41 Extending refrigerated shelf life of fluid milk using a novel HTST system. M. A. Drake* and G. Cartwright, *North Carolina State University*, *Raleigh*.

Shelf life remains a crucial economic issue for pasteurized fluid milk. The Feldmeier system is a tubular heat exchanger that functions as a piggyback system on a conventional high temperature short time (HTST) plate pasteurizer allowing higher heat treatment of the milk. The system may provide an alternative economical way to increase refrigerated shelf life of fluid milk. Raw milk (1000 kg) was obtained on three occasions, standardized to 1.5 % fat (w/v) and pasteurized at one of five different temperatures (75°C for 20 seconds only (control) or with the additional heat treatments of 103, 114, 125 or 136C for 3 seconds). Milk was packaged in paperboard cartons or bag-in-boxes and stored at 4C. Pasteurized milks were tested following 0, 7, 14, 21, 28, 42, 49, 66, 80 and 101 days. Microbiological quality and enzymatic quality were determined. Descriptive sensory analysis was conducted with a trained panel at each timepoint. Consumer acceptance testing (n=75) was conducted within 24 h and after 7 and 60 days. Conventionally pasteurized milks reached shelf life failure (>10E6CFU/mL and sensory failure) within 38 days while all Feldmeier milks retained microbiological and sensory shelf life through 80 days. Trained panelists detected higher cooked flavors in the Feldmeier system milks compared to control milks, but these flavors and differences decreased with storage time. Consumer acceptability was comparable to conventional HTST milk after 1 week of refrigeration. The Feldmeier system may be an economically feasible method to increase shelf life of refrigerated pasteurized milk.

Key Words: Shelf Life, Fluid Milk, Refrigerated Storage

42 Application of microwave processing to extend shelf life of fluid milk. J. Simunovic*, P. Coronel, and D. Clare, *North Carolina State University*, *Raleigh*.

One of the significant emerging markets for white and flavored fluid milk and milk-based beverages are vending machines, especially in schools districts where availability of milk has been regulated as mandatory. Distribution by existing beverage vending machines requires processing treatments to impart commercial sterility (i.e. shelf stability) due to unfavorable temperature conditions during the distribution, storage, and vending stages. Flavor quality of such milk preserved using conventional thermal processing is inferior to pasteurized milk based beverages and is considered one of the main concerns for marketability of shelf stable fluid milks.

Non-contact volumetric sterilization using microwave energy is one of the available options for rapid, uniform heating of milk under continuous flow, which could potentially address the noted flavor quality issues of shelf stable milks. Analyses of dielectric properties, recirculated pressurized test runs as well as sterilization and aseptic packaging trials were performed for white and chocolate milk beverages using 915 MHz microwave energy with proprietary cylindrical applicators as energy focusing and delivery structures. Some of the technical issues also addressed were design of high temperature and pressure-rated microwave-transparent conduits and modeling and simulation of dielectric properties and heating behavior of milks in order to formulate appropriate pre-sterilization solutions. Obtained shelf stable beverages were analyzed for microbial stability, flavor profiles and color and compared to same products sterilized using conventional thermal treatment after extended storage under ambient conditions. Flavor quality of microwave-treated products was confirmed as superior to products sterilized using conventional plate heat exchangers.

Key Words: Extended Shelf Life, Fluid Milk, Microwave

43 Use of microfiltration (MF) to improve fluid milk quality. D. M. Barbano* and M. W. Elwell, *Cornell University*, *Ithaca, NY*.

