Sciences at The Ohio State University in 1998. With approximately 450 undergraduate students in the Department of Animal Sciences, a structured and centrally-coordinated internship program was developed to: 1) facilitate the development of new internship opportunities for students, 2) incorporate a more substantial preparation and evaluation component to the internship experience, 3) facilitate ease of management by academic advisors, and 4) enhance the career development of students. Students are required to complete 200 to 400 work hours in an advisor-approved internship experience for 3 to 5 credit hours, graded satisfactory/unsatisfactory. Upon completion of the internship, students are required to present their internship experience to students, faculty, and staff at a quarterly Internship Forum. During the fall of 2002, approximately 75 students presented their experiences at the Internship Forum in areas ranging from avian research to dairy nutrition to emergency veterinary medicine. Internship job descriptions and supervisor contact information are maintained within the Department's Student Advising Center and student-initiated internship contacts are available for use by other students evaluating internship opportunities. Weekly emails provide students and advisors current information on available positions and application information. The Department's Student Services Coordinator assists students with internship searches, resume and cover letter development, interview and job search skills, and career planning. Preliminary observations indicate that participation in the Internship Forum has facilitated increased awareness, by students and advisors alike, of the variety of career opportunities available for Animal Sciences majors. Students also gain valuable communication experience through development and presentation of their internship experience to faculty and fellow students.

Key Words: Internship, Career, Teaching

103 Experiential learning through a short-term dairy internship program. A. Ahmadzadeh*¹, M. A. McGuire¹, and R. Hatch², ¹*University of Idaho, Moscow*, ²*Kowz R Us Dairy, Castelford, ID*.

Experiential learning is essential in preparing future graduates to advance knowledge and technology. The objective of this five-day course is to enhance students' learning experience in dairy management. To accomplish this objective we developed this program to enhance student knowledge, communication skills, and hands-on experience to better prepare them for the challenging dairy industry. This one-credit short-internship course is designed to expose animal and dairy science lower classman to modern dairy facilities, management strategies and practices of a dairy herd, and to allow them to interact with herd health

veterinarians and representatives of allied dairy industry. During the five-day period, students: a) tour several progressive dairy farms, a feed mill, and a dairy processing plant; b) work for two days on separate dairy farms and become intimately involved with all aspects on daily activities of a dairy (e.g. artificial insemination, balancing feed rations, assisting with animal treatments); c) travel with a representative of allied dairy industry (e.g. nutritionists, technical service personnel); and d) spend one day with a herd-health veterinarian and review all aspects of the herd health program while assisting the veterinarian. Furthermore, there are two evenings of round table discussion to share experiences and challenge students about the dairy industry. All students are required to submit a report after completion of the internship in order to earn the credit. This course provides students with the means to apply, analyze, synthesize and evaluate the knowledge they construct in the context of real-world situations. The project utilizes cognitive methods, which merge students into authentic practices through activity and social interaction in a way similar that of learning by craft apprenticeship.

Key Words: Dairy education, Experiential learning, Partnership

104 Recent advances in animal welfare: a Purdue-Michigan State long distance video course. E. A. Pajor*¹ and A. J. Zanella², ¹*Purdue University*, ²*Michigan State University*.

The field of animal welfare includes various scientific disciplines. Graduate courses in animal welfare that reflect its interdisciplinary nature and expose students to the latest scientific advances are lacking. In order to address this deficit we have developed the first long distance, multi-disciplinary, multi-instructional course for senior undergraduates and graduate students at Purdue and Michigan State University. Multiple lecturers allowed us to take advantage of the expertise available at both universities. Lecturers addressed a variety of issues relevant to animal welfare including, animal ethics, physiology, cognition, companion animal issues, euthanasia, and economics. Lectures originated at Purdue or MSU and were video-linked to the partner university. This course was offered as a 2 credit course and consisted of a 1-h lecture and 1-h discussion of a recent scientific paper. Course objectives included; a) developing an understanding of the intricacies associated with animal welfare science b) introducing students to the ethical issues associated with animal use and c) developing skill to critically evaluate the scientific literature as well as their own research in animal welfare. Evaluation included a midterm and a final examination. Students also submitted a written evaluation of each week's assigned paper and were awarded a significant number of points for their contribution to the weekly discussion. In addition, students prepared a term paper and gave a presentation based on their term paper or their graduate research project at a joint meeting at MSU during the last week of class. Student evaluations of the course at both institutions were fairly positive with all students encouraging the course organizers to offer the course again. Criticisms of the course included concerns over the effectiveness of distance learning and a desire to have met the students at the partner universities at least twice, at the beginning and the end of term.

Key Words: Distance education, Animal welfare, Teaching

105 Animal welfare judging: multimedia training material. D. R. Hains* and E. A. Pajor, *Purdue University*.

The welfare of farm animals is an issue of increasing societal concern. Training students in the objective assessment of animal welfare should be a goal of animal science departments. Using the traditional animal science livestock judging team as a model, the animal welfare judging teams have recently been developed (Heleski et al., 2001). In order to help teams comprehend animal welfare concepts and to prepare for competition we have developed a) a series of computer-based educational modules b) reading lists, and c) other animal welfare orientation activities. There are presently 6 modules in the computer based training package. The first is an introduction to the basic concepts and definitions used in the field of animal welfare. The next 5 modules are species specific covering swine, dairy, equine, poultry and beef cattle. Each module provides an overview of animal welfare related recommendations, indicators and issues associated with each of the various production stages, specific to that species. In order to clarify behavioral indicators of stress, Quick Time video clips have been integrated within the power point presentation. Examples include such abnormal behaviors as tongue rolling in cattle, cribbing in horses, bar biting in swine and feather pecking in poultry. Other topics within each species module

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 ruminant 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