

CS reduced LMA when compared to CON (86.1 vs 82.5 cm²; P < 0.04). Partial replacement of SFC with DDG yields satisfactory performance and carcass characteristics in cattle fed diets with CS as the roughage source. Additionally, it is possible to remove a significant portion of dietary roughage in diets containing DDG without compromising performance.

Table 1. Performance of heifers fed steam-flaked corn with dry distiller's grains with reducing roughage levels

Item	CON	HIGH	LOW	SEM	Contrasts		
					1	2	3
DMI, kg	9.01	8.77	8.52	0.16	NS	0.05	NS
G:F	0.146	0.148	0.151	0.59	NS	NS	NS
HCW, kg	312	309	309	3.20	NS	NS	NS
Prime/Choice, %	55.89	62.24	61.93	4.11	NS	NS	NS
Yield grade, avg	2.62	2.74	2.66	0.07	NS	NS	NS
Yield grade 4 & 5, %	5.68	14.12	11.09	3.13	0.07	NS	NS

Contrast 1: 0% DDG and 15% CS vs. 25% DDG and 15% CS; Contrast 2: 0% DDG and 15% CS vs. 25% DDG and 5% CS; Contrast 3: 25% DDG and 15% CS vs. 25% DDG and 5% CS

Key Words: Steam-Flaked Corn, Finishing Cattle, Dry Distiller's Grains

530 Effect of crude glycerin in finishing cattle diets. N. A. Pyatt, P. H. Doane, and M. J. Cecava*, *ADM Animal Nutrition Research, Decatur, IN.*

One hundred fifty-eight Angus-cross steers (387.4 ± 1.6 kg) were used in a 2 × 2 factorial to assess the effects of diet type (grain or co-product) and crude glycerin on feedlot performance. The grain diet consisted of (DM basis) 70% cracked corn, 15% corn silage, 10% DDGS, and 5% supplement; the co-product diet consisted of 35% cracked corn, 30% DDGS, 15% soyhulls, 15% corn silage, and 5% supplement. Glycerin replaced 0 or 10% corn in both diet types. Cattle were blocked by weight (4 pens per treatment), weighed at 28-d intervals, and processed at a constant backfat endpoint (116 to 153 d on feed). Period and cumulative (d 1-116 and 1-153) data were analyzed. No significant (P > 0.10) interactions were observed. Cumulative ADG was 11.4% greater in cattle fed grain diets with glycerin and 2.5% better for steers fed co-product diets with glycerin. Cattle fed co-product diets had 9.7% greater (P < 0.05) DMI relative to cattle fed grain diets (8.74 vs. 9.59 kg/d, respectively). Feeding glycerin resulted

in 10.1% lesser (P < 0.05) DMI (9.65 vs. 8.68 kg/d, respectively). Glycerin decreased DMI by 8.1% for the grain diet and 11.8% for the co-product diet. Feed efficiency was 11.0% greater (P < 0.05) for cattle fed grain diets versus co-product diets. Glycerin improved feed efficiency by 19.2% (P < 0.05). Feed efficiency improved by 21.9% and 16.4% when glycerin was fed in the grain and co-product diets, respectively. These data suggest that feeding crude glycerin can improve efficiency of cattle fed high-grain diets. Furthermore feeding crude glycerin in combination with co-products like DDGS and soyhulls may diminish feed intake but improve feed efficiency.

Key Words: Feedlot Cattle, Crude Glycerin, Co-Products

531 The effect of forage allowance and stage of growth on average daily gain, frothy bloat, and rate of ruminal in vitro gas production in steers grazing wheat pasture. W. E. Pinchak*¹, B. R. Min¹, D. P. Malinowski¹, J. W. Sij¹, J. D. Fulford¹, and R. Puchala², ¹Texas Agricultural Research Center, Vernon, TX85, ²E (Kika) dela garza American Institute for Goat Research Center, Langston, OK.