Our objectives were to model bacterial growth in commercially pasteurized skim milk as a function of storage temperature, to determine the efficacy of a MF and pasteurization process in reducing the number of total bacteria, spores, and coliforms in skim milk, and to estimate the shelf life of pasteurized microfiltered skim milk as a function of storage temperature. For objective 1, pasteurized skim milk was stored at 0.1, 2.0, 4.2, and 6.1°C. The bacteria count in these samples was determined semi-weekly. A total bacteria count >20,000 cfu/mL was considered to be the end of shelf life. Shelf life ranged from 16 d at 6.1°C to 66 d at 0.1°C. Decreasing temperature increased lag time and reduced logarithmic growth rate. The effect of temperature on lag time was the biggest contributor to longer shelf life. For objective 2, raw skim milk was microfiltered at 50°C using a Tetra Alcross M7 Pilot Plant equipped with a ceramic Membralox membrane (pore diameter: 1.4 μ) and pasteurized at 72°C for 15 s. Bacteria counts of MF and pasteurized MF skim milk were determined using a most probable number (MPN) method. Across 3 trials, raw milk bacteria count was reduced from 2400, 3600, and 1475 cfu/mL to 0.240, 0.918, and 0.240 cfu/mL, respectively, by MF. Bacterial counts in the pasteurized microfiltered skim milk for the 3 trials were 0.005, 0.008, and 0.005 cfu/mL respectively, for a 5.6 log reduction due to the combination of MF and pasteurization. For objective 3, pasteurized microfiltered skim was stored at 0.1, 2.0, 4.2, and 6.1°C and the bacteria count was determined weekly for 92 d. At 6 time points, decrease in CN/TP (%) was measured as an index of proteolysis. After 92 d, 50% of samples stored at 6.1°C and only 12% of samples stored at 4.2°C had a bacteria count >20,000 cfu/mL. No samples stored at 0.1 or 2.0°C reached a detectable bacteria level. When bacteria count was <1,000 cfu/mL, shelf life was limited by proteolysis to 32 d at 6.1°C, 46 d at 4.2°C, 78 d at 2.0°C, and >92 d at 0.1°C.

Key Words: Microfiltration, Shelf Life, Bacterial Removal

44 Dairy applications for microfiltration. H. Iversen*, *Tetra Pak*, *Vernon Hills, IL*.

In the mid 90s, the microfiltration technology was introduced in the Dairy industry Canada. Creating a brand name PurFilter, the industry was able to convert approximately 15 to 20% of the consumers to microfiltered milk. The product brought an extended shelf life (ESL) milk to the consumer, with a better taste and improved profit for the industry. The log reduction achieved is approximately 4 to 5, allowing a shelf life of 35 days in a market traditionally used to 15 to 20 days with pasteurized milk.

Since then a number of improvements where brought to the technology. The membranes now offer cutting points of 0.8 to 1.4 Âμ, log reduction higher than 6 or 7, and although the commercial sterility has not been reached yet, the milk shelf life can now be extended significantly. The application of this technology in the US market could impact significantly the industry, improving milk sensory bringing better profitability to the industry.

Key Words: Microfiltration, ESL

Graduate Student Competition: National ADSA Dairy Production

45 Processing barley grain for midlactation dairy cows: Steam-rolling versus grinding. A. Nikkhah*[1], H. Sadri[2], M. Alikhani[2], and G. Ghorbani[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Isfahan University of technology*, *Isfahan, Iran*.

Economical constraints of replacing conventional grinding with complex steam-processing equipment have faced the dairy industries with a major challenge. The objective of this study was to evaluate the rumen conditions and productivity of dairy cows fed differently processed barley grains. Eight multiparous Holstein cows in their midlactation (85 ± 15 days in milk) were used in a double 4 × 4 Latin square design with four 21-d periods. Processing index (**PI**), or the ratio of the processed barley grain density to the whole barley grain density expressed as %, was used to measure the processing extent of the rolled grains.

