

-0.6, SEM= 0.2 mmol/L) and creatinine (A= +11.3, B= -7.3, C= -5.8, D= -7.2, SEM= 3.5 umol/L) concentration from d 0-28 increased in a quadratic ($P < 0.05$) manner as CP concentration of the diet increased. These results indicated that 13.5% CP diets were deficient, 15% CP

diets were marginal, and 16.5 and 18% CP diets were adequate for calves 2-3 months of age.

Key Words: Calves, Protein

Sheep Species: Sheep Production and Management

921 Cobalt supplementation to the pregnant ewe reduces vitamin E levels in the newborn lamb. T. M. Boland*, L. Hayes, J. J. Murphy, T. Sweeney, J. J. Callan, and T. F. Crosby, *University College Dublin, Belfield, Dublin 4, Ireland.*

The objective of this experiment was to determine the effects of offering supplementary iodine or cobalt during late pregnancy on lamb serum vitamin E and IgG concentrations at 24 and 72 h *post partum*. Sixty twin-bearing ewes were individually penned and offered grass silage *ad libitum* supplemented with 800g/ewe daily of a 190g/kg crude protein concentrate, with or without supplemental cobalt or iodine, from day 126 of gestation until parturition. Ewes were allocated to one of the following treatments: **C:** no mineral supplement; **I-3:** 26.6 mg iodine from day 126 – parturition; **I-1:** 26.6 mg iodine from day 138 – parturition; **Co-3:** 20 mg cobalt from day 126 – parturition. Colostrum yield was measured following hand milking at 1, 10 and 18 h *post partum*, after which the lambs were fed measured quantities of colostrum, via stomach tube. A 10 ml blood sample was taken from lambs at 24 and 72 h *post partum* for IgG and vitamin E determination. The efficiency of IgG absorption at 24 h *post partum* was lower in the progeny of ewes offered supplementary iodine for either one or three weeks (I-3; 0.08, I-1; 0.18) than in the progeny of the ewes not offered supplementary iodine (C; 0.26, Co-3; 0.28; $P < 0.001$) resulting in reduced IgG concentrations at both 24 and 72 h *post partum* ($P < 0.001$) in the lamb's serum. Lamb serum vitamin E concentration was lower for both of the iodine supplemented treatments than for Co-3 at 24 h *post partum* (2.02, 2.06 v. 2.48; sem 0.137), while at 72 h *post partum* the lamb serum for all mineral supplemented treatments (I-3, I-1 and Co-3) had lower vitamin E levels than in the control (C) lambs ($P < 0.01$). We conclude that not only do excessively high levels of dietary iodine in late pregnancy lead to a reduction in IgG and vitamin E transfer but that excessively high dietary cobalt in late pregnancy (20 mg per ewe per day) also leads to a breakdown in the transfer of vitamin E from colostrum to the serum of the newborn lamb.

Key Words: Cobalt, Iodine, Vitamin E

922 Evaluation of alternative small ruminant finishing systems for the tropics. S. A. Weiss*, R. C. Ketrang, and R. W. Godfrey, *University of the Virgin Islands, St. Croix, Kingshill.*

The objective of the experiment was to evaluate the growth and carcass characteristics of Dorper \times times; St. Croix White lambs managed in two types of post-weaning alternative pasture finishing systems in the tropics. After weaning and background grazing on native pasture for eight months, lambs ($n = 37$) were stratified by weight and sex into two treatments consisting of native pasture (NP) and improved pasture (IP), with energy supplement. Native pasture consisted of a mix of guinea grass (*Panicum maximum*) and hurricane grass (*Boithrocloa pertusa*), while IP consisted of a mix of seeded tropical legumes

