

and increased 6 I neutral AAT and PepT1 mRNA. For a given class of transporter, mRNA expression was altered such that potential capacities of apical and basolateral membranes were changed in a parallel manner. These findings provide an initial understanding of the basal expression of bovine NT and AAT genes and their responsiveness to increased substrate or energy supply.

Key Words: amino acid transport, nucleoside transport, nutrient-gene interaction

486 Molecular adaptations in transition dairy cows. J. J. Loor*, *University of Illinois, Urbana.*

The periparturient period is characterized by dramatic alterations in metabolism and function of immune cells and key tissues such as liver, adipose, and mammary. Understanding the molecular adaptations of tissues during this physiological state remains a great challenge. Development of transcriptomic technologies has dramatically accelerated the rate at which biological information can be collected from agricultural animals. Use of oligonucleotide bovine microarrays on liver, adipose, and mammary tissue from transition dairy cows has demonstrated the potential of high-throughput technologies for identifying genes involved

in regulating and coordinating function and crosstalk among tissues. Work examining the role of prepartum level of dietary energy has revealed unique clusters encompassing functional categories including signal transduction, cell-to-cell signaling, molecular transport, insulin signaling, lipid metabolism (synthesis and beta-oxidation), immune or inflammatory processes, and cell death in adipose as well as liver. High-throughput technologies and associated bioinformatics tools are especially well-suited for studying the complex regulation of transcriptional networks in tissues from transition cows. Major advances in understanding biology of the transition cow may come from coupling existing knowledge of enzyme kinetics, biochemistry, and hormone action with transcriptomics, proteomics, and metabolomics approaches. Using a systems biology approach to integrate data generated at the mRNA, protein, metabolite, and tissue level can allow the assembly of the important components needed to model the transition cow. Such models will prove useful in determining how we can manipulate complex processes that could have significant long-term economic impact, e.g., lactation persistency, fertility, and efficiency of conversion of feed to milk. An important goal of the future will be to apply additional experimental tools (e.g., gene silencing, chromatin immunoprecipitation) and bioinformatics (e.g., transcription factor binding site identification) to studies focused on periparturient cows.

Key Words: transcriptomics, energy balance, systems biology

Small Ruminant: Production, Management, Lactation

487 Effects of kid genotype on carcass traits of meat goats from a three-breed diallel. R. Browning, Jr.*¹, W. Getz², O. Phelps³, and C. Chisley⁴, ¹Tennessee State University, Nashville, ²Fort Valley State University, Fort Valley, GA, ³USDA-AMS, Lakewood, CO, ⁴Southern University, Baton Rouge, LA.

Purebred and reciprocal crossbred buck kids (n = 275) from a complete diallel mating of Boer (B), Kiko (K), and Spanish (S) breeds were harvested at about 33 wk of age over three yr to assess breed of kid effects on carcass traits in meat goats. Kids were raised post-weaning on summer pasture supplemented with 0.4 kg/d of 16% CP pelleted feed. Each kid and carcass was graded using USDA meat goat standards. Live kid and chilled carcass grades differed ($P < 0.01$) among genotypes. Purebred BB had better ($P < 0.01$) live grades than KK and SS kids; whereas BB and KK had better ($P < 0.01$) carcass grades than SS. Among the crosses, BK and SB graded better ($P < 0.01$) live than KB, SK, and KS; carcass grades were better ($P < 0.01$) for BK than for KB, SB, and SK. Live weight, chilled carcass weight (without kidney-pelvic fat), and chilled dressing percent varied ($P < 0.01$) by genotype. Live and carcass weights among purebreds were heavier ($P < 0.01$) for KK (26.8 ± 0.8 kg; 11.2 ± 0.4 kg) than for BB (23.3; 9.3) and SS (23.2; 9.6). Crossbred live and carcass weights differed ($P < 0.01$) only between SK (27.0 ± 0.7 kg; 11.5 ± 0.4 kg) and SB (24.2; 9.9). Chilled dressing percent was higher ($P < 0.01$) for KK (41.6 ± 0.5%) than for BB (39.9). Among crosses, dressing percent was higher ($P < 0.01$) for SK (42.4 ± 0.4%) and KS (42.2) than for BK (40.9), KB (40.9), BS (40.2) and SB (40.5). Foreleg, hindleg, and combined boneless fore- and hindleg weights were affected ($P < 0.01$) by genotype. Purebred KK were heavier ($P < 0.01$) than SS and BB for each leg trait. Among the crosses, SK had heavier ($P < 0.01$) forelegs than BS and SB and heavier ($P < 0.01$) hindlegs and boneless leg than SB. Kid genotype did not affect lean content (69%) of leg cuts. Genotype affected ($P < 0.01$) loin weights. Loins were heavier ($P < 0.01$) for KK than for BB and heavier ($P < 0.01$) for SK than for SB. Kidney-pelvic fat differed ($P < 0.01$) by genotype. Among purebreds, internal fat was greater ($P < 0.01$) for KK (177 ± 16 g) than for BB