Barley grain was included as 25.6% of dietary dry matter (DM). Treatments included 4 total mixed rations containing, 1) ground (GB), 2) steam-rolled (SRB, **PI** = 68%), 3) finely dry-rolled (DB72, **PI** = 72%), and 4) coarsely dry-rolled (DB81, **PI** = 81%) barley grains. Milk quantity and quality, dry matter intake, ruminal pH and concentrations of volatile fatty acids, fecal and urinary pH, and apparent total tract digestibility of DM and organic matter were not affected ($P > 0.05$) by the processing techniques. Milk protein yield tended to be greater ($P = 0.08$) for cows fed finely dry-rolled barley (DB72) than for cows fed coarsely dry-rolled barley grain (DB81) (0.86 vs. 0.79 kg/d). *In situ* measurements using three Naeini ewes fitted with rumen cannulas revealed that the coarse (2 mm) vs. finely (1 mm) grinding significantly ($P < 0.01$) reduced the ruminal degradation rate of the DM (63 vs. 27 %/h) and crude protein (36.2 vs. 15.2 %/h) of barley grain. Results declared that when the inclusion rate of barley grain is 25.6% of the dietary DM, cows fed SRB perform similar to cows on GB. It is imperative to assess the impact of processing techniques with higher dietary levels of barley grain before deciding on the economical efficiency of the expensive steam-rolling over the easy-to-access, conventional grinding.

Acknowledgements: This study was funded by Isfahan University of Technology.

Key Words: Barley Grain, Processing Technique, Lactating Cows

46 Evaluation of dried and wet distillers grains included at two concentrations in the diets of lactating dairy cows. J. M. Ladd*, D. J. Schingoethe, K. F. Kalscheur, and A. R Hippen, *South Dakota State University*, *Brookings*.

The purpose of this study was to determine the lactation performance of dairy cows fed dried or wet distillers grains (DG) with solubles (DDGS or WDGS) at two dietary concentrations. Using 15 cows, a lactation trial was designed as a replicated 5 x 5 Latin square. Periods were 4 wks, with samples and data collection during wk 3 and 4. Diets, on a DM basis, were: control (C), 10% DDGS, 20% DDGS, 10% WDGS, and 20% WDGS. All diets contained 25% corn silage, 25% hay, and 50% of the respective concentrate mixes. Diets were balanced, using corn and soybean meal, for 17% crude protein. DMI tended (P <0.1) to be greater for cows fed C than DG (23.4, 22.7, 22.5, 23.0, 21.9 kg/d for C, 10% DDGS, 20% DDGS, 10% WDGS, 20% WDGS). Milk yield (39.8, 40.9, 42.5, 42.5, 43.5 kg/d) was greater (P <0.05) for cows fed DG than C. Milk fat percentage (3.23, 3.16, 3.28, 3.55, 3.40) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS. Milk fat yield (1.28, 1.32, 1.39, 1.44, 1.43 kg/d) was greater (P <0.05) for cows fed DG than C, and tended (P <0.1) to be greater for cows fed WDGS than DDGS. Milk protein percentage (3.05, 3.01, 3.02, 3.11, 3.06) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS. Milk protein yield (1.20, 1.23, 1.29, 1.29, 1.33 kg/d) was greater (P <0.05) for cows fed DG than C, tended (P <0.1) to be greater for cows fed WDGS than DDGS, and tended (P <0.1) to be greater for cows fed 20% DG than 10% DG. Milk urea nitrogen (13.3, 12.6, 12.4, 12.9, 14.1 mg/dL) was similar for cows fed C and DG, but greater (P <0.05) for cows fed WDGS than DDGS, and tended (P <0.1) to be higher for cows fed 20% DG than 10% DG. Rumen NH3 concentration (4.81, 3.75, 3.10, 3.91, 5.04 mg/dL) was greater (P <0.05) for cows fed WDGS than DDGS. Overall, feeding DG improved performance by increasing DMI, and yields of milk, protein, and fat. Responses were similar for 10% or 20% DG; however, feeding WDGS instead of DDGS increased milk fat and protein percentages.

