croma ($P < .01$), WBSF ($P = .089$), protein ($P < .05$), type IIB fiber populations ($P < .05$), and all three fiber type areas ($P < .05$) were higher in 25 kg LWS kids. Lean tissue from 25 kg LWS kids was darker, firmer, and drier. Few differences between LM and TB muscles were observed. Results suggest that increasing LWS (6 vs 25 kg) for kids does not have any negative effect on meat quality and would result in more kilogram of meat to be marketed.

Key Words: Meat Quality, Live Weight at Slaughter, Goat

546 Changes in Warner Bratzler shear values and mechanical strength of intramuscular connective tissue of chevon due to storage condition. G. Kannan*[1], C. B. Chawan[2], B. Kouakou[1], and S. Gelaye[1], [1]*Agricultural Research Station, Fort Valley State University, Fort Valley, Georgia,* [2]*Alabama A&M University, Normal.*

Chevon (goat meat) is considered to be lower in tenderness compared to beef, pork, or lamb. The objectives of this study were to determine the effects of storage time (ST) and conditions (SC) on tenderness and changes in intramuscular connective tissue (IMCT) strength of chevon. Spanish does (8 mo of age, avg BW 25 kg) were slaughtered (n = 12), carcasses kept at 4°C for 24 h, and then fabricated into 2.5 cm-thick leg, arm, and loin/rib cuts. The cuts from six carcasses were vacuum packed and wet aged at 2°C for 0, 4, 8, or 12 d. To assess the influence of oxidation on postmortem tenderization, the cuts from the remaining six carcasses were placed on styrofoam trays, wrapped with polyvinyl-chloride film, and stored at 2°C for similar periods. At each ST, longissimus dorsi (LD), semimembranosus (SM), and triceps brachii (TB) muscles were assessed for Warner Bratzler shear (WBS) values. The IMCT samples were prepared by treating LD tissues in NaOH solution and then embedding in an acrylamide solution. The NaOH-treated samples were prepared for scanning electron microscopy (SEM) using standard dehydration protocol, followed by freeze-drying and gold-coating. Intact perimysium and honeycomb structures of endomysium with no muscle fiber elements were observable under SEM. Neither SC nor ST influenced the mechanical strength of IMCT preparations, as measured by a texture analyzer, although raw LD shear values decreased over time. Cooked meat WBS values in both SC were different ($P < .01$) for the three muscles studied, with the values high in SM, low in LD, and intermediate in TB. The WBS values were also higher ($P < .01$) at 0 h than at other ST. However, there was no SC x ST interaction to indicate any adverse influence of oxidation on tenderization of chevon. The results suggest that IMCT may be a major factor contributing to chevon toughness.

Key Words: Chevon, Aging, Tenderness

547 Manipulation for out of season breeding in Spanish goats. T Wuliji*[1], A.L Goetsch[1], A Litherland[2], T Sahlu[1], R Puchala[1], and L.J Dawson[1], [1]*E (Kika) de la Garza Institute for Goat Research, Langston University, OK,* [2]*AgResearch Grasslands, Private Bag, Palmerston North, New Zealand.*

The manipulation of seasonal breeding in goats could improve profitability of meat goat production by producing out-of-season meat kids for Christmas festive markets and increasing the number of kids born per female. Therefore, the objective of this experiment was to evaluate means of manipulating the breeding season. Three Spanish bucks were conditioned for 2 mo of long-day photoperiod (16 h light:8 h dark) starting January 19, 1999, followed by a single dose of a continuous-release melatonin implant (18 mg, Regulin, Schering Pty. Ltd). Eighty Spanish does (15 two years of age and 65 yearling doelings) were allotted to three treatments of zero, melatonin implant, or oral administration of melatonin (Sigma Chemical Co., St. Louis, MO). Half of each melatonin group also received three pellets of bromocryptine mesylate (215 mg) implants (Innovative Research of America, Sarasota, FL). Therefore, treatments were: control (C), melatonin implant (MI), melatonin and bromocryptine mesylate implants (MIB), melatonin oral delivery (MO, 3 mg/d), and melatonin oral delivery and bromocryptine mesylate implant (MOB). At the end of the treatment period (April 13), does were randomized and bred in three single-sire groups for two estrus cycles (34 d). The number of does bred was 14, 14, 14, 14, and 15; number of does pregnant at ultrasonographic scanning was 5, 10, 12, 12, and 11; number of does kidded was 5, 10, 11, 8, and 8; and number of kids born was 8, 18, 18, 13, and 18 for C, MI, MIB, MO, and MOB, respectively. There was no difference among treatments in number of does bred, whereas the melatonin-treated groups had a greater ($P < .05$) number of does that kidded and number of kids born than the control. In conclusion, melatonin regardless of delivery mode increased the number of does kidding in the late summer/early fall.

Key Words: Goat, Melatonin, Breeding

548 Effects of physiological status and energy intake on cortisol, thyroid hormones and blood metabolites in dairy goats. B. Kouakou*[1], S. Gelaye[1], O.S. Gazal[2], G. Kannan[1], T.H. Terrill[1], and E.A. Amoah[1], [1]*Agricultural Research Station, Fort VAlley State University, GA,* [2]*Department of Biological Sciences, Saint Cloud State University, MN.*

Yearling does (BW = 42 ± 6.4 kg; n = 10) were used in a completely randomized design experiment to determine the effects of physiological status (non-pregnant vs pregnant) and energy intake on serum cortisol, triiodothyronine (T_3) and thyroxine (T_4), non-esterified fatty acid (NEFA), and blood urea nitrogen (BUN). Animals were stratified by BW then randomly assigned to be individually fed a 16% CP diet (2.9 MCal DE/kg DM) at either maintenance (M) or twice maintenance level (2M) for 21 d. Animals were weighed and blood samples taken weekly. At the end of this non-pregnant period, animals were pen-fed the station basal diet of concentrate and hay, their estrous cycles were synchronized using a standard lutalyse regimen, and they were bred to a single buck within 48 h after the last injection. On d 42 post breeding, pregnancy was determined in all does by progesterone assay (100% pregnancy rate). On d 43 of pregnancy, the does were weighed and put back on experiment under similar pre-breeding conditions. Serum samples were assayed for cortisol, T_3 and T_4, BUN, and NEFA. Overall, cortisol level was lower ($P < .005$) with maintenance intake. Dietary treatment did not affect ($P > .10$) thyroid hormones. Blood urea nitrogen was higher ($P < .001$) for M relative to 2M-fed does regardless of physiological status. Levels of NEFA were greater ($P < .001$) in M-fed than 2M-fed animals. Within the M-fed, the non-pregnant had higher ($P < .05$) NEFA than the pregnant does. However, NEFA concentrations were similar among the 2M-fed goats regardless of physiological status.

