is produced also suffers from a number of additional quality problems. Herders are moving from fine-wool production into more profitable meat production. This reflects not only a producer response to better markets for meat sheep but also to production risks associated with fine-wool sheep. This is creating concern over genetic regression in a significant proportion of the remaining fine-wool flocks in the pastoral areas and a need to evaluate breeding programs. Additionally, there is a need for programs to characterize and utilize breeds of mutton sheep in pastoral production systems. The objective of this presentation is to discuss genetic resources available in China for improvement of both fine-wool and mutton production and breeding programs to utilize these resources.

Key Words: China, Sheep, Genetic resources

698 A new paradigm for small ruminant production. J.W. Walker*[1], [1]*Texas Agricultural Experiment Station*.

In light of the decades long decline in the sheep industry it appears past time to reconsider the place of the industry in U.S. agriculture. Solutions to sheep industry problems have focused either at increasing the efficiency of production or increasing consumer demand for the products. It is doubtful that the potential for increasing productivity is great enough to offset the effect of currency exchange rates and high land prices. As for increasing demand, with lamb imports supplying 37% of domestic consumption and increasing at a rate of 6% annually, there is little evidence to support the need for increased product demand. The trend toward globalization of world economies suggest that foreign competition is here to stay and the only solution is to develop markets that foreign products can not compete for. The one market that imported lamb or wool cannot compete for is the potential positive effects of sheep on grazing land ecosystems. There are many examples of using sheep and goats to control noxious weeds and manage vegetation. Although the commodity can be imported the positive effects of sheep grazing cannot be imported. The American Sheep Industry Association is to be lauded for its sheep ecology program that promotes the use of sheep to improve grazing lands. Unfortunately few producers and even fewer academics give any consideration to the potential positive environmental benefits of sheep grazing. However, as shown by the latest issue of *The Futurist* magazine, which was subtitled *Eco-Economy*, the environment is the market of the future. Sheep producers need to accept the reality of the new economy while there is still infrastructure to process the by-products, i.e., lamb and wool, of their industry.

Key Words: Ecology, Grazing, Sheep

699 Using sheep to graze noxious weeds in Montana. B. Olson*, *Montana State University*.

Noxious weeds are continuing to spread across Montana, despite extensive and expensive control efforts, primarily associated with herbicides. In 1991, we began a series of studies to assess the efficacy of using sheep to control noxious weeds. Animal related studies have included grazing behavior, grazing use patterns, nutritive value of weeds versus native plants, and rumen microbial response to noxious weeds. Plant related studies have included response of plants, plant populations, and plant communities to sheep grazing, and noxious weed seed viability after passing through the digestive tract of sheep. A related study assessed the economic feasibility of using sheep to control leafy spurge. In Montana, over 2.2 million ha are infested with the Eurasian spotted knapweed, 0.2 million ha are infested with leafy spurge, also from Eurasia. In Montana, about 45,000 ha of noxious weeds are being grazed by sheep or goats with no or little exchange of money between sheep producer and landowner. In the long term, the declining number of sheep available to graze these weeds may limit the efficacy of this ecologically and economically viable tool to control weeds.