Key Words: Distillers Grains, Dairy Cows

47 Increasing time on a high energy diet increases expression of leptin in the mammary gland of prepubertal heifers. L. Davis*[1], M. Weber Nielsen[1], D. Keisler[2], L. Chapin[1], J. Liesman[1], and M. VandeHaar[1], [1]*Michigan State University*, *East Lansing*, [2]*University of Missouri*, *Columbia*.

We previously found that a high energy diet fed to prepubertal heifers for increasing lengths of time results in a linear decrease in mammary parenchymal tissue mass and increase in mammary fat when adjusted for carcass wt. We believe leptin may play a role in this phenomenon. Our objective was to determine the effects of feeding a high energy diet to prepubertal heifers for increasing lengths of time on expression of leptin and leptin receptor and concentrations of leptin in the mammary gland. Heifers (n = 64; age = 11 wk; BW = 107 kg) were randomly assigned to 1 of 4 treatments and fed 2 diets (low, L; high, H) for different lengths of time: H0, H3, H6, and H12 were on the L diet for 12, 9, 6, and 0 wk followed by the H diet for 0, 3, 6, and 12 wk, respectively. The L and H diet were formulated for 0.6 and 1.2 kg daily gain, respectively. Animals were slaughtered at 23 wk of age. Gene expression was measured by real time RT-PCR and presented as -ddCt with H0 as the reference. Statistical analysis tested linear, quadratic, and cubic contrasts of time on H diet. Results in the table are from samples collected at 23 wk of age. We conclude that high energy diets fed to prepubertal heifers for longer durations result in a linear increase in leptin concentrations in serum and mammary tissue and leptin expression in mammary tissue. This is consistent with the idea that leptin may mediate the negative effects of high energy diets on mammary development.

	H0	H3	H6	H12	Linear P
Mammary leptin (ng/g tissue)	2.5	3.2	3.6	3.8	< 0.01
Serum leptin (ng/ml)	1.8	2.1	2.4	2.5	< 0.03
Leptin expression (-ddCt)	0.0	0.9	0.9	1.2	< 0.02
Leptin receptor expression (-ddCt)	0.0	-0.2	0.0	0.1	> 0.4

Key Words: Leptin, Mammary Growth, Heifer

48 Effects of short-term glucagon administration on gluconeogenic enzymes in the liver of mid-lactation dairy cows. E. L. Williams*[1], S. Rodriguez[1], D. C. Beitz[2], and S. S. Donkin[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Iowa State University*, *Ames*.

During lactation, the dairy cow experiences an increased demand for glucose to support milk production. This demand can be met through increased capacity for gluconeogenesis or increased supply of glucose precursors. Glucagon, a key hormone in glucose homeostasis, promotes gluconeogenesis and glucose output from liver. The objective of this study was to determine the effect of short-term administration of glucagon on expression of gluconeogenic enzymes in lactating dairy cattle. Sixteen multiparous Holstein cows were selected from the Purdue University Animal Sciences Dairy Research Center herd. Cows were stratified based on milk production and days in milk and randomly assigned to either a saline or glucagon injection group (n=8 per group). Cows were injected subcutaneously at -21, -14, -7, and 0 h relative to final glucagon and saline injections with either 3.75 mg of lyophilized glucagon dissolved in 0.15 *M* NaCl (pH 10.25) or 60 ml 0.15 *M* NaCl. Liver biopsy samples were obtained 1 wk before injection to establish baseline values and at 3 h after cows received final injections. Biopsy samples were analyzed for mRNA and protein abundance, enzyme activity, and in vitro measures of gluconeogenesis. Glucagon did not alter pyruvate carboxylase (PC) mRNA, protein abundance, or enzyme activity. There was a tendency for greater cytosolic phosphoenolpyruvate carboxykinase (PEPCK-C) mRNA expression with the glucagon treatment. Gluconeogenesis from 2.5 m*M* [2-^{14}C]propionate and 2.0 m*M* [U-^{14}C]lactate was similar in liver biopsy samples from all cows. Glucagon did not effect DMI and milk production. Glucose, non-esterified fatty acids, β-hydroxybutyrate acid, and insulin were not altered by glucagon. Blood glucagon was elevated for cows receiving glucagon injections. The data indicate that short-term administration of glucagon may have residual effects on mRNA expression of PEPCK-C, but these changes are not reflected through immediate alterations in total PEPCK enzyme activity and gluconeogenic capacity.