Key Words: Goats, Hormones, Metabolites, Intake Level

GRADUATE STUDENT PAPER COMPETITION
ADSA NORTHEAST BRANCH - ASAS NORTHEAST SECTION

549 Growth hormone (GH) response to growth hormone-releasing hormone (GHRH) in beef cows divergently selected for milk production. T.L. Auchtung*[1], D.S. Buchanan[2], C.A. Lents[2], S.M. Barao[1], and G.E. Dahl[1], [1]*University of Maryland, College Park,* [2]*Oklahoma Agricultural Experiment Station, Stillwater.*

In dairy cattle, increased circulating growth hormone has been associated with selection for greater milk yield. This study tested the hypothesis that beef cows divergently selected for milk production would have differing GH responses to a challenge dose of GHRH. GH response to a challenge of GHRH was measured in 36 Angus sired cows ranging from 2 to 10 yr of age. The cows were classified as HIGH (n=20) or LOW (n=16), on the basis of their sires' Milk EPD. Mean Milk EPDs (kg) were 16.6 and -14.4 for HIGH and LOW, respectively. Mean BW (kg ± SD) was 592 ± 61 and 607 ± 43 for HIGH and LOW cows, respectively. Blood samples were taken immediately prior to and 10 min following a clearance dose of 4.5 μg GHRH/100 kg BW (injected i.v.) and, 3 hr later, immediately prior to and 10 min following a challenge dose of either 1.5 or 4.5 μg GHRH/100 kg BW. Each animal received both challenge doses; the doses were randomly assigned across the 2 d of blood collection. The GHRH was a bovine analog (1-30) GHRH.Concentrations of GH and IGF-1 in serum were measured by RIA. IGF-1 was measured in the baseline blood sample on Day 1. A positive relationship (r = .35, P <. 03) was found between the cows' rankings for each dose of GHRH, i.e. high responders to the low dose were high responders to the

high dose. Milk EPDs of the sires were positively related to the 4.5 μg /100 kg BW challenge dose of GHRH (R^2 = .10, P < .03) in a model that included both HIGH and LOW cows. Sire Milk EPDs tended (P < .08) to be related to the 1.5 μg GHRH/100 kg BW challenge dose in a model that included only HIGH cows. In addition, Milk EPDs were inversely related to IGF-1 concentrations of HIGH cows. Growth hormone response to GHRH challenge has potential as an additional tool in selection for higher milk production in beef cattle. Studies are underway to evaluate the relationship of GH response to GHRH at weaning and subsequent milk production in beef females.

Key Words: Beef Cattle, Milk Production, Growth Hormone

550 Effect of age and equine somatotropin treatment on immune function in female horses. P.D. Guirnalda*, V. Roegner, and K. Malinowski, *Rutgers-The State University of New Jersey, New Brunswick.*

Aging has been associated with declines in somatotropin and IGF-I levels as well as various parameters of immune function. In order to determine whether ST administration could reverse immunosenescence in horses, 8 young and 8 aged female Standardbred horses were given 10mg/d recombinant equine somatotropin (eST) or vehicle for 49 d. IGF-I was elevated in ST-treated mares (P<0.0001). Monocyte and lymphocyte number tended to be lower in ST-treated mares (P<0.07). Aged mares treated with ST demonstrated lower granulocyte number (P<0.05) and CD8+ lymphocyte counts were higher in young mares (P<0.01) resulting in a higher CD4:CD8 ratio in aged mares. There was a trend towards lower mitogenn induced T and B lymphocyte proliferative response in aged mares (ConA, PHA, PWM; P=0.17, 0.17, and 0.13, respectively). ST treatment resulted in a reduced primary antibody response in aged mares compared to vehicle-treated and ST-treated young mares (P<0.05). Young ST-treated mares displayed a higher primary antibody response compared to all other treatment groups (P<0.05). Horses are similar to other species in that they exhibit similar signs of age-related declines in immune function which were not reversible with ST treatment.

Key Words: Horses, Aging, Somatotropin

551 Age related changes of somatotropin, insulin-like growth factor-I and insulin-like growth factor binding protein-2 and -3 in male and female Hereford calves. K.E. Govoni*[1], T.A. Hoagland[1], and S.A. Zinn[1], [1]*Department of Animal Science, University of Connecticut, Storrs 06269.*

The overall objective of this study was to examine the ontogeny of the somatotropic axis in male (M) and female (F) beef cattle from birth to nine months of age. To meet this objective, eight M and eight F Hereford calves were used and all animals were managed similarly. Briefly beginning at two weeks of age, calves were moved onto grass pasture with dams and weaned at 207d of age. Following weaning, calves were moved to pens and fed a corn silage based diet with 42% concentrate top dress (1kg/calf) formulated for calves to gain 1.2 kg/day. Blood serum samples, collected by venipuncture of a jugular vein, and body weights (BW) were taken weekly. Somatotropin (ST) and Insulin-like Growth Factor-I (IGF) were analyzed by RIA. IGF Binding Protein (BP) -2 and -3 were quantified by Western Ligand Blot and data were expressed as a percent of standard BP-3 density. To date, 75% of the data have been collected and analyzed. Averaged across all samples (41 samples/animal), serum concentrations of ST were greater in M (20.7 ng/mL) than F (9.5 ng/mL) through 277d of age. From birth to 277d of age, serum ST decreased in M (23 to 20 ng/mL;p<.05) and F (32.8 to 4.4 ng/mL;p<.01). In males, IGF increased from birth to 186d of age (42.1 to 164.5 ng/mL;p<.01), but not in F (95.3 to 107.5 ng/mL;p=.6). From birth to 165d of age, BP-3 increased in M (75 to 152%;p<.01) and F (85 to 134%;p<0.01). However, BP-2 increased in F (81 to 139%;p<0.05), but not in M (88 to 105%;p>0.1) in the same time frame. Growth rates of M and F were equal from birth to 109d of age, but M grew 8% faster than F from 109 to 291d of age. In conclusion, there are changes with age in several characteristics of the somatotropic axis and these changes are different between M and F.

Key Words: Calf, Somatotropic Axis, Growth

552 Effects of prepartum somatotropin and/or monensin on periparturient metabolism and production. J. E. Vallimont*[1], G. A. Varga[1], A. Arieli[2], and T. W. Cassidy[1], [1]*Pennsylvania State University, University Park,* [2]*Hebrew University of Jerusalem, Israel.*

Fifty-five multiparous Holstein cattle were used to evaluate the effects of increasing glucose precursors during the late dry period on postpartum health and production. Treatments were TMR topdressed with 300 mg monensin/day (**M**), n = 15; injection of exogenous somatotropin (**ST**), n = 14; monensin and somatotropin in combination (**ST+M**), n = 13; or no supplement (**C**), n = 13 during the last 28 days prior to expected parturition. A 500 mg subcutaneous injection of somatotropin (POSILAC®) was administered in the tail head at d -28 and -14 relative to expected calving. Cows (n = 8) not expected to calve within 48 hours of their due date were given a third somatotropin injection. The prepartum diet contained 14.5% crude protein and 1.6 Mcal/kg NEl, both on a DM basis. Diet and management were the same for all cattle after parturition. Production and intake were measured daily until 63 days in milk. Milk composition, blood metabolites, and body weight and condition score were measured weekly. Cows in the ST group consumed 1.2 kg more DM in the prepartum period than all other groups (P<0.05). Prepartum NEFA levels were higher (P<0.05) in the C group than the ST and ST+M groups (159.8 μeq/L vs. 126.2 μeq/L and 123.8 μeq/L, respectively). Postpartum results are presented in the table. M and ST treatments significantly increased milk production over C. Prepartum M treatment resulted in lower plasma NEFA postpartum. Results from this study indicate that prepartum treatment with monensin reduces adipose tissue mobilization and improves milk production of the periparturient dairy cow.

		Postpartum			
Treatment	C	ST	M	ST+M	SEM
DMI/ kg/d	21.75^a	22.75^b	23.78^c	22.94^b	0.48
Milk Yield, kg/d	44.28^a	45.23^b	46.22^c	45.05^{ab}	0.91
Fat yield, kg/d	1.68	1.66	1.68	1.62	0.04
Protein yield, kg/d	1.34^a	1.37	1.40^b	1.38	0.03
NEFA, μeq/L[1]	408.0^a	380.7	330.8^b	347.0	28.09

^{abc} Means in a row without common superscripts differ (P<0.05) according to Student-Newman-Keuls Test. [1] NEFA average for first 3 weeks in lactation.