A combination of grazing and in vitro experiments were conducted over 3 yrs. to determine the effect of plant chemical composition, forage allowance and two stages of growth on the severity of bloat and ADG in steers grazing wheat forage. Concurrently, in vitro ruminal gas production was quantified at the same time of bloat measurement. Wheat forage protein dynamics, related with forage allowance and plant stage of growth, are presented. ADG was greater for high forage allowance than for low forage allowance during yr 2004 (P < 0.01) and 2005 (P < 0.001). Mean bloat score tended to differ with forage allowance during vegetative (P = 0.07) and reproductive (P = 0.16) stages of growth. Across the yrs, average percentage of bloated steers in the low forage allowance treatment was consistently less (21 vs. 45%; P < 0.001) than in animals grazing the high forage allowance treatment. Bloat frequency on wheat forage is temporally variable with most frothy bloat occurring during the vegetative stage of growth (32%) compared to the reproductive stage of growth (13%). Frothy bloat negatively effected (r = -0.37 to -0.54; P < 0.001) and linearly decreased (P < 0.001) ADG in steers grazing wheat forage. Average in vitro potential gas and methane production were greater (P < 0.001) for the reproductive stage of growth than for vegetative stage of growth. Wheat forage bloat is a complex disorder that varies across stage of plant growth, forage allowance and experimental yrs. Frothy bloat negatively impacts ADG and animal performance.

Key Words: Average Daily Gain, Frothy Bloat, Gas Production

Teaching/Undergraduate & Graduate Education: Shaping Animal Sciences Curricula for 2020

532 Animal sciences curricula: A historical perspective. J. A. Sterle*, *Texas A&M University, College Station.*

When the Land Grant University system was officially started at the time President Lincoln signed the Morrill Act in 1862, animal husbandry courses were already being taught at various colleges and universities across the country. Soon, individual courses began to develop into series, and series into an overall curriculum. Originally set

up to teach farmers' and ranchers' sons new technological advancements so they could return to the ranch, courses included nutrition, animal breeding and reproductive physiology. Curricula in animal science departments across the nation has developed, ebbed and flowed over time in response to a variety of factors. "Husbandry" became "science", and not in name only. New disciplines, from ethology to genomics, and new technology, from molecular biology techniques to artificial insemination brought about new courses and new requirements in

degree plans. Departments of Animal Science, Dairy Science, and Poultry Science faced the decision of whether to remain separate entities or join together. Capstone courses became popular in the 1990s, bringing together concepts and information from multiple courses, bridging gaps between them. Changing demographics influenced courses as well. These changes not only included the addition and eventually acceptance of women in the animal science field, but also the more recent influx of students with little to no animal agriculture background. This latest change is currently forcing many departments to go “back to the basics”, and teach students things that were previously assumed known, such as how to handle livestock, or explaining more of the “whys” of production practices, instead of only the “hows”. Career opportunities have also influenced curricula. Instead of graduating and moving back home to take over the family operation of producing food and fiber, today’s graduates choose from a huge variety of professions previously unheard of, including the feeding or pharmaceutical industries, meat science and food safety, and public policy. Professional school opportunities are also accepting more animal science graduates than previously, including veterinary, medical, dental and law school.

Key Words: Teaching, Curricula

533 Changing demographics and enrollment trends. K. L. Esbenshade*, *North Carolina State University, Raleigh.*

The demographics of the population in the US are shifting resulting in changes in the composition of students attending higher education (HE) and studying agriculture and related subjects. Between 1900 and 2000, the US population living in metropolitan areas increased from 28% to 80%, the average age increased from 22.9 to 35.3 years, and the percent non-white increased from 12 to 25. The US foreign-born population was 13.6% in 1900, 4.7% in 1970 and 7.9% in 1990. Before 1960, more than 80% of the immigrants were European, after which the majority of immigrants were from Latin America and Asia. The current distribution of non-whites is not equal among the states, with southern and western states being more diverse. The number of high school graduates peaked in 1978 and has remained steady during the past decade averaging 2.7 million students annually. Between 1970 and 2000, enrollment and degrees awarded in HE increased 78% and 72%, respectively, with associate, bachelor (B), master (M) and doctoral (D) degrees increasing, respectively, 129%, 48%, 103% and 40%. In 2004, 14.8 million undergraduate students were enrolled and 1.4 million B degrees awarded. Between 1976 and 2004, B degrees awarded to females increased from 46% to 59%, to minority students from 17% to 34%, and to nonresident aliens from 2% to 3%. Between 1970 and 2000, the number of B, M and D degrees awarded in agriculture and natural resources (ANR) increased 84%, 74% and 4%, respectively, representing 1.9% of the total B degrees awarded in 2000. ANR B degrees awarded to females were 4% in 1970 and 45% in 2000, and to minority students were 9% in 1991 and 11% in 2003. The number of B degrees in animal science (ANS) increased 27% between 1987 and 2003 representing 17% of ANR degrees in 2003. B, M and D degrees awarded to females in ANS were, respectively, 70%, 53%, and 34% in 2002. The demographic trends in the US are projected to continue with the population becoming older, more diverse and living in major metropolitan areas. HE, ANR and ANS must adapt their academic programs to be relevant and to serve these populations in the future.