Key Words: Gluconeogenesis, Gene Expression, Glucagon

49 Effect of biotin supplementation on biotin status of lactating dairy cows of different milk yields. G. Ferreira*, W. P. Weiss, and L. B. Willett, *The Ohio State University*, *Wooster*.

We hypothesized that biotin status is lower for high-producing cows than for low-producing cows. Twenty high-producing (HP) and 20 low-producing (LP) Holstein cows (43±5 and 23±4 kg/d, respectively) were used. Treatments consisted of a basal diet that contained 0 or 0.96 mg of supplemental biotin per kg of DM (C and B, respectively). Biotin status was determined by measuring avidin-binding substances (ABS) in plasma and milk. Plasma and milk samples were collected on d 15. Biotin status was also determined by measuring the urinary excretion of 3-hydroxy-isovaleric acid (3HIA) before and after an intraruminal challenge (d 16) with 1.36 mol of isovaleric acid (IVA). Urine samples were collected at 0, 8, 12, 24 and 48 h after challenge. Milk yields were 23.7, 24.4, 41.1 and 44.5 kg/d for LP-C, LP-B, HP-C and HP-B, respectively (SEM = 1.5). Concentrations of ABS in plasma and milk were not affected by production, but were increased by biotin supplementation. Concentrations in plasma were 1.09 and 1.92 ng/mL and 45 and 153 ng/mL in milk for C and B, respectively. No interaction was observed between production and biotin supplementation for ABS in either plasma or milk. The output of ABS in milk was increased by both production and biotin supplementation (0.8, 1.7, 3.4 and 7.0 mg/d for LP-C, LP-B, HP-C and HP-B, respectively). The 3HIA to creatinine ratio (3HIA/CREAT) in urine at 0 h was not affected by either production or biotin supplementation (67 mmol/mol). Intra-ruminal challenge with IVA increased the 3HIA/CREAT in urine, being greatest at 8 h, and greater for HP cows than for LP cows (150 and 119 mmol/mol, respectively). The 3HIA/CREAT in urine was not affected by biotin supplementation. Based on these results, production does not affect suggested measures of biotin status (i.e., plasma and milk ABS and urine 3HIA). Our data suggest that either our hypothesis is incorrect, or that the suggested measures are not appropriate measures of biotin status. Measuring actual biotin in fluids and/or measuring urine 3HIA after an extended challenge with IVA might be more appropriate measures of biotin status.

Key Words: Biotin Status, 3-Hydroxy-Isovaleric Acid, Isovaleric Acid

50 Effects of milk feeding period and anthelmintic treatment on fecal egg counts and growth in pastured dairy steers. B. M. Thompson*, S. P. Washburn, B. A. Hopkins, J.-M. Luginbuhl, H. M. Glennon, and C. Brownie, *North Carolina State University*, *Raleigh*.