(*Desmanthus vergatus*, *clitoria ternatea*, and *Lablab purpureus*) and volunteer guinea grass. All lambs were supplemented with crushed corn daily at 1% of BW for 100 d and slaughtered at approximately 365 d of age. During the finishing trial, IP lambs had greater total weight gain ($P < 0.0001$) than NP lambs (10.8 vs. 6.8 ± 0.6 kg, respectively). In addition, IP lambs had higher ADG ($P < 0.0001$) than NP lambs (112.2 vs. 66.5 ± 5.9 g/d, respectively). Compared to NP lambs, IP lambs were heavier at slaughter ($P < 0.0001$; 37.8 vs. 32.4 ± 0.9 kg, respectively), had heavier carcasses ($P < 0.0001$; 18.7 vs. 15.1 ± 0.6 kg, respectively), and greater dressing percentages ($P = 0.0633$; 49.5 vs. $46.7 \pm 1.1\%$, respectively). Further, IP lambs had greater leg circumference ($P < 0.0005$; 43.4 vs. 40.1 ± 0.6 cm, respectively), body wall thickness ($P < 0.0001$; 14.8 vs. 9.6 ± 0.7 , mm, respectively), and rib eye area ($P < 0.0001$; 12.9 vs. 10.1 ± 0.4 cm², respectively) than NP lambs. Back fat thickness for IP and NP lambs was 3.1 and 2.1 ± 0.3 mm, respectively ($P < 0.02$). The IP lambs had greater percent KPH ($P < 0.02$) than NP lambs (3.8 vs. $3.1 \pm 0.2\%$, respectively). In this study, crossbred hair sheep lambs grown under tropical conditions responded with improved growth rate and carcass muscularity to mixed legume improved pasture but had similar yield grades compared to lambs grown on native pasture.

Key Words: Sheep, Legumes, Pasture Finishing

923 Potential for onions to reduce bitterweed toxicity in sheep. E. S. Campbell*¹, T. R. Whitney², C. A. Taylor¹, and N. Garza¹, ¹Texas Agricultural Experiment Station, Sonora, TX, ²Texas Agricultural Experiment Station, San Angelo, TX.

Bitterweed (*Hymenoxys odorata*) toxicity is a major cause of death losses in sheep. Supplements high in sulfhydryl groups (i.e. L-cysteine) can be used to prevent bitterweed intoxication. Cull onions (*Allium cepa*) are an inexpensive and commercially available feed source that also contain high levels of naturally occurring disulfide compounds. Yearling Rambouillet ($n = 12$; 22.9 kg BW) and Dorper \times times; Barbado (Dorpad) ram lambs ($n = 12$; 22.5 kg BW) were used to evaluate whether onions have the potential to reduce bitterweed toxicity in sheep. Each breed was randomly assigned to one of four groups: no onions, 25% onions, 50% onions, and 75% onions (DM basis). The remainder of the isonitrogenous diet consisted of alfalfa pellets to provide 43 g DM/kg BW per d. The study was divided into three periods. Period 1 represented control data, prior to onion and bitterweed challenge. In period 2, lambs were incrementally adapted to respective onion diets for 14 d. In period 3 lambs were dosed with an aqueous slurry of dried bitterweed (0.25% live weight) for five days. At the end of each period blood samples were analyzed for serum chemistry measurements. Hematocrits, overall DMI and feed refusals were also measured. The statistical model included breed, onion level, and the two-way interaction. Following period 3 there was a breed effect ($P < 0.05$) for serum measurements reflective of bitterweed

toxicity; GGT and AST levels were higher ($P < 0.001$) for Dorpados (465.6 U/l and 877.0 U/L) than for Rambouillets (117.1 U/L and 186.5 U/L), indicating greater susceptibility to hepatic insult by bitterweed. Bilirubin, though numerically greater for Dorpados (0.542 mg/dL) than Rambouillets (0.400 mg/dL) did not vary by breed ($P > 0.10$). For period 3 there was an inverse correlation (-0.42 , $P < 0.05$) between level of onions in the diet and levels of serum GGT after bitterweed dosing. Results indicate that further study is required to confirm the benefit of onions as a prophylactic feed during periods of bitterweed consumption.

Key Words: Bitterweed, Sheep, Onions

924 Effectiveness of allopathic and homeopathic dewormers on gastrointestinal nematodes and gain in ewes. A. Baños L, E. Cortés D*, S. Vázquez, J. L. Zaragoza, P. A. Martínez, and T. González, *UACh-Chapingo, Mexico*.