Key Words: Transition cow, Somatotropin, Monensin

553 Effect of a short-term treatment with a Controlled Internal Drug Releasing (CIDR)device and Follicle Stimulating Hormone (FSH)on induction of estrus and lambing rates in anestrous ewes. M. Knights*, T. D. Maze, P. E. Lewis, and E. K. Inskeep, *West Virginia University, Morgantown.*

Objectives of this study were to evaluate, in anestrous ewes, effectiveness of: 1) a CIDR device (.3 g progesterone, P_4) administered for 5 d to induce estrus, and 2) FSH (Folltropin; 55 mg NIH-FSH-P1 equivalent) in propylene glycol 24 h before insert removal (d 0), to increase ovulation rate and prolificacy. Crossbred ewes on 7 farms were assigned at random to 3 treatments, control (C; n= 125), 5 d P_4 (P5; n = 257) and 5 d + FSH (P5F; n = 271). Raddled rams were joined at insert removal and ewes were observed for 3 d to detect estrus. On d 14, ovulation rates (OR) of all ewes detected in estrus were determined using transrectal ultrasonography. On d 26-30, rams were removed and ewes were examined for pregnancy to the first service period. Ewes were reexamined 20-25 d later to detect conception at the second service period. Percentage of ewes detected in estrus was higher in P_4-treated (76%) than in C (20%; P< .0001) but did not differ due to FSH in P_4 -treated ewes. Mean OR (1.95± .04) did not differ due to FSH. Mean conception rate (CR; 66.5%) and pregnancy rate (PR; 42%) to the first service period were higher in P_4 -treated ewes (P< .001) than in C (0 %), but did not differ due to FSH in P_4-treated ewes. Overall pregnancy rates based on examination at d 46-55 and on number of ewes lambing (70 and 61.4 %) were higher in ewes receiving P_4 (73± 1 and 65.3± 1%; P < .001), than in C ewes (56.8±4 and 44.8±4 %), but did not differ between ewes receiving P_4 only (P5; 71.6± 3 and 63.4±3 %), and ewes receiving P_4 and FSH (P5F; 74.5±3 and 67.2±3 %). Prolificacy to the first service period and overall did not differ among treatments (0 and 1.5 ±.1; 1.5±.1, and 1.5±.1; and, 1.6± .1 and 1.6±.1 for C, P5 and P5F groups, respectively). Mean lambing rates (.7±.1, 1.0 ±.1, and 1.1±.1 lambs born per ewe exposed for C, P5 and P5F, respectively)

were higher in P_4-treated ewes ($P < .001$), and tended to be higher ($P = .09$) in FSH-treated ewes than in ewes treated with P_4 alone. A 5-d treatment of anestrous ewes with P_4 induced estrus, increased the PR to two service periods (20 percentage points), and the lambing rate (0.3). FSH at the dosage and time used did not increase OR.

Key Words: CIDR, Anestrous Ewes, Lambing Rates

554 Comparision of energy parameters in Jersey and Holstein dairy cows in early lactation. R. R. Rastani* and S. M. Andrew, *University of Connecticut, Storrs, CT.*

The objective of the study was to evaluate the effect of breed on the rate and extent of energy mobilization in early lactation. Nine Jersey and nine Holstein dairy cows were paired by breed, parity, and calving date. Cows were individually fed a total mixed ration, ad libitum, from parturition through 120 DIM. The total mixed ration was comprised of 37 % corn silage, 13 % grass silage, and 50 % concentrate on a dry matter basis. Feed intake and milk production were measured daily; BW and milk composition were measured every two weeks. Energy balance was calculated utilizing 1989 NRC equations. Holsteins had a higher daily milk production compared to that of Jerseys, 44.9 kg and 26.6 kg, respectively ($P < 0.01$). Milk fat and protein composition were higher for Jerseys relative to the milk composition of Holsteins ($P < 0.01$). Average BW was 462 kg for Jerseys and 683 kg for Holsteins. Net energy intake was higher for Holsteins compared to that of Jerseys, 37.8 Mcal/d and 28.2 Mcal/d, respectively. Milk energy was 21.2 Mcal/d and 30.5 Mcal/d, for Jerseys and Holsteins, respectively ($P < 0.01$). Energy balance differed between breeds through the seventh week of lactation ($P < 0.05$). Jerseys remained in negative energy balance for a shorter period of time and to a lesser extent relative to Holsteins. The energy balance nadir was -6.19 Mcal/d for Jerseys and -12.9 Mcal/d for Holsteins. Expressed as a proportion of metabolic BW ($BW^{0.75}$), net energy intake did not differ between breeds; however, milk energy was higher for Holsteins compared to Jerseys when adjusted to metabolic BW. This resulted in a higher calculated energy balance for Jerseys during early lactation.

Key Words: energy balance, Jersey, early lactation

555 The effect of urea calcium chloride fertilization on yield and nutrient composition of cool-season forage grasses for prepartum dairy cows. K.M. Danahey*[1,2], E.D. Thomas[2], J.R. Knapp[1], C.S. Ballard[2], and C.J. Sniffen[2], [1]*University of Vermont, Burlington,* [2]*W.H. Miner Institute, Chazy, NY.*

The objective of this research was to examine the effects of nitrogen (N) and chloride (Cl) fertilizers in the production of cool-season forage grasses for prepartum dairy cows. "Palaton" reed canarygrass was fertilized in two consecutive trials, April 1998 and again in April 1999. Four fertilizer treatments: {unfertilized control; 22.7 kg of Cl as urea calcium chloride (8-0-0-25 Ca-44 Cl); 45.4 kg N as ammonium nitrate (33.5-0-0); and combined 45.4 kg NH_4NO_3 plus 22.7 kg NH_4CaCl_2} were randomly assigned within four plots following a split-plot design. A second application of 45.4 kg of N was applied immediately after first harvest to the treatments that received it initially. There was no second application of NH_4CaCl_2. Two cuttings were harvested each year at approximately 20% bud stage from a 0.92 m x 0.32 m section of each treatment block to determine yield, DM and nutrient composition. Data were analyzed using a split-split plot design. Growing conditions were wet in 1998 and dry in 1999. In both 1998 and 1999, application of N fertilizer increased forage yield for both harvests ($p<0.05$). The application of Cl had no effect on yield ($p>0.05$). Application of N fertilizer decreased forage Cl concentration significantly ($p<0.05$). Alternatively, forage Cl concentration was significantly increased nearly three-fold across all harvests when Cl fertilizer was applied ($p<0.01$). Dietary cation-anion (DCAD) levels were significantly decreased from 383 to 194 for 1^{st} cut and 293 to 118 for 2^{nd} cut when Cl fertilizer was applied ($p<0.05$). It is evident from this study that the application of NH_4CaCl_2 has the potential to increase DM yield and Cl concentration of the forage. The high Cl forage is beneficial in decreasing the DCAD used to balance prepartum rations and may reduce or eliminate the use of commercial anionic salts.