Key Words: Sheep, Grazing, Economics

700 Using goats to control juniper. C. A. Taylor, Jr., *Texas Agricultural Experiment Station, Sonora*.

Juniper infestation of Texas rangelands is an important dilemma because of its impact on forage and livestock production, water yield and quality, wildlife habitats, and rapidly increasing costs of conventional control methods. Ashe juniper (Juniperus ashei) is a serious problem on approximately 4.1 million hectares and redberry juniper (Juniperus pinchotii) on 4.9 million hectares of Texas rangelands. Junipers contain monoterpenoid oils, which are volatile. These phytochemicals are composed of terpene compounds, which are five-carbon rings with alcohol, ketone, and hydrogen side groups. The kind of side group makes a difference in the properties of each terpenoid. The terpenoids in juniper affect its taste and a number of the animal's metabolic processes. Since we know that juniper intake is limited by the presence of terpenoids, we can overcome this limitation through two different management schemes. We can manage juniper to reduce terpenoid concentration in the foliage and/or we can manage goats to increase their tolerance of the terpenoids. Terpenoid composition for immature juniper is lower than for mature juniper. There appears to be a threshold after which leaf material becomes significantly less palatable as the juniper foliage ages and terpenoid composition increases. This has important management implications. If juniper can be maintained below this threshold with control methods such as fire, consumption by goats can be increased. Our second approach to juniper management is to increase the tolerance of goats to the terpenoids. Terpenoids are thought to deter goat browsing of juniper plants by being toxic or by reducing nutrient assimilation, or by influencing forage selection at sub-toxic levels by imposing high detoxification costs post absorption. Because of the additional demand for nutrients, adequate nutrition is important to meet the demands of detoxification. Spanish or Spanish x Boer cross goats have a higher tolerance to terpenoids than Angora goats. Spanish goats crossed with the Ibex breed (wild goats) consume even larger quantities of juniper. There also appears to be large within-breed differences in regards to juniper intake. Habitability has ranged from near 0 to 26%.

Key Words: Goat, Juniper, Rangeland

Milk Synthesis

701 Production of DNA Arrays by Expression Profiling. K.M.S. Smuga-Otto*, W. Luo, J.L. Smith, E. Reinfried, and L.G. Sheffield, *University of Wisconsin, Madison*.

DNA arrays consisting of hundreds to thousands of DNA fragments arrayed on a solid support are widely available for humans and many model species. For less widely utilized species, the costs of obtaining DNA arrays can be prohibitive. Part of this cost is the redundancy involved in screening large numbers of clones to obtain complete coverage of the genome. Recently, we used display profiling to obtain a large library of low-redundancy bovine DNA sequences. mRNA was extracted from control and pokeweed mitogen-stimulated bovine leukocytes. Double stranded cDNA was synthesized and the resulting library digested with TaqI restriction endonuclease. Linkers were then ligated to the resulting sticky ends. These linkers were then used as primer sequences for PCR amplification of the library (to give a larger amount of starting material, not absolutely necessary for the procedure). Next, PCR primers containing the linker sequence, the TaqI recognition sequence and the first 3 bases of unknown sequence were synthesized. Each possible primer was synthesized independently, such that we had 64 possible primers. These were then used in pairs to amplify the DNA fragments. A total of 2,016 non-redundant primer pairs are possible, each of which amplifies a small percentage of the possible DNA fragments in the sample. After PCR amplification with these primers, fragments were separated by PAGE electrophoresis, silver stained and bands excised manually. Each PCR reaction gave between 10 and 30 bands suitable for excision and reamplification. From 900 PCR reactions, we have isolated over 11,000 unique bands of sufficient quality for array production. Thus, this procedure provides a rapid and relatively inexpensive method of producing DNA arrays, well suited to species or projects for which a full-fledged functional genomics effort would be prohibitive.

Key Words: DNA Arrays, Expression Profiling, Array Methods

702 Relationship of lactose synthesis to glucose transport in bovine mammary epithelial cells in vitro. C.T. Xiao*, J.P. Cant, M.I. Lindinger, R.R. Hacker, and B.W. McBride, *University of Guelph*.

The relationship between lactose synthesis and glucose transport across the plasma membrane was studied in bovine mammary epithelial cells isolated from lactating Holstein cows. Two hundred μl of cell suspension were incubated at 37 °C with 400 μl Dulbecco's Modified Eagle's Medium containing 10 mM glucose for up to four hours or varying glucose concentrations (0.75 - 20 mM) for one hour. Lactose was assayed using a bioluminescent method. At the end of incubation lactose was mainly present in incubation media while lactose in cell lysates was negligible ($p<0.01$), indicating the secretory capability of the cell preparation. Lactose accumulation in media containing 10 mM glucose was linear with incubation time up to 4 hours at a rate of 181 nmol per mg cell protein per hour. Facilitative glucose transport inhibitor cytochalasin B (20 μM) significantly reduced ($p<0.05$) lactose synthesis while no effects of SGLT1 inhibitor phlorezin (200 μM) were detected ($p>0.05$). Synthesis of lactose exhibited Michaelis-Menten kinetics under varying extracellular glucose concentrations ($[Glc]_o$) with K_m of 1.29 mM. Assuming a K_m' of 0.16 mM for intracellular glucose utilization in lactose synthesis, the relationship between intra- and extracellular glucose concentrations was derived as $[Glc]_i$ / $[Glc]_o = K_m$' / K_m . This provided a novel indirect estimation of the intracellular glucose concentration and indicated an 8-fold glucose concentration gradient across the plasma membrane of mammary epithelial cell. Calculated intracellular glucose concentrations were used to solve a kinetic equation for bidirectional transport of glucose.