A 2 x 2 factorial trial with 2 phases was conducted to evaluate the effects of weaning age (6 wk vs 12 wk) and anthelmintic treatment (none vs dewormed) on weight gain (ADG) in 36 Holstein and Jersey x Holstein crossbred steer calves born in Fall (Oct-Nov) and Winter (Dec-Feb) 2003-2004. Steers were blocked into 4 treatment groups by birth weight and breed. Calves of similar age were managed together in pastures regardless of treatment and group-fed 3.8 to 7.6 L of whole milk/d until weaning. Phase 1 (P1) extended from birth to July 15, 2004. Phase 2 (P2) started on July 15 and ended on Nov 18, 2004. Dewormed calves received 1mL ivermectin/10kg BW at 12 and 20 wk of age, and again on July 15 and Sept 23. Fecal samples and BW (birth to Nov 18, 2004) were taken from each calf at 4-wk intervals. Fecal egg counts (FEC), BW (see table), and ADG (during P1, P2 and P1& 2 combined) were compared among deworm, wean age, %Holstein, birth season, and their interactions. Parasite eggs were not detected until April and were lower (P<.001) in dewormed calves after July and Sept treatments. Fall-born calves usually had lower (P<.05) FEC than Winter-born calves. Gains during P1 were higher (P<.01) for Fall-born calves. In P2, dewormed calves actually had a higher ADG (P<.05) than non-dewormed calves. Gains across P1 and P2 were higher in Fall-born calves and tended to be higher (P=.06) in calves weaned at 6 wk. Gains and BW generally were higher with increasing %Holstein. Although steers that were not dewormed had higher FEC and differing ADG during parts of the trial, their overall performance was similar to those that received 4 doses of ivermectin.

LS Means +/- SE for Body Weights by Deworm, Wean Age, and Breed

	Deworm +	Deworm -	Wean Age 6wk	Wean Age 12wk	25% Holstein	50% Holstein	75% Holstein	100% Holstein
Birth	35.5+1.3	35.3+1.3	35.4+1.2	35.4+1.3	29.4+2.3^{a}	36.2+1.8^{b}	37.0+1.7^{b}	39.0+1.2^{b}
July 15	184.1+8.0	188.6+7.7	193.1+7.6	179.7+7.8	167.4+13.7^{a}	184.5+10.7^{ab}	190.6+11.5^{ab}	203.0+7.6^{b}
Nov 18	243.8+8.1	236.0+7.8	249.1+7.7^{c}	230.6+7.9^{d}	231.8+13.9	230.8+10.8	244.4+11.7	252.6+7.7

*All values reported in kg BW; Means with different symbols differ:a,b P<.05; c,d P=.07

Key Words: Anthelmintic, Weaning, Gain

Horse Species: Emerging Equestrian Varsity Competition

51 Integration of academic equine sciences and intercollegiate equestrian programs. G. Potter*, *Texas A&M University*, *College Station*.

Students in equine science programs need hands-on laboratory and extracurricular experiences with horses to enrich their academic training. The Intercollegiate Horse Show Association (IHSA) was formed in the late 1960's to provide college students extracurricular riding opportunities. Historically, IHSA programs have been conducted at the student club level at most institutions. Also, the overwhelming majority of students in equine sciences and IHSA activities are women. Thus, a women's equestrian team is an attractive option for athletic departments that have interest in adding women's sports. Recently NCAA division I universities have begun fielding varsity, women's equestrian teams. Such is the case at Texas A&M University (TAMU). An IHSA club-level program had been in place at TAMU for many years as a part of the Equine Sciences Program. In the late 1990's, the Associate Director of Athletics and the Equine Sciences Program Leader at TAMU began discussions regarding offering a varsity Women's Equestrian Team and merging that program with the existing Equine Sciences Program. Subsequently, the Director of Athletics and the Head of the Department of Animal Science approved a proposal outlining mutual use of the existing Equestrian Center and horses to support a varsity Equestrian Team and the riding component of the Equine Sciences Program. This program is jointly managed by both departments, and is a win-win program. The Equine Sciences Program benefits tremendously from the enhanced exposure and financial support of the Athletics Department, and serves as a recruiting tool for the Equestrian Team. The Athletics Department benefits from the use of facilities and horses to field the Equestrian Team and having another women's team with a large number of students. This has been and a very successful merger. It works primarily because of the mutual respect and support of the combined program by all the people involved, and it has generated tremendous visibility and support in both the horse industry and the alumni of Texas A&M University.

Key Words: Equestrian, Varsity, Equine Sciences