Key Words: Chloride, DCAD, Forage

556 Supplementing Natuphos with an *Escherichia coli* phytase expressed in yeast improves its in vitro and in vivo efficacy. C.H. Stahl*, K.R. Roneker, T. Xiang, J.R. Thornton, and X.G. Lei, *Cornell University, Ithaca, NY.*

We have expressed an *E. coli* phytase (EP) gene in a yeast system and the secreted glycoprotein exhibited distinct differences in pH optimum, resistance to proteolysis, and substrate specificity from those of Natuphos, a recombinant *Aspergillus niger* phyA phytase (AP). The objective of this study was to determine the in vitro and in vivo efficacy of EP and AP supplemented alone or in combination on phytate-phosphorus hydrolysis. In the in vitro experiment, 0.6 units of EP, AP, or a 1:1 combination of EP+AP were mixed with 2 g soybean meal that was suspended in 10 ml of 0.2 M citrate buffer, pH 3.5, and incubated at 37 C for 1 h. There was 146% and 26% more phosphorus ($P < 0.01$) in the supernatant released by the EP than that by the AP and the AP+EP, respectively. Incubating soybean meal with the AP+EP released 95% more phosphorus ($P < 0.01$) than the AP alone. Apparently, the combination of these two phytases was more effective than the AP alone, but showed no benefit over the EP alone. In the in vivo experiment, 42 pigs (6-wk old) were fed a corn-soybean meal, low-phosphorus basal diet supplemented with AP, EP, or AP+EP at 500 U/kg of diet for 6 wk. Although there were no significant differences in overall ADG, ADFI, or gain:feed among treatment groups, pigs fed the EP had higher ($P < 0.05$) plasma inorganic phosphorus concentrations and lower ($P < 0.05$) plasma alkaline phosphatase activities than those of pigs fed the AP at wk 4. Pigs fed the AP+EP were not significantly different from either of the other two treatment groups. Just as in the in vitro study, EP seemed to be more effective in releasing phytate-phosphorus from the corn-soy diet for pigs than AP. In conclusion, the biochemical differences between these two enzymes may offer us an innovative approach to enhance the activity efficacy of Natuphos phytase.

Key Words: Phytase, Pigs, Phosphorus

557 Replacement value of wet microbrewery grains in swine finishing diets. B.A. Altizio*, J.E. Wohlt, P.A. Schoknecht, and M.L. Westendorf, *Cook College, Rutgers University, New Brunswick, NJ.*

Previous reports have indicated that commercially produced brewers' grains have replacement value in corn/soybean diets fed to swine. Spent microbrewery grains contain less CP than commercial grains (21 vs. 25%). Thus, it is unknown if grains from microbreweries can provide the same results as commercially produced varieties. Therefore a feeding study was conducted with wet microbrewery grains (25% of diet DM) replacing corn, (23% of diet DM) and soybean meal (44% of diet DM) in swine finisher diets. Thirty-six hogs (40.5 kg $\pm$ 1.9; mean $\pm$ SEM) were blocked by sex and weight and fed one of three dietary treatments; corn/soybean meal (CS), corn/soybean meal/soy hulls (CSH), or corn/soybean meal/wet brewers' grains (WBG) for 10 wk. Diets varied in DM (CS, CSH 89%, WBG 55%), but were isonitrogenous (16% CP). Diets CSH and WBG contained similar ADF (7.3%, DM basis), higher than the CS diet (3.3%, DM basis) with energy content ranging from 3.1 to 3.3 Mcal/kg. Upon completion of the feeding trial, all hogs were slaughtered and carcass measurements collected. In the statistical model, effect of diet on performance and carcass measurements was evaluated by pen (n=4). Hogs fed CS, CSH, and WBG had similar DMI (3.0, 3.6, 3.0 kg/d, p=0.36); ADG (0.920, 0.943, 0.833 kg/d, p=0.07), and feed:gain (3.3, 3.6, 3.6, p=0.15); respectively. The higher moisture content of WBG did not limit feed intake or performance. Hogs fed CS, CSH, and WBG also produced similar carcass (74.8, 75.2, 68.7 kg, p=0.09), backfat (27.9, 28.7, 25.8 mm, p=0.38), ham (14.3, 14.5, 13.5 kg, p=0.18), and loin (13.6, 13.6, 12.7 kg, p=0.25); respectively. Even though diets had similar ADF and CP, hogs fed WBG tended to produce lighter, leaner, carcasses compared to those fed CSH. These data suggest that WBG from microbreweries can be used to replace a portion of the corn and soybean meal in finisher swine diets potentially decreasing feed costs.

Key Words: Wet microbrewery grains, Finisher pigs, Performance carcass merit

558 Effect of trough-anchored blind teats on production and welfare of early-weaned piglets, fed a liquid or pelleted diet. J.A. Rau* and I.J.H. Duncan, *University of Guelph, Colonel K.L. Campbell Centre for the Study of Animal Welfare, Guelph, Canada.*

A 2x2 factorial design was used to determine the effect of trough-anchored blind teats on food intake, water use, growth, and skin condition of piglets weaned at 14 days, fed a liquid or pelleted diet. 192 pure-bred Yorkshire piglets made up 4 treatments, with 6 replicates per treatment, 8 piglets per replicate, or pen, and pen as the experimental unit. All piglets were fed a commercial early wean diet from a trough with or without blind teats anchored to the lumen, for a period of 14 days immediately following weaning (Phase 1). At 14 days post-weaning experimental treatments were removed and all piglets were fed a commercial starter diet, ad libitum, from conventional food troughs for an additional 14 days (Phase 2). Measurements of food intake, water use (from nipple drinkers), body weight, and skin condition of piglets were taken over the first 28 days post-weaning. Trough-anchored blind teats significantly reduced the severity of skin lesions, thought to be a result of severe belly-nosing, on the bellies and flanks of piglets in both Phase 1 ($P<0.005$) and Phase 2 ($P<0.0001$). Feeding a diet in liquid form resulted in less water use over the 28 day trial ($P<0.005$), reduced the severity of skin lesions over Phase 1 ($P<0.05$) and Phase 2 ($P<0.0001$), and increased apparent dry matter intake ($P<0.0001$) and average daily gain ($P<0.01$) over Phase 1. These results suggest that there may be a critical period in which the development of misdirected massaging and sucking by early-weaned piglets becomes established. Directing the performance of the early-weaned piglet's innate sucking behaviour towards blind teats and liquid food curbs the development of misdirected massaging and sucking, and improves food intake immediately following weaning, resulting in overall improved piglet production and welfare.

Key Words: Feeding, Piglets, Welfare

GRADUATE STUDENT PAPER COMPETITION
ADSA DAIRY FOODS DIVISION

559 Bioavailability of vitamin A provided as a β-lactoglobulin Complex. J. J. Shaw*, J. C. Allen, and H. Swaisgood, *North Carolina State University, Raleigh.*

Fluid milk products have been fortified with vitamin A (along with Vitamin D) since the 1930s to reduce the incidence of disorders caused by fat-soluble vitamin deficiency in the USA. However, non-fat or low-fat milk products often do not comply with nutrition labeling requirements, possibly because the vitamin adheres to packaging or processing equipment. Because vitamin A, a fat-soluble nutrient, will bind with β-lactoglobulin, a major component of bovine milk, we propose that β-lactoglobulin can be used as a carrier to fortify skim milk. We tested bioavailability of this complex from skim milk and an aqueous solution and compared the bioavailability with an oil-based vitamin A vehicle. Rats were fed vitamin A deficient or control diets for 10 wk. During the last 4 wk, deficient rats were repleted by oral gavage with the 4 test treatments. At 6 wk, serum vitamin A was 2.3±.5 μg/dl in deficient rats vs. 15.3±2.6 in controls. At 10 wk, serum vitamin A was 24.7±6.5 in control and 12.6±2.0, 14.8±3.7, 3.3±.8, 6.2±.9 in rats repleted with vitamin A in oil, vitamin-A-β-lactoglobulin complex, vitamin A in oil added milk, and vitamin-A-β-lactoglobulin complex added milk, respectively. Thus, β-lactoglobulin complexes had bioavailability as good as or better than an oil-based fortifier. Skim milk reduced the bioavailability of both forms.