Key Words: Mammary epithelial cell, Glucose, Lactose

703 Dose-dependent reduction in milk fat secretion with abomasal infusion of *trans*-10, *cis*-12 conjugated linoleic acid (CLA) and comparison to diet-induced milk fat depression. D. G. Peterson*, L. H. Baumgard, and D. E. Bauman, *Cornell University, Ithaca, NY*.

Trans-10, *cis*-12 conjugated linoleic acid (CLA) is a potent inhibitor of milk fat synthesis and its concentration in milk fat increases during diet-induced milk fat depression (MFD). We examined effects of abomasal infusion of low doses of *trans*-10, *cis*-12 CLA on milk fat synthesis using Holstein cows in a 4 x 4 Latin square design. Milk yield and milk protein were unaffected, but abomasal infusion of 1.25, 2.5 and 5.0 g/d of *trans*-10, *cis*-12 CLA reduced milk fat yield by 7, 16 and 29%, respectively. Changes in milk fatty acid composition indicated that yield of all fatty acids were reduced; thus, the mechanism must involve an inhibition of de novo fatty acid synthesis and the utilization of circulating fatty acids. At these low doses there was no evidence that Δ^9-desaturase was affected based on the lack of change in fatty acid ratios representing product/substrate for this enzyme. When combined with previous data, the reduction in milk fat yield was curvilinear, relating to both quantity infused and milk fat content of *trans*-10, *cis*-12 CLA ($R^2 = 0.99$ and 0.96, respectively). Comparison with data from MFD induced by feeding a high concentrate/low fiber diet revealed a substantial divergence from the relationship between milk fat content of *trans*-10, *cis*-12 CLA and milk fat yield. This divergence suggests that in addition to *trans*-10, *cis*-12 CLA, there may be other unique fatty acids formed in rumen biohydrogenation that play a role in diet-induced MFD.

Key Words: CLA, Milk Fat, Milk Fat Depression

704 Sphingomyelin content in milk from Jersey and Holstein cows. E.L.F. Graves*, A.D. Beaulieu, and J.K. Drackley, *University of Illinois*.

Sphingomyelin is a phospholipid located in the outer leaflet of the plasma membranes of most mammalian cells. In milk, sphingomyelin is associated with the fat globule membrane. Sphingomyelin and its metabolites participate in several antiproliferative pathways that may suppress oncogenesis. Two studies were conducted to determine effects of breed, lactation stage, and parity on sphingomyelin concentration in milk and milk fat. Sphingomyelin was separated by TLC from chloroform-methanol extracts of milk fat and quantified by phosphorous analysis. In study one, milk samples were collected from 23 Holstein and 23 Jersey cows matched for parity and stage of lactation between breeds. Sphingomyelin was more concentrated ($P < 0.002$) in Holstein milk fat (1072 $\pm$ 139 μg/g milk fat) than in Jersey milk fat (851 $\pm$ 139 μg/g milk fat). Sphingomyelin concentrations in whole milk did not differ between breeds (36.4 vs. 35.6 μg/g milk, SEM= 3.2, P= 0.73). Whole milk sphingomyelin content was affected by days in milk suggesting that sphingomyelin content follows fat content in milk. In study two, milk was sampled from 32 Jersey cows in a commercial herd. Cows were grouped on lactation number (1, 2, 3, $\geq$4) with 8 cows per group; half were in early lactation (<100 DIM) and half in late (>200 DIM). Lactation number affected ($P < 0.05$) sphingomyelin concentration in milk fat (769 $\pm$ 44, 794 $\pm$ 49, 802 $\pm$ 56 and 652 $\pm$ 63 μg/g milk fat respectively). Sphingomyelin per unit of whole milk tended ($P < 0.10$) to follow the same pattern. No differences in sphingomyelin concentrations in milk fat were detected between early and late lactation. However, per unit of whole milk, sphingomyelin content was greater ($P < .0001$) for late lactation than for early lactation (38.2 $\pm$ 3.3 vs. 24.7 $\pm$ 3.1 μg/g milk). Our results suggest that the known larger milk fat globule size of Jersey cows decreases sphingomyelin content per gram of milk fat relative to Holstein cows. Sphingomyelin content in whole milk is not affected by breed, but may be altered by stage of lactation due to changes in milk fat content.