The objective was to evaluate the effectiveness of 4 allopathic (Albendazole, Levamisole, Closantel, Avermectin) and 5 homeopathic (*Aconitum napellus* L, *Antimonium crudum*, *Azadirachta indica*, *Artemisia cina*, *Chenopodium ambrosoides*) dewormers on gastrointestinal nematode control and gain of hair sheep from two communities in Tepalcingo, Morelos, Mexico. Ten treatments were compared: the 9 dewormers and a control group. Treatments were assigned at random to ewes, 12 ewes per treatment. Fecal samples were taken directly from the rectum before deworming and every month from February 2005 to March 2006. Nematode egg count in feces was by McMaster and nematode identification by Coproculture. Ewes were weighed at the beginning of the study and every month thereafter. Allopathic dewormers were administered every 3 mo and homeopathic dewormers were administered at 2 wk intervals. Data were analyzed as a completely randomized split-plot design. The main plot was the dewormer and the sub plot was the sampling date. Nematode egg count was different ($P < 0.01$) among sampling dates and treatments. There were two peaks (April to May and November to January); both considered as a reflection of the nematode life-cycle in a tropical range and both occurred at the same time as lambing. Allopathic and homeopathic dewormers showed similar ($P > 0.05$) nematode-egg counts which were lower than in control ewes (872 eggs/g feces). Monthly live-weight change was not different ($P > 0.05$) among treatments. The average monthly live-weight change per ewe ranged from 2348 to -474 g. Nematodes found were *Trychostrongylus*, *Bunostomum* and *Haemonchus*. This study shows that gastrointestinal nematode load in hair sheep can be controlled either by allopathic or homeopathic dewormers.

Key Words: Internal Parasites, Sheep, Dewormer

925 Influence of feeding tanniniferous sainfoin on the nitrogen balance of lambs artificially infected with the abomasal nematode *Haemonchus contortus*. A. Scharenberg¹, Y. Arrigo¹, F. Heckendorn², H. Hertzberg², A. Gutzwiller¹, H. D. Hess¹, M. Kreuzer³, and F. Dohme*¹, ¹Agroscope Liebefeld-Posieux, Research Station ALP, Posieux, Switzerland, ²Research Institute for Organic Farming (FiBL), Frick, Switzerland, ³ETH Zurich, Institute of Animal Science, Zurich, Switzerland.

Condensed tannins (CT) have the potential to suppress gastrointestinal nematodes in sheep. However, it is unclear, if the anthelmintic effect results from a direct impact of CT on the nematodes or from counterbalancing the nematode-caused higher protein requirements of the host by ruminal protection of dietary protein. To evaluate the effects of CT on infected lambs, 24 lambs, 18 of which were infected with the blood sucking abomasal nematode *H. contortus*, were subjected to 4 treatments ($n = 6$). After 4 wk, when the infection was established, 12 infected lambs were fed for 3 wk either dried sainfoin or dried sainfoin treated with polyethylene glycol (PEG) which inactivates CT. The third infected group and the uninfected group remained on a grass-clover hay diet. The lambs were offered 66 g/d forage OM per kg BW^{0.75}. To monitor the infection, egg count in fecal DM (FEC) and packed cell volume in the blood (PCV) were determined weekly throughout the experiment. During the third experimental wk, feed refusals were recorded daily, and feces and urine were collected quantitatively and results expressed per d and per kg BW^{0.75}. While the DM intake was not affected by treatments, the nitrogen (N) intake was higher in lambs fed PEG-treated sainfoin instead of grass-clover (2.29 vs. 1.51 g; $P < 0.001$) which resulted in a higher total N-excretion (1.64 vs. 1.22 g; $P < 0.001$) and a higher N-retention (0.65 vs. 0.29 g; $P < 0.001$). Lambs fed PEG-treated sainfoin excreted less fecal N than lambs fed sainfoin without PEG (0.66 vs. 0.75 g; $P < 0.01$). The proportion of urinary N (g/g N excreted) was higher with PEG-treated sainfoin than with untreated sainfoin ($P < 0.05$). The nematode infection had no influence on the N-balance. The PCV was lower in infected compared to uninfected lambs ($P < 0.001$). The FEC was not different among the 3 infected groups and averaged $10.5 \pm 8.21 \times 10^3$ eggs/g fecal DM at the end of the experiment. In conclusion, neither the CT of sainfoin nor the higher N-intake with sainfoin compared to grass clover increased the resilience of lambs infected with *H. contortus*.