Key Words: Vitamin A, β-lactoglobulin, Bioavailability

560 Impact of low concentration factor (CF) microfiltration (MF) on the composition and aging of Cheddar cheese. M. Neocleous*, D.M. Barbano, and M.A. Rudan, *Northeast Dairy Foods Research Center, Cornell University, Ithaca, NY.*

Raw skim milk was microfiltered twofold (2X) using a 0.1μm ceramic membrane at 50^o C. The average true protein content of the retentate and permeate across the four trials of cheese making was 5.31 and 0.53%, respectively. Cream and MF permeate were added back to the 2X skim retentate to achieve a constant casein to fat ratio of 0.68. Four cheeses were made from 1X (control), 1.3, 1.6 and 2X CF cheese milks in a 4x4 randomized block design on four different days from different batches of milk. Double strength rennet (Chymax) was used at a rate of 0.099 ml/kg of milk for the control and 80, 60 and 33% of this rate was used for the 1.3, 1.6 and 2X CF, respectively. A constant amount of starter was used per original volume of unconcentrated milk for all treatments. The 1, 1.3, 1.6 and 2X cheeses had moisture 35.3, 34.6, 34.4, 33.8%, protein 24.9, 25.1, 25.2, 25.7%, fat 34.5, 34.8, 34.8, 34.8%, pH 5.10, 5.12, 5.13, 5.16, calcium 0.77, 0.81, 0.82, 0.85%, and TPA Hardness 61.2, 65.7, 71.4, 75.0 Newtons, respectively. Cheese moisture decreased and protein, salt in moisture, initial pH, calcium and TPA hardness increased with increasing CF. The pH 4.6 and 12% TCA soluble nitrogen content of the cheese increased during 180 days of aging, but was significantly lower with increasing CF. The reduced rate of proteolysis with increasing CF could have been caused by one of the following: lower moisture, higher calcium or calcium to protein ratio, too little rennet added, or some other factor. A 2 x 3 paired comparison (control vs. 2X) follow up trial was done to identify the cause of the reduced rate of proteolysis. The make procedure was adjusted for the 2X treatment to increase cheese moisture and the rennet addition was increased from 33% to 48% of the control. The cheeses are currently aging.

Key Words: Microfiltration, Cheddar cheese, Proteolysis

561 Response of bifidobacteria to acid adaptation. V. Deibel* and J. Steele, *University of Wisconsin, Madison.*

Response of Bifidobacteria to acid adaptation
Probiotics, including Bifidobacteria, play a role in lowering the pH of the large intestine which restricts growth of pathogens and are believed to have other benefits that promote human health. Cell viability during gastrointestinal passage must be maintained to assure probiotic efficacy. The gastrointestinal tract presents stress conditions that include stomach acidity reaching a pH of 1.5. Contents can remain in the stomach for up to 140 minutes. Acid survival mechanisms were studied in two commercial strains and three human isolates of Bifidobacteria. Acid adaptive responses were induced by exposure to pH 4 for 10, 20 or 120 minutes after growth in batch cultures at a constant pH of 6.5. After exposure to pH 4, the pH was lowered to pH 2.0 for 140 minutes (acid challenge). Two of the three human isolates (*B. longum* JBL 3301 and JBL 3324) and the two commercial strains (*B. longum* and *B. lactis*) were able to survive exposure to pH 4.0 for 10 minutes without significant ($P > 0.05$) loss of viability. The other human isolate (*B. longum* JBL3300), showed a 2 log decrease in CFU/ml after acid adaptation. Strains were tested for the ability to survive acid challenge with and without prior acid adaptation. The commercial strains were unable to survive acid challenge without acid adaptation but with acid adaptation 10^4 CFU/ml survived. The human isolates were unable to survive acid challenge with or without acid adaptation. To determine if changes occur in the fatty acid composition of the cellular membrane in response to pH changes, the cellular membrane fatty acid profiles were examined in a commercial strain and human isolate (both *B. longum*). Cells were grown at pH 4.5, 5,0, 5.5 and 6.5 with and without acid adaptation. Cellular membrane fatty acid profiles for n14:0, n16:0, n18:0, n18:1 and 19:0 revealed significant changes ($P <0.05$). These data suggested that the cell membrane fatty acid composition may play a role in the acid tolerance response of Bifidobacteria and that membrane fatty acid profiles are altered within 10 minutes after acid adaptation.
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Key Words: Probiotics, Bifidobacteria, Cell membrane fatty acids

562 Survival of acid adapted and non-acid adapted enterohemorrhagic *Escherichia coli* O157:H7 during the manufacturing and curing of reduced-fat Cheddar cheese. P. Kaothien* and D.R. Henning, *Minnesota-South Dakota Dairy Foods Research Center, South Dakota State University, Brookings.*

The objective of this study was to compare the ability of acid adapted and non-acid adapted *Escherichia coli* O157:H7 to survive in reduced-fat Cheddar cheese manufacturing process and curing. Two treatments,

each consisting of six replications, were designed utilizing a cocktail of three strains of *E. coli* O157:H7. *E. coli* O157:H7 cocktail was adapted to acid by culturing for six hours at pH 5.0. Reduced-fat cheddar cheese was made by 33% fat reduction method using active lactic mesophilic starter culture. The target for both treatments was 5,000 to 50,000 CFU/ml. Samples were taken during cheese manufacturing and 1, 2, 3, 7, 14, 30, and 60 days of curing at 6 to 7°C. Samples were grated, stomached with 2% sodium citrate, serially diluted and spread plated on MacConkey Sorbital Agar and incubated at 37°C for 24 hours. Typical colorless colonies were counted as *E. coli* O157:H7. The results from both treatments indicate that *E. coli* O157:H7 can grow during reduced-fat Cheddar cheese manufacturing and can survive 60 days of curing with less than two log reduction in populations at 2.93 to 4.65% salt in moisture phase (SMP). And also no significantly difference between survival of acid adapted and non-acid adapted populations ($P > 0.05$).

Key Words: Reduced-fat Cheddar cheese, Acid adapted, Cheese curing

563 Application of chemometrics to sensory, analytical and gas chromatography olfactometry data of Ragusano Cheese from milk from pasture and TMR fed cattle.

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The objectives of this work were to determine the effect of cattle feed on cheese quality and to determine relationships between cheese sensory and chemical analysis. Milk was collected from pasture and Total Mix Ration (TMR) fed cattle. The Ragusano cheeses were produced from the two milk sources in duplicate, replicated four times and were subjected to chemical analysis, conventional sensory testing and gas chromatography olfactometry (GCO). Each block of results was examined by Exploratory Data Analysis (Principal Components and Factor Analysis) and by pattern recognition (SIMCA) to see if it contained sufficient information for classification into pasture fed and TMR fed groups. The data was also examined to see if relationships between the analytical and sensory results could be elucidated with the modeling technique Partial Least Squares Regression (PLS). Factor analysis revealed that the 26 sensory, 7 chemical analysis and 11 GCO data represented 9, 3, and 6 fundamentally different phenomena, respectively. The SIMCA procedure was able to correctly classify the cheese samples as to the type of feed using either the sensory data or chemical analysis data. Five of the nine conventional sensory odor descriptors ("butyric odor", "toasted", "almond", "floral" and "butter") were successfully modeled from the GCO data ($R^2 \geq 0.66$). Three of the eight taste descriptors ("acid", "bitter" and "butyric taste") were successfully modeled from the GCO data ($R^2 \geq 0.79$). Two of the consistency descriptors ("smooth" and "fracture") and one of the mouth structure descriptors ("teeth stickiness") also led to good models with GCO data ($R^2 \geq 0.70$). This chemometric application clearly indicate that there are significant differences between the cheeses made from milk from pasture fed and TMR fed cattle that are perceptible to a taste panel and from chemical analysis. It was possible to relate a number of sensory odor, taste and other characteristics to the GCO results.