Key Words: US Demographics, Enrollment, Students

534 Curricular trends: Shifts in traditional animal sciences courses and degree programs. J. C. Swanson* and D. A. Nichols, *Kansas State University, Manhattan.*

During the past 20 years dramatic changes have taken place in animal agriculture. Concurrent with this change has been shifts in the demographic of students entering into the animal sciences. Scientific discoveries and development of technologies in the animal sciences have widened the scope of opportunity beyond the traditional staples offered in animal science teaching programs. For example, some departments have introduced a biotechnology option for students desiring a career path that could lead to employment in different scientific communities. Companion animal science, equine science, zoo or exotic animal biology and management, and food safety and biosecurity are examples of emerging areas where students desire to apply their animal science training. The current focus on animal care, welfare assessment, and auditing may offer placement opportunities for students in food animal production programs, government animal care assurance, or in biomedical research facilities. Animal science departments should consider the unique niche it occupies in the understanding of the biology, care, production, and management of animals under domestic or captive conditions. Also, regional differences in student demographics and stakeholder needs play a role in curricular development or revision. We are not proposing an abandonment of current livestock and poultry curricula. We propose to extend our expertise in the understanding and management of animals, and the related development and application of science and technologies, for students interested in alternative career paths.

Key Words: Animal Science, Curriculum, Trends

535 Thinking outside of the box: Incorporating innovative experiential & inquiry-based learning opportunities. J. N. Spain*, *University of Missouri, Columbia.*

Student learning is accomplished through a wide array of teaching methods. Lectures and note-taking is a staple approach applied in large and small courses. In animal agriculture, we have an opportunity to incorporate active engagement of students through experiential and inquiry-based learning. The use of teaching farms allows instructors to take advantage of place based learning that allows students to connect new knowledge to several senses. The ability of instructors to challenge students to apply knowledge and facts to problems that are real life scenarios gives students a learning advantage. Indeed, experiential learning can be incorporated into the curriculum from first semester introductory courses through capstone courses that utilize student managed teaching herds and flocks. Challenging students through learner driven inquiry-based learning is also effectively incorporated into animal/dairy/poultry science curriculum. One prime example is undergraduate discovery research which allows the student to experience the research process. Another example of inquiry based learning involves the use of bioethics based courses. Experiential and inquiry based learning is effectively used to enhance student learning and understanding.

Key Words: Experiential Learning, Inquiry Based Learning, Animal Science

536 Thinking outside the box: Linkages with agencies and educational opportunities for undergraduates and graduate students. M. A. Ottinger*, *University of Maryland, College Park.*

The range of career paths and training requirements has become increasingly complex in the animal sciences. As a result, our students often spend most of their time in the classroom and some highly motivated students seek experience at veterinary clinics to meet the criteria for acceptance to professional school. Experiential learning and internships provide opportunities for broadening the experiences of our students outside the classroom. Internships in agriculture related organizations, which may be involved in research, policy, or many other potential activities provide wonderful opportunities for our students to deepen their understanding of the demands of various careers. At the University of Maryland, our students can work with numerous federal and state agencies, other universities, and private corporations. Working relationships with these entities may be on many levels, including MOUs, centers, adjunct faculty, or informal collaborations. Student internships may be for academic credit, as volunteer or paid positions. It is critical that these experiences have some type of structure to ensure high quality and commitment by student and the agency mentor. The types of positions and several methods for structuring this program will be discussed, including establishing MOUs and consideration of appropriate work demands and deliverables from the student. These partnerships with scientists and professionals in regional federal and state agencies can provide benefits for our students, including extending their technical capabilities and providing experience in a range of potential career choices. These experiences will encourage our young scientists to become enthusiastic contributors to agricultural sciences and energize them in interesting career paths in global agricultural programs. Furthermore, networking with our international collaborators will keep us on the cutting edge of international advances in agriculture and in affiliated disciplines.