Key Words: Nitrogen Balance, Condensed Tannins, *Haemonchus Contortus*

926 Prediction of carcass measures and wholesale product weights in sheep using B-mode ultrasound. T. D. Leeds*¹, M. R. Mousel¹, D. R. Notter², and G. S. Lewis¹, ¹USDA-ARS, U. S. Sheep Experiment Station, Dubois, ID, ²Virginia Polytechnic Institute and State University, Blacksburg.

Widespread use of ultrasound (US) in the sheep industry to predict carcass traits requires knowledge of its reliability. Our objectives were to 1) evaluate US estimates of carcass measures in live sheep via correlations (r) and other statistical measures (prediction SE [SEP]; repeatability SE [SER]; and bias [TB]) established for beef and swine; and 2) compare US estimates of loin muscle area (LMA), depth (LMD), width (LMW), and an elliptical interpretation (LME) as single predictors of roast ready rack (RRR) and trimmed loin (TL) weights. Wethers ($n = 172$) from four sire breeds were reared in an extensive production system, weaned at approximately 130 d, finished on a concentrated diet, and harvested at a mean weight of 62.9 kg (SD = 9.5 kg). Before harvest, 12th/13th rib transverse US images were captured using an ALOKA SSD-500V US device with a 3.5-MHz, 14.5-cm linear transducer and standoff. Images were interpreted using ImageJ software (v1.36b). After a 24-h chill, carcasses were ribbed, measured for LMA and backfat (BF), and fabricated. Weights of RRR and TL were described using linear models with LMA, LMD, LMW, and LME as single predictors. Predictors were evaluated via model R^2 and root

mean square error (RMSE) statistics. For Objective 1, SEP, SER, and TB for BF were 0.14, 0.08, and 0.07 cm, respectively, and r was 0.81. The SEP, SER, and TB for LMA were 1.55, 1.31, and -0.004 cm², respectively, and r was 0.75. For Objective 2, single-prediction models for RRR had R^2 of 0.46, 0.09, 0.40, and 0.37 and RMSE of 0.22, 0.28, 0.23, and 0.24 for LMA, LMW, LMD, and LME, respectively. Single-prediction models for TL had R^2 of 0.46, 0.11, 0.39, and 0.38 and RMSE of 0.31, 0.39, 0.33, and 0.33 for LMA, LMW, LMD, and LME, respectively. Based on these data, the best single predictor for RRR and TL was LMA; LMW and LME should not be used to predict RRR or TL. Ultrasound can be used to reliably predict corresponding carcass measures in sheep.

Key Words: Sheep, Ultrasound, Carcass

927 Prediction of lamb carcass leg and loin weights using leg score and leg width measurements. M. R. Mousel¹, T. D. Leeds¹, D. R. Notter², and H. N. Zerby³, ¹USDA-ARS U.S. Sheep Experiment Station, Dubois, ID, ²Virginia Polytechnic Institute and State University, Blacksburg, ³The Ohio State University, Columbus.

Lamb carcass leg score (LS; 1 = low cull to 15 = high prime) is considered a subjective estimate of carcass muscling. We compared the predictive value of LS, live leg width (LLW), and carcass leg width (CLW), individually, and in combination with live (LWT) or carcass weight (CWT), of various leg and trimmed loin (TL) weights. Wether lambs ($n = 170$) from four sire breeds were weaned at approximately 130 d, finished in a feedlot, and harvested at a mean weight of 62.9 (SD = 9.5) kg. Before harvest, LLW was measured at the widest point between hip and stifle. The CLW was measured on hanging carcasses at the dorsal tip of the visible gluteus and a trained evaluator assessed LS. As single-predictors of leg weights or TL, R^2 values ranged from 0.16 to 0.32 for LS, 0.31 to 0.48 for LLW, 0.60 to 0.83 for CLW, 0.70 to 0.88 for LWT, and 0.75 to 0.95 for CWT (Table 1). Based on the data, CWT was the best single-predictor of leg and TL weights. When comparing LS, LLW, and CLW as single-predictors, CLW was consistently best. No additional leg weight ($P > 0.5$) and very little TL weight ($P < 0.08$) variation was explained when LLW was added to LWT model. The R^2 improved slightly for boneless leg weight when LS or CLW ($P < 0.01$) was added to CWT model. However, after accounting for CWT, LS and CLW explained a significant ($P < 0.01$) portion of leg weight variation.

Table 1. Model R^2 and root mean square error (RMSE) for predicting weights from live and carcass measurements.