(74) and SS (119). Crossbred genotypes did not differ for kidney-pelvic fat. In conclusion, kid genotype has significant effects on carcass yield traits for meat goats.

Key Words: meat goats, breed, carcass

488 Advantages of using electronic identification for automated lambing data and body weight recording in sheep. A. Ait-Saidi, G. Caja*, S. Carné, and A. A. K. Salama, *G2R, Universitat Autònoma de Barcelona, Bellaterra, Spain.*

Manual (M), semi- (SA) and fully-automated (A) systems for sheep performance recording were compared in 2 on-farm experiments. System M used visual identification (plastic ear tags), on-paper data recording and manual typing for data uploading. Systems SA and A used electronic identification (20 g mini-boluses, 56 × 11 mm, containing 32 mm half-duplex transponders); performance data were recorded using a reader with keyboard in SA (i.e. lambing data) or automatically in A (i.e. BW), and data uploading was done automatically for SA and A. Each ewe wore an ear tag and a mini-bolus. Exp. 1 compared M and SA lambing recording (1.57 lambs/ewe) in dairy (n = 73) and meat ewes (n = 80) processed in groups of 10. Time for lambing data recording was greater in dairy than meat ewes ($P < 0.05$), due to the lower operator experience and because half of the dairy ewes needed ear tag cleaning, but when systems were compared, M was greater than SA ($P < 0.05$) for both dairy (1.11 vs. 0.80 min/ewe) and meat (0.78 vs. 0.68 min/ewe) ewes. Average time for data uploading was greater in M vs. SA (0.54 vs. 0.06 min/ewe; $P < 0.001$). Consequently, overall time for lambing recording was greater in M than SA in dairy (1.67 vs. 0.87 min/ewe; $P < 0.001$) and meat ewes (1.30 vs. 0.73 min/ewe; $P < 0.001$). Data uploading errors were 4.9% in M, but no errors were detected in SA. In Exp. 2, ewes' BW was recorded by M and A systems in dairy (n = 120) and meat ewes (n = 120). Ewes were processed in groups of 20 using an electronic scale which was interfaced to a computer for A. Weighing

time varied according to breed behavior and recording system, with M being greater than A (0.45 vs. 0.23 min/ewe; $P < 0.05$). Average time for data uploading (0.18 vs. 0.02 min/ewe; $P < 0.05$) and errors (8.8 vs. 0%) were greater in M than A. Overall time for BW recording in M and A was 0.63 and 0.25 min/ewe, respectively. In conclusion, the semiautomatic and automatic performance recording systems done through electronic identification increased the throughput and reliability of sheep recording data, which resulted in significant savings in farm labor time.