Key Words: Chemometric, Cheese, Feed

564 Characterization of a novel phage resistance mechanism in *Lactococcus lactis*.

J. D. Bouchard*, E. Dion, and S. Moineau, *Universite Laval, Quebec, Canada.*

It is well documented that milk fermentation can be slowed down by lytic bacteriophages. Studies on phage-host interactions led to the discovery of natural lactococcal plasmids coding for anti-phage activities. The transfer of these plasmids into phage-sensitive industrial strains constituted an important milestone in the late 80s. Several constructed cultures were successfully used for a decade in commercial large-scale fermentations. However, new phages have emerged. Thus, it is necessary to find novel anti-phage mechanisms. Here, we report the isolation and characterization of a new lactococcal anti-phage system encoded on a 12.2-kb plasmid, named pED1. This mechanism confers resistance against phages of the 936 and the P335 species but not against the c2-like phages. Phage p2 (936 species) had an efficiency of plaquing (EOP) of 9.5×10^{-6}, a 15-fold diminution of its efficiency to form centers of infection (ECOI), and a 10-fold reduction of its burst size. Phage ul36 (P335 species) was similarly affected with an EOP of 3.0×10^{-7}, a 18-fold decrease of the ECOI and a 12-fold reduction of the burst size. Phage adsorption and cell survival following phage infection were unaffected by the mechanism, indicating the presence of an abortive infection system (Abi). A 2.2-kb fragment containing four open reading frames (ORFs) conferred the phage resistance phenotype. Inactivation of two of these ORFs (127 and 213 amino acids) resulted in the loss of the phenotype. The products of these putative genes had no homology with proteins in the databases and their G+C content was 31.9%. Phages p2 and ul36 DNA was detected in Abi^+ cells, but only in its immature forms. Phage mutants insensitive to the Abi were isolated in laboratory. Mutants of ul36 had different restriction profiles and restriction mapping revealed that all of the late genes were replaced. In summary, a novel abi system that conferred resistance against 936 and P335 phages was isolated, at least two proteins were required for the anti-phage phenotype and they blocked a late step of the phage lytic cycle.

Key Words: *Lactococcus lactis*, Bacteriophages, Abortive infection

565 Human Flavor Threshold for Acetaldehyde in Milk of Various Fat Content, Chocolate Milk, and Spring Water.

M. Van Aardt*[1], S.E. Duncan[1], and D. Bourne[1], [1]*Virginia Tech, Blacksburg.*

The implications of milkfat on detection threshold of acetaldehyde were determined on whole -, lowfat -, and nonfat milks, chocolate flavored milk, and spring water. Acetaldehyde threshold in milk of various fat content is of great importance to the dairy industry since acetaldehyde develops in milk during storage and it is also a degradation product of polyethylene teraphthalate, a relatively new packaging choice for milk. Sensory threshold testing of all mediums was duplicated using a panel of 25 untrained subjects. Although acetaldehyde is lipid soluble, there was no significant difference in acetaldehyde threshold in milk of various fat content. Thresholds ranged from 3,939 to 4,040 ppb. Fat content thus seems to play no role in the flavor threshold for acetaldehyde in milk. Chocolate flavored milk and spring water showed thresholds of 10,048 and 167 ppb respectively, which compares favorably with previous studies. This high threshold of acetaldehyde in chocolate flavored milk is most likely due to masking of acetaldehyde flavor by chocolate flavor. Solid phase microextraction (SPME) was verified as an effective method for recovery of acetaldehyde in all mediums. Acetaldehyde could be detected as low as 200 and 20 ppb in milk and water respectively when using a Carboxen-PDMS SPME fiber in static headspace at 45 degrees C for 15 min

Key Words: Acetaldehyde, Threshold, Fat Content

566 Citrate catabolism and succinate production by Cheddar cheese nonstarter lactobacilli.

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Succinate is an organic acid known to affect the flavor of fermented foods and beverages. Nonstarter lactobacilli (such as *Lactobacillus casei*, *Lactobacillus plantarum*, and other related lactobacilli) are primarily responsible for the production of succinate in Cheddar cheese, however limited information exists concerning the pathways utilized. Three strains of *L. plantarum*, and one strain each of *L. casei*, *L. zeae*, and *L. rhamnosus* were grown in a lactose and citrate containing complex medium under anaerobic conditions at 37C. All six strains were able to catabolize citrate. After 24h of growth, all strains had completely utilized the lactose present and had acidified the media to a pH between 4.8 and 5.2. Cells were harvested, washed, and resuspended in phosphate buffered saline containing 10mM: (1) citrate; (2) L-lactate; (3) both citrate and L-lactate; (4) aspartic acid; or (5) isocitric acid. After 24h incubation at 37C, the three strains of *L. plantarum* produced between 0.3 and 1.9mM succinate from citrate and between 0.8 and 2.8mM succinate from the combination of citrate and L-lactate. *L. plantarum* strains did not produce detectable levels of succinate from aspartic acid or isocitric acid. Also, no succinate production was detected with the other three *Lactobacillus* species under any of the conditions tested. Therefore, it appears *L. plantarum* produces succinate from citrate, and this pathway is enhanced by the presence of L-lactate. Current studies are aimed at deducing the pathways of citrate catabolism for these four *Lactobacillus* species.

Key Words: Lactobacillus, Succinate, Citrate

567 Effect of the combination of milk pre-acidification and cream homogenization on the post-baking chewiness and whiteness of low fat (6%) Mozzarella cheese. P. R. Benitez*[1], D. M. Barbano[1], and P. S. Kindstedt[2], [1]*Cornell University, Ithaca NY,* [2]*University of Vermont, Burlington.*

Previous experiments have separately demonstrated that homogenization of cream increased whiteness and that pre-acidification of milk decreased post-baking chewiness of low fat Mozzarella. It has not been determined however, if the combination of these two techniques is effective. Cheese was manufactured by the stirred curd no brine method using a 3 x 3 randomized block design. The three treatments were milk pre-acidification (citric acid) to pH 5.8 without homogenization and to pH 5.8 and 5.6 with homogenization. Mean moisture (55.7, 59.0, and 61.7%, respectively) and calcium (0.55, 0.51, and 0.33%, respectively) content of the cheeses was significantly different among treatments. The initial apparent viscosity and TPA hardness of the pH 5.6 cheeses were significantly lower, due to their lower calcium and higher moisture content. Cheese chewiness was measured using an empirical sieving test. The initial cheese chewiness (27% of solids on sieve #4) of the pH 5.6 cheeses was similar to values obtained for typical LMPS Mozzarella and significantly lower than both pH 5.8 treatments (90%). Homogenization significantly increased cheese whiteness. At 4°C, the pH 5.8 and 5.6 homogenized treatments had Hunter L-values of 78.0 and 79.0 respectively, while the non-homogenized treatment was 63.4. The cheeses reached L-values between 85 and 90 when heated to 71°C. After 60 days of storage the difference in whiteness after heating to 71°C and cooling was significant with the pH 5.6 homogenized cheese retaining its white color the best with a final L-value of 83.9 at 7°C, in contrast to the non-homogenized cheese L-value of 74.7. Similar results were observed with a pizza bake test. It was determined that homogenization of cream and pre-acidification of milk do not interfere with each other to produce a white but less chewy low fat Mozzarella cheese.