Key Words: Sphingomyelin, Jersey, Milk

705 Endogenous synthesis of *cis*-9, *trans*-11 conjugated linoleic acid in pasture-fed dairy cows. J.K. Kay*[1], T.R. Mackle[2], M.J. Auldist[3], N.A. Thomson[1], and D.E. Bauman[4], [1]*Dexcel, Hamilton, New Zealand,* [2]*Fonterra, Auckland, New Zealand,* [3]*Depart. Natural Resources & Environment, Ellinbank, Victoria, Australia,* [4]*Department of Animal Science, Cornell University, Ithaca, NY*.

Four rumen-fistulated Friesian cows were randomly assigned to treatments in a 4 x 4 Latin square design to verify the endogenous synthesis of *cis*-9, *trans*-11 conjugated linoleic acid (CLA) in pasture-fed cows. All animals were fed fresh pasture *ad libitum* and were infused abomasally with 4kg skim milk/d. Treatments were 1) control, 2) sterculic oil (SO; abomasal infusion of 9g SO/d), 3) sunflower oil (SFO; twice daily rumen dosing of SFO (500ml/d), and 4) SO + SFO. Each of the four periods consisted of a 2-d uniformity interval, a 4-d infusion interval and an 8-d washout interval. Data from day four of the infusion interval was used for analysis. Dry matter intake, milkfat and milk protein concentrations were unaltered by SO and SFO treatments. Milk yield was unaffected by SO infusion but a small increase ($P<0.01$) occurred with SFO administration. Infusion of SO reduced the concentration of CLA in milkfat by 71% (3.6 c.f. 12.1 mg/g fatty acid $\pm$ 1.48; $P<0.001$). This reduction is a minimum estimate of endogenous synthesis as the presence of *cis*-9 C14:1 in milkfat following SO infusion suggests that the Δ9-desaturase enzyme was not completely inhibited. Concentrations of monounsaturated fatty acids containing a *cis*-9 double bond decreased ($P<0.05$) following SO infusion and consequently the substrate to product ratios of fatty acid pairs dependent on Δ9-desaturase increased ($P<0.05$). Sunflower oil resulted in a 17% increase ($P<0.05$) in *trans*-11 vaccenic acid in milkfat but no increase in CLA. Linoleic and oleic acids, the major components of SFO, increased in milkfat by 58% and 27% respectively indicating a large portion of SFO was not ruminally biohydrogenated. Overall, the results demonstrate that endogenous synthesis is the major source of CLA in milkfat of pasture-fed cows. Four days of SFO treatment had no effect on milkfat CLA concentration. This may be due to the twice-daily SFO administration method or rumen micro-organisms having insufficient time to adapt from a 100% pasture to a pasture plus SFO diet.

Key Words: Conjugated linoleic acid, Pasture, Endogenous synthesis

706 Effect of linoleic acid and oleic acid on conjugated linoleic acid (CLA) and milk fat content during feeding of low forage diet. T. W. Hanson*[1], M. L. Theurer[1], J.M. Griinari[2], and M. A. McGuire[1], [1]*University of Idaho, Moscow,* [2]*University of Helsinki, Finland*.