Key Words: sheep recording, electronic identification, transponder

489 Using retinal image recognition for auditing identity of live and harvested lambs. M. A. Rojas-Olivares, G. Caja*, S. Carné, and A. A. K. Salama, *G2R, Universitat Autònoma de Barcelona, Bellaterra, Spain.*

With the aim of auditing the traceability of sheep, retinal image recognition (RIR) was used in a total of 152 lambs of 2 breeds (Lacaune, $n = 70$; Manchega, $n = 82$). The RIR is based on the uniqueness and invariability of the retinal vascular pattern of the eye. Lambs wore ear tags and electronic boluses as controls. Retinal image and capturing time (CT) were recorded twice from the 2 eyes of each lamb using an OptiReader device (Optibrand, Fort Collins, CO), at: 3 (live, $n = 152$; slaughtered, $n = 50$), 6 ($n = 58$) and 12 mo of age ($n = 58$). The first 2 wk (264 images) were used for operator training. Digitalized images (1,272 images) were treated by using the Optibrand Data Management Software (v. 4.1.3) and 3 mo enrolment images used as the reference for further analysis. Intra- and inter-age comparison of pairs of images were done using the Optibrand's matching score (MS, range 0 to 100) with $MS < 80$ as exclusion criterion. Values of MS and CT in 3-mo images during the training period averaged 92.1 ± 0.8 and 144 ± 15 s, and improved to 96.4 ± 0.5 and 63 ± 5 s when the operator was trained. Intra-age breed effects were detected in MS at 3 mo ($P < 0.10$), but no effects were observed at 6 (96.2 ± 0.6) and 12 mo (96.3 ± 0.6); moreover, breed affected CT ($P < 0.001$) being longer in Lacaune than Manchega lambs, and decreased by age to 34 ± 4 s and 21 ± 2 s, for 6 and 12 mo respectively. Values in the slaughtered lambs were $67.4 \pm 2.0\%$ and 45 ± 7 s, both varying by breed ($P < 0.05$). Live vs. slaughtered image comparisons were unsatisfactory ($MS = 58.4 \pm 1.8$). Inter-age image analysis, used as traceability indicator, showed no effects ($P > 0.05$) by age (6 mo, 90.9 ± 1.2 ; 12 mo, 90.6 ± 1.1) and breed (Manchega, 91.7 ± 1.7 ; Lacaune, 89.9 ± 1.4). On average, MS and CT values were 90.8 ± 1.1 and 27 ± 2 s. Percentage of images showing an inter-age MS higher than 70, 80 or 90 were 97.5, 83.6 and 68.1%, respectively, indicating the convenience of using a $MS = 80$ as breaking value. In conclusion, RIR was a useful technology for auditing the identity of live lambs, but its use was not adequate in harvested lambs.

Key Words: retinal scannig, traceability, sheep

490 Comparison of body composition measurements in sheep using dual energy X-ray absorptiometry (DXA) *in vivo* and *post mortem*. A. M. Scholz*¹, C. Mendel², P. V. Kremer¹, E. Gruber¹, A. Steiner², K.-U. Goetz², and M. Foerster¹, ¹Ludwig Maximilians University Munich, Livestock Center, Oberschleissheim, Bavaria, Germany, ²Bavarian State Research Center for Agriculture, Institute for Animal Breeding, Poing, Bavaria, Germany.

Sheep breeders need to improve the performance of their herds steadily for economic reasons --especially in order to meet consumer demands. Therefore in this study, 39 male lambs were studied by dual energy