Key Words: Experiential Learning Opportunities, MOUs with Agencies, Internships and Academic Credit for Student Interns

537 Animal sciences curricula: Future directions. T. Field*, *Colorado State University, Fort Collins.*

The fortunate reality of offering a futuristic perspective is that we are rarely held to account for our predictions. Nonetheless, our profession and our students will be faced with one certainty - change. Demand for food, fiber, and other products originating from livestock and poultry will increase on a global scale. Concurrently, consumers will demand higher value, more convenience, better food safety, environmental compatibility, and evidence of excellent animal husbandry in our production practices. The opportunities for graduates of animal, dairy, and poultry science programs will continue to diversify as will the availability of enhanced tools and technologies that can be applied in the industry. Practitioners of our craft in the future will have to successfully merge biological, financial, public policy, marketing, and human resources skills to be successful in the future. While technical training will continue to be an important focus of our teaching efforts, our students will not be well prepared for the challenges that will confront them unless they receive an education that is also broad in scope - particularly at the bachelors and masters levels. Curriculum design must also accommodate training that moves students beyond disciplines and into the realm of systems thinking and multi-disciplinary problem solving. Effective curricula will contain significant experiential learning opportunities, case-based course design, and international study. The challenge of the future will be to find the optimal balance of rigor, depth, breadth, and customization in the development of a course of study.

Key Words: Future, Curricula, Students

Growth and Development - Livestock and Poultry II

538 Ontogenic expression of microRNA in bovine mammary gland. A. V. Capuco*¹, L. L. Coutinho², C. M. Evock-Clover¹, A. Minuti³, T. S. Sonstegard¹, Y. R. Boisclair⁴, M. E. Van Amburgh⁴, G. Bertoni³, and L. K. L.K. Matukumalli¹, ¹*Bovine Functional Genomics Laboratory, USDA-ARS, Beltsville, MD*, ²*University of Sao Paulo-ESALQ, Piracicaba, SP, Brazil*, ³*Institute of Zootechnics, Catholic University, Piacenza, Italy*, ⁴*Cornell University, Ithaca, NY.*

MicroRNAs (miR) are small RNA molecules (~22 nucleotides) that are important regulators of numerous biological processes, including organ and tissue morphogenesis and function. In this capacity, most miR inhibit protein synthesis by binding to the 3'-untranslated region of targeted mRNA species. Hundreds of genes can be regulated in this fashion. The objective of this experiment was to evaluate expression of miR in mammary tissue from Holstein cows at different developmental and functional stages. Tissues were obtained from: prepubertal heifers (6 mo) that were (1) intact, (2) ovariectomized, (3) intact + estrogen, (4) ovariectomized + estrogen; (5) from primiparous cows, 100-250 d of gestation; (6) from lactating cows, 14 d lactation; (7) from cows

during the dry period, 40 d dry and 20 d prepartum. Total RNA was extracted from three or four animals at each stage and pooled to determine patterns of miR expression by hybridization to a microarray containing modified RNA targets complementary to all known miR. Expression of miR such as miR-221 and miR-127 appeared to be differentially expressed prepubertally. Expression of miR-615 was enhanced by estrogen treatment and miR-29a by ovariectomy. During first gestation, expression of miR-20a was increased. During lactation, miR were typically expressed at low levels, but there was increased expression of a limited number of miR, including miR-326 and miR-350. During the dry period, there was increased expression of miR-542-5p and miR-690. We subjected individual RNA samples to quantitative RT-PCR and confirmed patterns of expression revealed by microarray in 4 of 5 genes tested. Our quantitative RT-PCR results confirmed the utility of evaluating miR expression by microarray and suggested that miR function as regulators of mammary gland development and function.

Key Words: Regulatory RNA, Gene Expression, Lactation