Cut		LLW + LS + CLW +							
		LLW	LS	CLW	LWT	CWT	LWT	CWT	LWT
Whole Leg	R^2	0.48	0.27	0.83	0.88	0.95	0.88	0.95*	0.96*
	RMSE, kg	1.16	1.37	0.66	0.57	0.35	0.57	0.35	0.34
Bone-in Leg	R^2	0.42	0.29	0.78	0.82	0.90	0.82	0.90*	0.90*
	RMSE, kg	0.76	0.84	0.46	0.42	0.32	0.42	0.31	0.31
Boneless Leg	R^2	0.39	0.32	0.78	0.70	0.79	0.70	0.81*	0.83*
	RMSE, kg	0.50	0.53	0.30	0.35	0.29	0.35	0.28	0.27
TL	R^2	0.31	0.16	0.60	0.70	0.75	0.71 ⁺	0.75	0.75
	RMSE, kg	0.35	0.38	0.27	0.23	0.21	0.23	0.21	0.21

*LS or CLW $P < 0.01$ in model; ⁺LLW $P < 0.08$ in model.

Key Words: Sheep, Leg Measurement, Carcass

928 Influence of body weight and body condition score at breeding on conception and prolificacy of Merino and Composite Coopworth, East Friesian, Romney and Texel sheep in Tasmania, Australia. A. E. O. Malau-Aduli^{*1}, G. H. Bond¹, and M. Dunbabin², ¹University of Tasmania, Hobart, Tasmania, Australia, ²Bangor, Dunalley, Tasmania, Australia.

We evaluated ewe conception and prolificacy in six flocks on three sheep farms with similar commercial management conditions in the Australian State of Tasmania. The aim was to investigate the effects of BW and BCS at mating, age group, and breed on reproductive traits. 1759 Merino, Composite Merino/Coopworth (M/Coop), Composite East Friesian/Romney (EF/Rom), and Composite Coopworth/East Friesian/Texel (Coop/EF/Tex) ewes of maiden (7 mo) and mature (18 to 30 mo) age groups were evaluated. Body weight and BCS of ewes were recorded before rams were introduced to the breeding mob. Ultrasound scanning 90 d after ram removal was carried out. Results demonstrated that ewes that conceived were consistently of greater BW and BCS than barren ewes. The average BW of non-pregnant, single, and multiple-bearing ewes were 41.3, 43.7, and 54.6 kg respectively, while their corresponding BCS were 2.77, 2.80, and 2.85. However, highly significant ($P < 0.0001$) breed, age group, and flock variations were observed: 7 mo-old maiden ewes had a significantly lower conception rate than 18 mo-old ewes at the same BW at breeding. Within the 18-mo age groups, percentages of non-pregnant ewes were 16.7, 3.0, and 2.4% and percentages of multiple fetus-bearing ewes were 1.4, 53.6, and 74.2% for Merino, Coop/EF/Tex, and M/Coop, respectively. The Coop/EF/Tex flocks were consistently more prolific than other breeds with 74.2, and 77.5% of ewes scanned as multiple fetus-carrying at ages 18 and 30 mo, respectively. Above BW of approximately 55 kg, the probability of multiple conceptions began to increase at a greater rate at the expense of single conceptions. The study shows that nutritional management prior to joining in commercial Tasmanian sheep flocks has the potential to increase reproductive performance in ewes. This is of particular importance when ewes are bred as lambs or from breeds with characteristically low fertility levels.

Key Words: Conception, Prolificacy, Sheep Bodyweight

929 Body weight changes and subsequent lambing rates of western white-faced ewes grazing winter range. J. B. Taylor*, C. A. Moffet, and T. D. Leeds, USDA, ARS, U. S. Sheep Experiment Station, Dubois, ID.