X-ray absorptiometry (DXA) at an average live body weight of 42.5 ± 2.6 kg and an average age of 111 ± 11.6 d. The male Merino (land type or 'Wuerttemberger') lambs originating from seven different Bavarian breeders and from two Bavarian research herds were fattened at the central Bavarian performance test station. The performance test started at an age between 6 and 10 wk and at a body weight between 20 and 24 kg. They received a concentrate diet with 18% crude protein and 10.5 MJ ME *ad libitum* and daily 300 g hay. At the end of the fattening period, a whole body scan was performed by DXA with a GE Lunar DPX IQ pencil beam scanner in order to measure the amount and percentage of fat tissue, lean tissue, and bone mineral *in vivo*. Four d later, the lambs were slaughtered. The whole, empty carcass without head (20.2 ± 1.9 kg) was X-rayed again with the GE Lunar DPX IQ scanner. *In vivo*, the 'pediatric large' whole body software mode was applied. The 'pediatric small' whole body software mode served for the scan of the carcasses. A regression model procedure using SAS 9.2 was used to analyze the data. There was a medium to high agreement between the *in vivo* and carcass measurements for all traits (table). The lower relationship between the DXA lean mass recordings is most likely affected by the varying filling state of the rumen *in vivo*. Unexpectedly, the highest coefficient of determination showed the DXA bone mineral (g) followed by DXA lean (%), and DXA fat (%). DXA measurements *in vivo* can predict the DXA carcass body composition of male Merino lambs with a high accuracy and may be used for performance testing in meat type sheep.

Table 1. Relationship between *in vivo* and carcass DXA measurements

Trait	Adjusted R ²	√MSE	F value*
DXA fat mass (g)	.73	466	105.1
DXA fat (%)	.74	1.92	111.5
DXA lean mass (g)	.43	1092	30.0
DXA lean (%)	.75	1.88	116.6
DXA bone mineral (g)	.84	41	195.8
DXA bone mineral (%)	.46	.18	33.1

Carcass DXA traits as predictors; * $p < .0001$ for all traits

Key Words: lambs, body composition, dual energy X-ray absorptiometry

491 Cost-benefit evaluation of implementing the electronic identification for performance recording in sheep farms. G. Caja*, M. J. Milán, A. Ait-Saidi, A. A. K. Salama, and S. Carné, *G2R, Universitat Autònoma de Barcelona, Bellaterra, Spain.*

Automated performance recording based on electronic identification (e-ID) proved to be a useful tool for increasing reliability of data collection and for saving labor/time in sheep farms. Despite this, there are few data available on cost-benefit analysis of implementing e-ID in practice. With this aim, previous results comparing manual, semi-automatic and automatic performance recording in dairy and meat sheep farms were integrated in a cost-benefit analysis under Spanish conditions. The analysis scenarios considered: production aim (dairy, meat), intensification level (semi-intensive, extensive), flock size (400, 700), lambing rhythm (1, 1.5), milking or milk recording frequency (once-, twice-daily), and included weighing (2, 3) and 1 annual flock inventory as stated in the current EU regulations. Annual extra costs (Euro 1 = \$1.3) necessary to buy the ID devices and the required reading equipment for e-ID ranged between 0.43 and 0.66 Euros/ewe according to scenarios. On the other hand, annual savings achieved by implementing

e-ID ranged between 0.36 and 0.79 Euros/ewe according to scenarios. As a result, benefits of using e-ID fully covered the annual extra costs in the case of dairy farms with 2X (or A4 milk recording) and in intensive meat farms having 1.5 lambing/yr. For dairy farms performing 1X (or AT method) or in extensive meat production, the savings only covered 93 and 86% of the extra costs for e-ID, respectively. Benefits of using automatic recording reached break-even points at: dairy sheep farms (477 ewes milked 1X, or 279 ewes milked 2X) and meat sheep farms (1,110 ewes under extensive, and 565 ewes under intensive management conditions). In conclusion, the implementation of electronic identification for performance recording showed to be cost-effective, especially for large flocks. Ongoing innovations and new software management will also make the use of e-ID more profitable in the future.

Key Words: cost-benefit, identification, sheep

492 Use of sodium dodecyl sulfate (SDS) as a microbicide in goat colostrum. A. Morales-delaNuez¹, J. Capote², M. C. Juste¹, D. Sanchez-Macias¹, N. Castro¹, and A. Argüello*¹, ¹Las Palmas de Gran Canaria University, Arucas, Las Palmas, Spain, ²Instituto Canario de Investigaciones Agrarias, La Laguna, Tenerife, Spain.