Key Words: Low fat Mozzarella, Pre-acidification, Homogenization

568 Effect of dissolved carbon dioxide on the thermal destruction of *Pseudomonas fluorescens* R1-232 in milk. C Loss*[1] and JH Hotchkiss[1], [1]*Cornell University, Ithaca, NY.*

Carbon dioxide (CO_2) is a natural component of milk and is added to dairy products to extend shelf life. The effect, if any, of this CO_2 on thermal destruction of spoilage microorganisms is unknown. Our objective was to determine if low levels of dissolved CO_2 significantly effected the thermal destruction of a common milk spoilage organism. *Pseudomonas fluorescens* R1-232 (isolated from milk) was inoculated into sterile milk and the thermal death time curves determined using the capillary tube method at 50 C. $CO_2$was added at levels of 660, 920, and 1580 ppm. The pH was reduced by 0.37, 0.52, and 0.67 units for 660, 920, and 1580 ppm, respectively. Controls contained less than 50 ppm CO_2. A linear regression model was used to compare the slopes of the thermal death curves for different CO_2 concentrations ($p \leq 0.05$). Slopes were significantly affected by added CO_2. For example, 920 ppm dissolved CO_2 increased the negative slope of the survivor curve by 45% compared to controls. At this CO_2 concentration, the time to reduce the survivors by 90% was decreased from 14.3 minutes to 7.8 minutes. Thermal death time was linearly related to CO_2 concentration over the range of concentrations tested. These data suggest that low levels of dissolved CO_2 affects the efficacy of thermal treatment of milk. This may have implications for the pasteurization of milk containing dissolved CO_2.

Key Words: carbon dioxide, thermal death, milk

GRADUATE STUDENT PAPER COMPETITION
ADSA PRODUCTION DIVISION

569 Effect of incubation fluid pH on the dry and organic matter degradation of alfalfa stems treated with fibrolytic enzymes. D. Colombatto*[1], F. L. Mould[1], M. K. Bhat[2], and E. Owen[1], [1]*University of Reading, UK,* [2]*Institute of Food Research, Norwich, UK.*

The degradability of the dry matter (DM) and organic matter (OM) of alfalfa stems was examined *in vitro* using the ANKOM system, to evaluate the effects of incubation medium pH and fibrolytic enzymes addition. Bags containing approximately 0.5 g DM of pre-dried and milled (2 mm screen) alfalfa hay stems were placed in fermentation vessels and incubated anaerobically for up to 96 h at 39C. Rumen fluid was taken from a dry, grass hay-fed cow, and the incubation medium pH was adjusted to 6.72 (L1); 6.48 (L2); 6.20 (L3) and 5.72 (L4) using 1 M citric acid. For each pH level, a commercial enzyme mixture (Liquicell 2500, *Speciality Enzymes*, USA) was applied directly into the vessels at two levels: 0 (Control) and 7.58 units xylanase activity/g forage DM (determined on birchwood xylan at 39C and pH 5.5). Bags were removed in quadruplicate at 6, 12, 18, 24, 48 and 96 post-incubation, washed, dried and ashed to determine dry and organic matter degradation (DMD and OMD, respectively). The experiment was replicated twice. Decreasing the medium pH reduced ($P<0.05$) DMD from 374 to 333 g/kg; and OMD (from 385 to 345 g/kg) after 24 hours. End point (96 h) DMD was also affected ($P<0.05$), but the differences were small and likely to be of no biological importance (from 591 to 604 g/kg). In contrast, end point OMD did not change ($P>0.05$) due to pH effect. Enzyme addition increased ($P<0.05$) DMD and OMD after 24 h in L1 and L2 compared to their respective controls (374 vs. 419, and 369 vs. 416 g/kg; and 381 vs. 434, and 385 vs. 441 g/kg, respectively), but no differences ($P>0.05$) were found in L3 and L4. Also, enzyme addition did not affect ($P>0.05$) end point DMD and OMD, regardless of the pH level. It is concluded that Liquicell 2500, applied at the time of feeding, has potential to improve the DMD and OMD of alfalfa stems *in vitro*, but the medium pH appears to be an important factor in these responses.

Key Words: Fibrolytic enzymes, *in vitro*, pH

570 Milk response to concentrate supplementation of high producing dairy cows grazing at two pasture allowances. F. Bargo*, L.D. Muller, J.E. Delahoy, and T.W. Cassidy, *The Pennsylvania State University, University Park.*

Twenty Holstein cows (101 DIM, 631 kg BW, 4 ruminally canulated) were assigned to five 4 x 4 Latin squares with 21-d periods. Cows within squares were assigned to four treatments: (LU) low pasture allowance-unsupplemented; (LS) low pasture allowance-supplemented; (HU) high pasture allowance-unsupplemented; (HS) high pasture allowance-supplemented. Cows grazed in two groups a grass pasture at allowances of 25 and 40 kg DM/cow/d. Supplemented cows received a corn-based concentrate (1 kg/4 kg of milk) and unsupplemented cows a mineral mix (1 kg/d) in two equal feedings after milking. Pasture and concentrate had 18.5, 12.4%CP; 53.6, 16.2%NDF; 69.3, 88.1%in vitro DM digestibility, respectively. Pasture DMI was measured in the 4 periods using Cr_2O_3 as fecal marker. Interaction between pasture allowance and concentrate supplementation was found for milk yield and total DMI. Milk response to supplementation was higher (1.36 vs. 0.96 kg milk/kg concentrate) and substitution rate was lower (0.26 vs. 0.55 kg pasture/kg concentrate) for cows grazing at low pasture allowance. Concentrate supplementation decreased fat but increased protein percent in milk. Milk urea nitrogen and rumen NH_3-N concentration decreased with supplementation. Interaction was found for rumen pH and total VFA concentration. Supplemented cows grazing at low pasture allowance (LS) produced the same amount of milk as HS with 37.5% less pasture offered.

	LU	LS	HU	HS	SEM	Effect
Milk, kg/d	19.1	29.7	22.2	29.9	0.8	PxC[1]
Fat, %	3.82	3.29	3.79	3.32	0.07	C[2]
Protein, %	2.98	3.08	2.93	3.11	0.04	C[2]
MUN, mg/dl	13.9	11.6	14.2	11.1	0.4	C[2]
Total DMI, kg/d	18.3	24.1	21.3	24.8	0.4	PxC[4]
Conc DMI, kg/d	0.7	8.6	0.7	8.7	0.1	C[2]
Pasture DMI, kg/d	17.5	15.5	20.6	16.1	0.4	PxC[4]
NH_3-N, mg/dl	15.2	9.1	15.3	8.7	0.5	C[2]
pH	6.57	6.25	6.40	6.29	0.04	PxC[4]
VFA, mm/L	116.3	130.0	129.8	130.6	2.3	PxC[4]

[1],[4]pasture allowance x concentrate supplementation interaction (PxC), $P<0.10$ and $P<0.05$ [2]concentrate supplementation effect (C), [3]pasture allowance effect (P), $P<0.05$

571 Milk Production and Composition from Cows Fed Fish Oil, Extruded Soybeans, or Their Combination. L. A. Whitlock*, D. J. Schingoethe, A. R. Hippen, R. J. Baer, N. Ramaswamy, and K. M. Kasperson, *MN-SD Dairy Foods Research Center, South Dakota State University, Brookings*.

Milk production and composition were measured for eight multiparous Holstein and four multiparous Brown Swiss cows which were randomly assigned in a replicated 4 x 4 Latin square design with 4 wk periods. The four treatments consisted of a control diet (C) with a 50:50 ratio of forage to concentrate, diet C with 2% (on DM basis) added fat from menhaden fish oil (FO), diet C with 2% added fat from extruded soybeans (ES), and diet C with 1% added fat from menhaden fish oil and 1% added fat from extruded soybeans (FOES). All diets consisted of 25% corn silage, 25% alfalfa hay, and 50% of the respective concentrate mix. Milk production from cows fed the C, FO, ES, and FOES diets was 31.8, 29.1, 34.4, and 31.2 kg/d, respectively. Milk fat (3.51, 2.85, 3.26, and 3.11%) was lower ($P < 0.05$) when fed FO, while protein (3.40, 3.47, 3.32, and 3.30%) was similar ($P > 0.05$) for all diets. Milk from cows fed the FO and FOES treatments had a four-fold increase ($P < 0.01$) in the concentration of cis-9 trans-11 isomer of conjugated linoleic acid (CLA) when compared to the C treatment, and a two-fold increase ($P < 0.01$) when compared to the ES treatment; transvaccenic acid (TVA) was similarly increased. These results indicate that, when fed with a fat source high in linoleic acid (i.e. ES), fish oil served as a rumen modifier to cause a greater than expected increase in CLA and TVA content of milk fat.