Conjugated linoleic acid is present in products from ruminant animals including milk and beef. The predominant isomer (*cis*-9, *trans*-11 CLA) has powerful anticarcinogenic effects, whereas the *trans*-10, *cis*-12 CLA dramatically inhibits milk fat synthesis. The objective of this study was to examine the effects of rumen available linoleic (LIN) or oleic (OLE) acids on milk fat content during the feeding of a low forage diet. Our hypothesis was that feeding a low forage diet to promote milk fat depression (MFD) would only result in MFD when LIN but not OLE was

fed. Further, the ruminal production of *trans*-10, *cis*-12 CLA from LIN would be associated with MFD. Three late lactation Holstein cows fitted with ruminal cannulae were fed 4x/d for ad libitum consumption of a diet based on chopped alfalfa hay and ground degermed shelled corn. Diets were adjusted over a 3-d period to 20% forage and 80% concentrate. Cows then randomly received either an oil containing LIN (93.7%) or OLE (79.5%) (Natural Lipids, Norway) for 7 d. Oils were placed directly in the rumen (2x/d) to provide a daily dose of 200 g of fatty acid. At the end of the 7-d period, cows were switched to the other oil. Feed intake and milk yields were recorded daily. Data are the last 3 d of each 7 d period. Feed intake and milk yield were not affected by oil. Rumen pH averaged 5.56. LIN resulted in higher *cis*-9, *trans*-11 CLA (10.0 vs 6.2 mg/g fat) and *trans*-10, *cis*-12 CLA (0.94 vs 0.11 mg/g fat) in milk fat than did OLE. Milk fat content was lower during the administration of LIN ($P<0.1$) compared to OLE (2.5 vs 3.4%). *Trans*-10, *cis*-12 CLA was correlated to milk fat percentage ($R^2 = 0.31$, $Y = -15.5x + 3.97$) but *cis*-9, *trans*-11 CLA was not. Feeding a low forage diet resulted in a decreased rumen pH. Under this condition, LIN converted to *trans*-10, *cis*-12 CLA caused MFD, whereas the biohydrogenation of OLE did not produce an intermediate to cause MFD.

Key Words: CLA, Milk Fat Depression, Biohydrogenation

707 Fatty acid changes in milk fat from Holstein cows fed rumen-protected CLA during the transition period. J. W. Perfield II*, G. Bernal-Santos, T. R. Overton, and D. E. Bauman, *Cornell University, Ithaca, NY.*

We observed that feeding Holstein cows rumen-protected CLA had no effect on milk or milk components immediately postpartum, but starting at wk 4 there was a decrease in the fat content of milk and a simultaneous increase in milk yield (J. Dairy Sci. 84(Suppl. 1):82). Over wk 4 to 20 postpartum, milk fat averaged 2.95 vs 3.45% ($P < 0.001$) and milk yield averaged 48.4 vs. 45.2 kg/d ($P < 0.10$) for the CLA-supplemented and control groups, respectively. Our objective was to extend these data by analyzing the fatty acid composition of milk fat. Multiparious cows were blocked into two treatments- dietary supplement of EnerGII (Bioproducts, Inc.) (control) or rumen-protected Ca-salts of CLA plus palm oil fatty acids (Agribrands Purina Canada Inc.; Bioproducts, Inc.). Supplements (100 g/d of fat) were top dressed on the TMR and the CLA supplement provided 43 g/d of CLA (predominant isomers were *trans*-8, *cis*-10 (9.2%), *cis*-9, *trans*-11 (25.1%), *trans*-10, *cis*-12 (28.9%), and *cis*-11, *trans*-13 (16.1%). Supplements began 2 wk prepartum and continued through wk 20 postpartum. Milk fatty acid composition did not differ between treatments for wk 1 to 3 postpartum. However, fatty acid composition shifted in CLA-supplemented group beginning at wk 4 concurrent with the decrease in milk fat content; differences persisted throughout the remainder of treatment. From wk 4 to 20, the CLA-supplemented group had a reduced fat content of fatty acids < C16 (23.4 vs 24.6%; $P < 0.06$), and C16 & C16:1 (26.0 vs 28.7%; $P < 0.001$), with an increased concentration of fatty acids > C16 (49.0 vs 46.0%; $P < 0.01$). *Trans*-10, *cis*-12 CLA is a potent inhibitor of milk fat. In contrast to the temporal changes in most milk fatty acids, fat content of *trans*-10, *cis*-12 CLA was immediately increased in the CLA-supplemented group and remained elevated throughout the 20 wk treatment period (0.03 vs <0.01% of fatty acids; $P < 0.001$). Overall, CLA supplementation initiated at parturition had no effect on milk fat until wk 4 postpartum when a decrease in the fat content and a major shift in fatty acid composition of milk occurred.