To describe BW change (BWC) and subsequent lambing rates of western white-faced ewes grazing on sagebrush steppe of the northwest United States, Columbia (1,174 records), Polypay (910 records), Rambouillet (1,280 records), and Targhee (868 records) ewe BW and lambing-rate records for 1989, 1990, and 1991 were extracted from the USDA, ARS, U. S. Sheep Experiment Station breed database. In December, after breeding each year (October to December), ewes were moved to winter range. Depending upon severity of climatic conditions and vegetation accessibility, ewes grazed winter range for 30 to 60 d. The BW that were analyzed were collected 2 d before winter-grazing commenced and 2 to 7 d after ewes were transported off winter range. Only data from litters with at least one live lamb were included in these analyses. Because initial BW may influence BWC during grazing, daily BWC was calculated as a proportion of initial BW: $BWC, g \cdot kg^{-1} \cdot d^{-1} = ([\text{exit BW} - \text{initial BW}] / \text{initial BW}) / d$ of grazing. Data were analyzed within each breed, with age as the fixed effect and

management year as the random effect. For all breeds, 2-yr-old ewes were lightest going on to winter range and had the lowest lambing rate. Ewes lost weight while grazing winter range, but mature BW, once achieved, was restored annually, with the exception of the 7-yr-old Targhee ewes. Regardless of breed or age, ewes were able to achieve acceptable lambing rates following early-gestational weight loss. Compared to younger ewes, lambing rates were similar or greater in older ewes, even though they generally lost more BW during winter grazing.

Key Words: Sheep, Winter Grazing, Reproduction

930 Changes in metabolic and endocrine measurements during feed restriction in dairy ewes with different BCS. G. Pulina*¹, G. C. Bomboi², A. Mazzette¹, B. Floris², C. Dimauro¹, S. P. G. Rassu¹, and A. Nudda¹, ¹Dipartimento di Scienze Zootecniche - Università di Sassari, Sassari, Italy, ²Dipartimento di Biologia Animale - Università di Sassari, Sassari, Italy.

The effects of feed restriction on metabolic and endocrine measurements of Sarda lactating ewes were evaluated. Ten ewes, divided into two groups according to the level of BCS (low: BCS < 2.75; high: BCS > 2.75), were fed 2.5 kg of a complete pelleted diet (CPD) for 7 d (preliminary period, PRE), followed by 3 d (treatment period, RESTR) of feed restriction (1.25 kg/head per day of CPD, i.e. 50% of the intake of the PRE period) and 3 days of recovery (REC). Blood samples were collected at -24, -12, 0 (beginning of RESTR), 6, 14, 24, 36, 52, 76, and 126 h during the trial. Blood concentrations of NEFA, urea, glucose, insulin, leptin, and IGF-I were measured. Data were analyzed by a mixed model with BCS, period and their interaction as

fixed factors and ewe within BCS as a random factor (Table 1). BCS did not show significant effects on any blood measurement. Period influenced almost all measurements, except glucose concentration. Blood IGF-I and insulin concentrations showed a rapid response to feed restriction whereas the effect of feed restriction on NEFA, urea and leptin concentrations was observed in the REC period. The expected increase in NEFA during the RESTR period was observed only in low BCS ewes, whereas this measurement tended to slightly decrease in the high BCS group. Low BCS ewes had lower insulin concentrations during the PRE and RESTR periods than high BCS, whereas the opposite happened during the REC period. The results suggest that feed restriction of 50% for only a 3-d period is enough to cause metabolic changes in lactating dairy ewes. Moreover the differences found between the two BCS groups suggest an important role of the capability of body reserve mobilization when feed restriction occurs. *Funded by MIPAF project on Small Ruminant Welfare.*

Table 1. Metabolic and endocrine measurements

Parameter	Period PRE	Period RESTR	Period REC	BCS High	BCS Low	P level Per	P level BCS	P level P x BCS
Urea, mg/dL	55.6 ^A	52.5 ^A	36.0 ^B	47.9	48.2	**	ns	†
Glucose, mg/dL	69.8	72.2	72.1	71.0	71.8	ns	ns	ns
Leptin, ng/mL	3.75 ^a	3.70 ^a	3.36 ^b	4.15	3.05	*	ns	ns
Insulin, µ/dL	0.16 ^a	0.22 ^b	0.53 ^c	0.31	0.30	**	ns	**
IGF-I, ng/mL	111 ^a	102 ^b	118 ^a	119	102	**	ns	ns
NEFA, mmol/L	0.137 ^{ef}	0.156 ^e	0.125 ^f	0.121	0.157	†	ns	*

^{A,B}P < 0.01; ^{a,b,c}P < 0.05; ^{e,f}P < 0.10; †P < 0.10; *P < 0.05; **P < 0.01; ns = not significant

Key Words: Feed Restriction, Dairy Sheep, Metabolic Parameters