The present study aim was to evaluate the use of SDS as a microbicide in goat colostrum and the effects on passive immune transfer. Twenty goat colostrum samples from Majorera goat breed were treated with SDS at two concentrations, 0.1 and 1% during 1 h at 36°C, recording the colony forming unit (CFU) and IgG concentration at the beginning and at the end of the process. Twenty male goat kids were fed during 2 d with a colostrum pool that was previously divided in 2 aliquots, one untreated (n = 10) and other one treated with SDS at 1% (n = 10). After 2 d of age, goat kids were fed with milk replacer. IgG, creatinin, glucose, cholesterol, BUN, bilirubin, AST and ALT evolution was recorded on plasma during the first 5 d of age. Differences between IgG and CFU on colostrum for treatments were evaluated using a two Sample t test for means, while differences on goat kid blood parameters during the first 5 d of age were evaluated using a Proc Mixed model of SAS (V9.0). Treatment colostrum with SDS at 1% reduced the CFU from 6.5 to 4.6 log CFU/mL while colostrum treated with SDS at 0.1% did not show CFU reduction. IgG after SDS treatments (1 and 0.1%) was 10% lower than before treatments. No differences were observed for IgG, creatinin, glucose, cholesterol, BUN, bilirubin, AST and ALT during experimental period between goat kids that received untreated or SDS 1% treated colostrum. Previous results support the use of SDS as a new method for colostrums sanitation, although the effects of SDS on caprine arthritis encephalitis virus must be investigated.

Key Words: SDS, goat colostrum, immune pasive transfer

493 Testing the performance of a mechanistic mathematical model of the mammary gland in dairy sheep. C. Dimauro*, A. S. Atzori, A. Cannas, N. P. P. Macciotta, and G. Pulina, *Dipartimento di Scienze Zootecniche, Università di Sassari, Sassari, Italy.*

A mechanistic mathematical model of the mammary gland, which simulates the milk production process in dairy sheep, was constructed by using a computer-aided simulation with Stella software (Dimauro et al., 2007. *Livestock Science* 106, 200-209). The main inputs of the model were energy available for milk production coming from diet and energetic reserves at lambing. The outputs of the model were number of active alveoli throughout lactation, milk production, energy balance and

potential milk production. The objective of the present work was to test the model performance in dairy sheep fed a balanced diet. With this aim, the lactation curve of a mature Sarda dairy sheep was fixed assuming a milk production of 0.98 L/d at lambing, 1.50 L/d at peak and 0.50 L/d at the end of lactation. Body reserves were estimated assuming a BCS of 3.0 at lambing, 2.5 after 60 DIM, 2.8 after 150 DIM and 3.0 at the end of lactation. The SRNS model (<http://nutritionmodels.tamu.edu/srns.htm>) was used to design a balanced daily diet for that animal. The estimated daily energy from diet, minus the energy of maintenance, was used as external energy input of the model. In the first run of the model, the estimated lactation curve did not follow the expected one. Therefore, some model parameters were recalibrated to obtain the desired lactation curve. In particular, the optimal combination of active and progenitor alveoli at lambing was 9×10^9 and 4.2×10^9 , respectively. The model predicted the dynamics of the active alveoli throughout lactation, the energy balance and the potential milk production. Milk production over the entire lactation was 234 L, whereas total potential milk production was 256 L. The largest difference between estimated and potential milk production occurred from lambing to 60 DIM. In conclusion, the difference between daily milk production and potential daily milk production could be used to estimate the deficit of dietary energy which would have to be supplied in order to produce the maximum quantity of milk allowed by the mammary gland.