Key Words: Conjugated Linoleic Acid, Milk

572 Ascorbic acid and a Beta-glucan product from *Saccharomyces cerevisiae* influnce on dairy calf well-being. C. A. McKee*[1], S. D. Eicher[1], and T. R. Johnson[2], [1]*USDA-ARS, West Lafayette, IN,* [2]*Purdue University, West Lafayette, IN*.

Dairy calves are exposed to many stressors within the first few days of life affecting health, growth, and well-being. The objectives of this study were to measure the effects of a -glucan product and Vitamin C as supplements in milk replacer on behavior, health, growth and immune function and to determine the efficacy of these supplements to reduce the use of antibiotics in animal production. Health and growth parameters are reported here. Forty-eight Holsteins dairy calves were blocked by date of birth and placed on 1 of 4 supplements added to an all milk, milk replacer; control (C), -glucan (Bg), Vit C (AA), and -glucan plus Vit C (Both). Calves were fed 10% of their BW per day in two equal feedings (12.5% dry milk replacer). Supplemental Vit C (Stay-C;Roche Vitamins, INC.) was given at 250mg and -glucan product (Nutri-ferm, Energy Plus, Natural Chem Industries,LTD.) was added at 2.5% of dry milk replacer. Weekly BW, body temperature, and blood samples were taken for six weeks, starting three days after birth. Fecal scores, nasal and ocular discharge were recorded daily. Weekly hematology measures were hematocrit, fibrinogen, percent granulocytes and lymphocyte counts. Means reported are C, Bg, AA, and Both ± SE, respectively. Hematocrit showed a main effect of Bg and an interaction of Bg and AA (P< .01; 29.64± .22, 29.68± .21, 30.48± .22, 28.47± .24). Interactions for AA and Bg were significant for BW change (P< .01), percent hematocrit (P< .01), fecal scores (P< .01), and fibrinogen (P< .01). Mean BW change was 1.81± .12, 1.96± .12, 1.48± .12, 2.32± .12 kg/wk, fecal scores were 1.38± .03, 1.55± .03, 1.48± .03, 1.38± .03, and fibrinogen was 411.09± 12.92, 456.92±12.76, 442.34± 12.92, 416.47± 13.63 mg/dl. AA, Bg, and Both tended to increase percent lymphocytes (P< .10). There were no significant effects on percent granulocytes and ocular discharge. This study suggests that supplemental ascorbic acid and -glucan synergistically improve weight gain, health status, and overall well-being of dairy calves.

Key Words: Ascorbic acid, Beta-glucan, Calves

573 Alteration of apoptosis-related gene expression and 92 kDa-gelatinase activity in *Escherichia coli* infected bovine mammary glands. E. Long*[1], A.V. Capuco[2], D.L. Wood[2], T. Sonstegard[2], G. Tomita[2], M.J. Paape[2], and X. Zhao[1], [1]*Dept. of Animal Science, McGill University,* [2]*USDA-ARS*.

Induction of programmed cell death during experimentally induced mastitis was assessed. Expression of the Bcl-2 family of proteins, that are important regulators of apoptosis, was compared between uninfected and mastitic glands. Five hundred CFU of *Escherichia coli* (P4: 032) were infused into the left quarters of six healthy lactating Holstein cows and left rear quarters were biopsied 24 or 72 h post-infusion. Uninfected right quarters, biopsied before *E. coli* infusion, served as controls. Somatic cell counts (SCC) increased in 4 of 6 infused rear quarters and peaked 24 h after bacterial infusion (10.7 x 10^6 cells/ml). Body temperature also increased, peaking 12 h after infusion (40.1C). Bacteriological analysis of milk samples verified coliform infection in these 4 quarters. Western blot analyses were conducted using the mammary biopsies obtained at 0, 24 and 72 h post-infusion. Compared with uninfected controls, expression of the pro-apoptotic protein, Bax, increased in mastitic tissues 130 and 100% at 24 and 72 h, respectively. Conversely, expression of the anti-apoptotic protein, Bcl-2, decreased 75% at 24 h but did not differ significantly from controls 72 h post-infusion. Expression of Bcl-x was not affected by *E. coli* mastitis. Apart from altered expression of Bcl-2 family genes, activity of 92-kDa gelatinase increased 10- or 7-fold at 24 or 72 h after bacterial infusion. These results suggest that *E. coli* mastitis increase the incidence of programmed cell death in bovine mammary tissue. Degradation of the extracellular matrix by gelatinase may be a part of the apoptotic response to *E. coli* infection.

Key Words: *E.coli* induced mastitis, Programmed cell death, Gelatinase

574 Pregnancy rates to a timed insemination in lactating dairy cows pre-synchronized and treated with bovine somatotropin: cyclic versus anestrus cows. F. Moreira*, C. Orlandi, C. Risco, F. Lopes, R. Mattos, and W. W. Thatcher, *University of Florida, Gainesville*.

Bovine somatotropin (bST) increased pregnancy rates (PR) in cows that underwent a pre-synchronization (presynch) treatment prior to initiation of a timed insemination (TI) protocol. Objective was to use plasma progesterone (P_4) concentrations to examine presynch and bST effects on PR in anestrus and cyclic cows. The TI protocol was initiated at random stages of the cycle (control) or cows were pre-synchronized with two $PGF_{2\alpha}$ (25 mg; i.m.) at 37 and 51 days in milk (DIM). The TI protocol was initiated at 63 DIM with GnRH (100 μg; i.m.), $PGF_{2\alpha}$ (40 mg; i.m.) 7 d later, GnRH 48 h after $PGF_{2\alpha}$, and cows were TI 16 h later. Injections of bST (500 mg; s.c.) started at first GnRH (bST63), or at TI (bST73), or at 147 DIM (control). Groups were: control/bST63 (G1; n = 82), control/bST73 (G2; n = 83), control/control (G3; n = 90), presynch/bST63 (G4; n = 82), presynch/bST73 (G5; n = 80), and presynch/control (G6; n = 82). Blood samples (BS) at 51 and 63 DIM identified anestrus (two consecutive $P_4 \leq 1.0$ ng/ml; n = 117) and cyclic cows (at least one $P_4 > 1.0$ ng/ml; n = 382). BS at 63 and 70 DIM identified occurrence of premature luteal regression (pre-reg; $P_4 > 1.0$ ng/ml and ≤ 1.0 ng/ml, respectively). Presynch and bST increased PR (at 74 d after TI) in cyclic cows (Table) but did not affect PR of anestrus cows (overall PR = 20.7 ± 4.7 %). In cyclic cows, PR was less for pre-reg cows than for cows not having pre-reg (19.4 ± 8.8 % < 44.5 ± 3.4 %; P < 0.01). Incidence of pre-reg was less in presynch than in control cows (Table). Presynch and bST increased PR in cyclic but not in anestrus cows. Presynch increased PR by reducing the incidence of pre-reg.

Response	G1	G2	G3	G4	G5	G6	SE
PR %	34.2^{a1}	33.7^{a1}	25.3^{a2}	58.2^{b1}	56.1^{b1}	42.6^{b2}	2.8
Pre-reg %	12.0^{a}	12.3^{a}	22.2^{a}	5.0^{b}	4.8^{b}	7.7^{b}	1.5

^{a,b} Different superscripts within row indicate presynch effect (P < 0.01).
^{1,2} Different superscripts within row indicate bST effect within control or presynch groups (P < 0.04).

Key Words: Bovine somatotropin, Pre-synchronization, Timed insemination