Key Words: CLA, Milk Fat, Transition Cow

Production, Management, and the Environment
Management and Decision-Making

708 Flavoring drinking water for post-weaning pigs increases water and feed intake and improves average daily gain. M.J. Bertram*[1], J.A. Pudenz[1], and E. Roura[2], [1]*Pork Technologies, Ames, IA,* [2]*Lucta SA, Montornés del Vallés,Barcelona, Spain.*

A study was conducted to examine the impact of adding a flavoring agent to drinking water on pig water and feed intake and growth. 1292 pigs were weaned at 13 to 17 d of age and allotted by weight to one of four drinking water treatments consisting of either fresh water or water containing a flavoring agent (Luctarom TM, Lucta USA Inc, Northbrook, IL) at the rate of .141, .282, .423 g/l. Flavoring was provided for 14 days post-weaning. Pigs were penned 28 to 32 per pen in a 7.19 m x 2.87 m wean-to-finish pen and pig number was equalized across treatment with-in rep. There were 10 reps of each treatment. Water was available ad-libitum from 2 nipple drinkers per pen. All pigs were feed a common commercial diet and feed was available ad-libitum. Pig weight and feed consumption were recorded by pen on d 5, 14, 28, 42, and 61 post weaning. Water disappearance was recorded by treatment for all pigs consuming each water treatment (1 observation per treatment) on a daily basis for the first 14 d. Daily water consumption increased with increasing flavor concentration. When comparing fresh water with the highest concentration of flavored water, consumption was increased by 34% during the first 24 h and by over 4% during the 14 d treatment period. From d 0 to 61 feed consumption and body weight gain increased linearly ($P<.05$). Average pig weight at the end of each period was increased linearly ($P<.05$) as flavor concentration in the water increased and at 61 days pigs consuming water containing .282 g/l of strawberry flavor were 1.5 kg heavier than those consuming fresh water. Feed conversion was not improved with water flavor inclusion. Based on these results, adding a flavoring agent to drinking water of pigs for 14 d post-weaning improved water consumption, feed intake and growth rate.

Water Flavor Cons, g/l	0	.141	.282	.423	Lin P<
Start Wt, kg	5.05	5.07	5.05	5.07	.55
5d Wt, kg	5.68	5.71	5.75	5.85	.07
14d Wt, kg	7.49	7.63	7.64	7.80	.02
28d Wt	12.02	12.12	12.41	12.56	.01
42d Wt	18.99	19.04	19.88	19.76	.01
61d Wt, kg	33.07	33.21	34.58	34.35	.001
ADG 0-5d, g/d	126	128	140	155	.05
ADG 0-61d, g/d	455	446	476	474	.07
ADF 0-5d	123	123	133	138	.05
ADF 0-61d, g/d	702	687	733	737	.05
GF 0-5d	1.024	1.019	1.031	1.124	.17
GF 0-61d	.649	.650	.649	.644	.29
Water Disapp. d1, l/d	2.01	2.34	2.21	2.70	N/A
Water Disapp. 0-14d, l/d	2.80	2.84	2.88	2.90	N/A

Key Words: Pigs, Water, Flavor

709 Specialization and contracting in the dairy industry: the case of custom heifer growers. C.A. Wolf*, *Michigan State University.*

As dairy farms specialize in milking cows, other enterprises are often curtailed. One increasingly common example of outsourcing is utilizing a custom replacement heifer grower. By outsourcing the heifer enterprise, a dairy farmer frees up labor, management, feed, and facilities. To examine this new industry sub-sector, nation-wide survey was undertaken to examine commercial custom heifer growers. The survey was intended to: examine the size, structure, and management of the heifer grower industry; identify important practices; and examine contract and performance specification. The survey was targeted to commercial heifer growers. Surveys were sent to 187 custom dairy heifer growers in 2001. Sixty-six respondents from across the US that identified themselves as heifer growers. The average operation had 1,223 heifers with a range from 30 to 20,000. The average operation farmed 637 acres. Just over half of the respondents indicated that they were commercial heifer growers with no off-farm employment. About forty percent were heifer growers with other significant farm operations with the most common being cash crops. Fifty-four percent indicate that