Key Words: mechanistic model, lactation curve

494 Effect of lamb age on response to immunization. M. E. Gailor, J. Gavalchin, and M. L. Thonney*, *Cornell University, Ithaca, NY.*

Lamb response to early immunization is not clear. The objective of this experiment was to determine whether the immune response would be different for lambs first vaccinated at 3 d (3D), 5 wk (5W), and 10 mo (10M) old. There were 5 lambs in control (C), adjuvant (A, 0.5 mL of 10% aluminum hydroxide) and vaccinated (V, 0.5 mL adjuvant + 0.25 mg of keyhole limpet hemocyanin (KLH)) treatments within each age group (45 lambs). At 2 and 4 wk after the initial vaccination, blood samples were taken in order to measure KLH-specific lymphocyte proliferation and antibody (Ab) production, and the animals were revaccinated. Samples were also taken 6 wk after the initial vaccination. The statistical model for log-transformed data included the effect of vaccine treatment, lamb age, lamb as a random variable within vaccine treatment and lamb age, sampling time and all interactions (repeated measures model). In vitro lymphocyte proliferation responses to KLH relative to no stimulation or to stimulation by concanavalin-A (ConA) or pokeweed mitogen (PWM) were positive but unrelated to vaccination. Lymphocytes from the 10M lambs and those from the earliest sampling times had the highest proliferative response to KLH, but lamb age x sampling time interactions ($P < 0.01$) complicated the interpretations of proliferation responses to ConA and PWM. Serum KLH Ab was affected by a vaccine treatment x lamb age interaction ($P < 0.001$). V lambs had higher Ab levels than C or A lambs at all 3 ages but the response was greatest for 5W lambs. There was a lamb age x sampling time interaction ($P = 0.001$) for log₂ values of KLH Ab titers measured in serum of V lambs (Table 1). At 2 wk after initial vaccination and prior to the first booster, titers were very low for 3D lambs, much higher in 5W lambs and dramatically higher in 10M lambs. Surprisingly, titers declined in 10M lambs after both boosters while they increased in both 5W and 3D lambs. Perhaps this was the result of clonal exhaustion (functional state of non-responsiveness) due to chronic exposure to KLH in the 10M lambs. These results indicate that lambs less than 1 wk old are unlikely to respond to an initial vaccination, but that subsequent boosters are effective.

Table 1. Geometric means of antibody titers against KLH in serum of lambs vaccinated at 3 initial ages and sampled at 3 times after initial vaccination.

Wk after initial vaccination	3 d age	5 wk age	10 mo age
2	38	132	606
4	210	264	400
6	1213	765	264

Key Words: sheep, vaccine, age

495 Control of *Haemonchus contortus* using three chemical classes of anthelmintics and copper oxide wire particles in meat goat kids.

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Resistance to chemical anthelmintics is becoming a very common problem in many small ruminant herds throughout the US, with an increasing number of herds experiencing total anthelmintic failure. Research has shown copper oxide wire particles (COWP) to be a potential alternative to current chemical control products for *H. contortus* in sheep and goats. To determine the effectiveness of COWP, a research project was conducted to compare COWP to each of the three classes of chemical

dewormers in young meat goat does. Forty meat goat doe kids were available for this project and represented two age groups (fall and spring born). The does were randomly assigned within age group to one of five treatments: control, albendazole (20 mg/kg), COWP (2 g/hd), levamisole (12 mg/kg), or moxidectin (0.4 mg/kg). Fecal samples were collected and egg counts performed, using modified McMaster procedure on d 0, 7, 14, 21, and 28 for each animal. Anemia levels were monitored using the FAMACHA system. Animals were treated on d 0 according to their assigned treatment group and all animals were placed in dry lot on fescue hay and a pelleted feed for 14 d. After 14 d all animals were turned out on a highly infected pasture. Data were analyzed using Proc Mixed in SAS with age and treatment as fixed effects. Correlations between FAMACHA scores and FEC were all positive and significant. The correlation decreased at d 7 ($r = 0.37$, $P = .019$) but recovered by d 28 ($r = 0.50$, $P = .0013$). Treatment had an effect ($P < 0.01$) on egg counts on all days post treatment. Levamisole was the most effective treatment in both age classes on all days. There were no differences between other treatments except albendazole had lower egg counts than the others on d 7 of the experiment. In this study, COWP showed no reduction in fecal egg counts in young does. Over the whole study, COWP and moxidectin did not differ from the control treatment in reducing egg counts. All chemical classes reduced ($P < 0.05$) egg counts by d 7 when compared to the control but only levamisole was still lower by d 14.

Key Words: meat goat, parasite, COWP

Teaching/Undergraduate and Graduate Education: Teaching Issues

496 Comparative development of critical thinking skills in animal science undergraduates who enroll in evaluation courses. L. M. White* and K. D. Layfield, *Clemson University, Clemson, SC.*

Challenges faced by American colleges and universities are numerous, including preparing an individual that is capable of higher order thinking. This stipulates that a person is proficient at making independent decisions and thinking critically. Producing a person that is capable of these essentials is no easy task and has been the topic of much discussion and deliberation. Evaluation courses have remained an integral part of animal science programs throughout the country. An evaluation course teaches general accepted criteria for evaluating a particular animal, industry standards and rules to compare multiple animals, and emphasizes defense of judgments both written and orally. Popular opinion believes that students in an evaluation class gain needed and useful experience in judgment, analytical and critical thinking. These attributes of evaluation courses are believed to contribute to higher order thinking. Therefore, this study sought to quantify the change in critical thinking ability of students enrolled in an evaluation course. The Watson-Glaser Critical Thinking Appraisal (WGCTA) exam provided means to objectively analyze critical thinking ability by examining five constructs: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. The sample population consisted of students enrolled in evaluation courses (E) and a non-evaluation course (N) at Clemson University: Equine Evaluation (n=17), Livestock Evaluation (n=20), and Animal Reproduction (n=45). Students were issued the WGCTA during the first (pre-test) and last week (post-test) of class. The N group scored 19% of a standard deviation lower than the mean for both groups, while the E group scored 25% of a standard deviation higher than the mean. The mean change in score from pre-test to post-test for the N and the E group was -3.16 and 0.12, respectively and showed a trend toward significance ($P < 0.06$). Students enrolled in an evaluation course tended to have increased their critical thinking ability score from pre to post test.

Key Words: critical thinking, Watson-Glaser, evaluation

497 Enhancing underrepresented, minority student learning through agricultural and natural resources based research. R. L. Stanko*^{1,2}, S. D. Nelson¹, J. C. Laurenz³, and M. R. Garcia¹, ¹Texas A&M University, Kingsville, ²Texas AgriLife Research, Beeville, ³Eastern New Mexico State University, Portales.

A multi-disciplinary, multi-institutional project was initiated to increase the experiential learning of minority agriculture students. A focal point of this program was to provide first-hand experience to scientific research as an opportunity to increase skills in an ever-increasingly, competitive, and science-oriented job market. Two upper-level courses were established to teach experimental techniques and research methodology. One course was developed for teaching Experimental Techniques in Plant, Soil, and Environmental Science and the other for techniques in Animal Science. Courses combine experimental techniques and hands-on laboratory exercises. Students completing either course and interested in pursuing agricultural research in their own area of interest were encouraged to seek faculty mentors. USDA-Hispanic Serving Institution grant monies were made available and selected students were supported to serve as research aides, conduct research projects, and present research findings at annual symposia and professional society conferences. The program has expanded to include support for graduate students who receive short-term research experience external to the university. During the course of the project, 31 undergraduate and 11 graduate students were supported under the guidance of faculty mentors or senior scientists at collaborating institutions. Over 50% of participants were Hispanic, and 90.5% considered to be minorities in the agricultural sciences. Retention rate has been 100% with all students in the program either graduating or planning to graduate. Eight of the 11 (72.7%) M.S. students went on to Ph.D. or DVM and 14 of 31 (45.2%) B.S. graduates have continued onto M.S. thus far. All other graduating seniors have obtained career positions in their field of study within 3 mo. of graduation. Participation and completion of this program has given students experiential learning and skills necessary to make sound decisions concerning future employment