61 Effects of forage source and corn particle size on milk production and composition, nutrient digestibility and ammonia emission from manure in Holstein dairy cows. N. E. Brown*, V. A. Ishler, T. W. Cassidy, K. Heyler, and G. A. Varga, *The Pennsylvania State University*, *University Park*.

A replicated 4 X 4 Latin square design was conducted to evaluate the effects of forage source and corn particle size on cow performance, nutrient digestibility and ammonia (NH_3) emissions from manure. The four treatments were: 1) grass silage (G) with fine (F) ground corn (GF), 2) G with coarse (C) ground corn (GC), 3) alfalfa silage (A) with F (AF) and 4) A with C (AC) in diets for lactating cows. Cows averaged 119 ± 5 d in milk. Diets were formulated to contain approximately 1.5 NE_L Mcal/kg, 16.5% CP, and 32% NDF. Each period lasted 28 d, the final 7 d were used for sample collection of milk yield and components, nutrient digestibility and NH_3 from manure. A photo-acoustic gas monitor was used to record NH_3 concentrations in 20 min intervals from manure samples. Cows fed A had greater dry matter intake (DMI) (P<0.01) compared to cows fed G (27.9 vs. 22.1 kg/d, respectively). The increased DMI for cows fed A resulted in greater (P<0.01) milk yield (MY; 35.3 vs. 30 kg/d) than for cows fed G. MY efficiency was greater (P<0.02) for cows provided G vs. cows fed A (1.43 vs. 1.30, respectively). Corn particle size had no effect on DMI, MY, FCM, or milk yield efficiency. Milk fat, protein and milk protein % were higher for cows fed A vs. G diets. Cows fed G had higher (P <0.08) milk urea N compared to cows fed A. DM digestibility was not affected by forage source but was higher (P<0.02) for F vs. C (58.8% vs. 55.1%, respectively). A greater decrease (P<0.04) in DM digestibility was observed with C for cows on G compared to A (57.4% vs. 56.4%). Fiber digestibility was higher (P< 0.04) for F vs. C (34.7% vs. 29.1%). No differences were observed between forage or corn source on manure NH_3. Results of this study demonstrate that fiber from G is more filling than A resulting in reduced DMI and milk yield. Corn particle size may impact nutrient digestibility and these effects may differ based on forage source.

Key Words: Grass silage, Alfalfa silage, Ammonia emission

62 Withdrawn by author.

63 Accelerated calf growth: When does it make sense? D. Berthiaume* and J. Smith, *University of Vermont*, *Burlington*.

Scientific evidence is lacking on which to base recommendations of the age at which feeding levels should be increased to maximize gains without compromising health in milk-fed calves. In this experiment, growth and health response of Holstein heifer calves fed different types of milk replacer (MR) at different feeding rates were determined. Calves (n=30) weighing 40-50 kg at birth were randomly assigned to 1 of 5 treatments. Treatment 1 were control calves fed MR containing 20% Crude Protein (CP) and 20% fat, offered 0.272 kg Dry Matter (DM) 2 times per day reconstituted to 12.5% w/w. All other treatments were fed a 26% CP, 18% fat MR. There were 3 levels of milk replacer fed twice per day: 0.272 kg reconstituted to 12.5%, 0.408 kg reconstituted to 14.7%, and 0.544 kg reconstituted to 16.1% w/w. Calves were initially fed 0.272 kg per feeding. Amounts fed were increased to level 2 on d 3, 10, 14, or 3 for treatments 2, 3, 4, and 5, respectively and to level 3 on d 7, 14, 21 and 7 for treatments 2, 3, 4, and 5 respectively. Treatments 1-4 received free choice starter grain from 3 d through weaning; treatment 5 did not receive starter until 21 d of age. During wk 5 all calves were offered 0.272 kg DM once per day and were weaned at 42 d of age. Weights and hip heights were measured weekly for 8 weeks. Body temperatures, respiratory scores, and fecal scores were recorded daily. Blood samples were obtained at birth, 24, 48, and 96 h after colostrum feeding, and weekly thereafter for 8 wk and analyzed for immunoglobulins, nonesterified fatty acids and β-hydroxybutyrate. Although ADG through wk 8 were not different among treatments, days scouring were affected by treatment.

Table 1. Treatment Results

Treatment	1	2	3	4	5	*P*-value
Total MR						
DM intake, kg	44±1.3	77±2.0	71±3.2	66±7.5	77±6.8	<0.001
Total starter						
DM intake, kg	40±6.1	37±4.5	40±5.9	40±2.8	29±7.1	.029
ADG, kg/d	0.6±.10	0.7±.09	0.7±.12	0.7±.07	0.6±.12	.347
Days Scouring	6±2.3	5±2.9	10±2.9	7±3.5	7±3.1	.001

[1]- Fecal scores ranged from 1=solid to 4=liquid [*]- A score 3+ was considered scouring

Key Words: Calf, Growth, Protein

Graduate Student Paper Competition: National ADSA Dairy Foods Division

64 Fatty acid composition and thermal properties of lipid from milk and butter from lactating Holstein cows fed a supplemental lipid either high or low in palmitic acid. M. K. Beam*[1], L. W. Lassonde[2], B. C. Veltri[1], S. J. Taylor[1], R. Jimenez-Flores[2], and E. J. DePeters[1], [1]*University of California*, *Davis*, [2]*California Polytechnic State University*, *San Luis Obispo*.

Milk fat offers new roles as a functional-food ingredient in many foods. Modification of the fatty acid (FA) composition of the triacylglycerol (TG) and phospholipid (PL) components impacts the nutritional value and physio-chemical properties of milk lipids. The objectives were to determine the impact of feeding either a low (LP) or a high (HP) palmitic acid supplemental fat to lactating cows on the (1) FA composition of lipids in milk fat and the subsequent butter and buttermilk and (2) thermal properties of the butter. Multiparous (8) and primiparous (4) Holstein cows were used in a cross-over design. Diets were similar in composition with the only difference the supplemental fat included at 2% of diet dry matter used to alter the palmitic acid intake of cows. The HP supplement was Energizer-RP10, and the LP supplement was yellow grease. Milk yield did not differ, but dry matter intake tended (P < 0.06) to be lower for HP (24.8 kg/d) than LP (25.1 kg/d). Yields of 4% fat-corrected milk (44.1 vs 41.2 kg/d) and fat (1.8 vs 1.6 kg/d) were significantly greater for HP than LP. Changes in the FA composition of TG and PL occurred. C16:0 in TG was higher for HP than LP (41.9 vs 28.2 g/100 g fat) while C18:1 *cis* was lower (18.1 vs 23.1 g/100 g fat). Total C18:1 *trans* was lower for HP (2.63 g/100g fat) than LP (4.82 g/100 g fat). Buttermilk PL was high in unsaturated FA. Butter from each cow was noticeably harder when cows were fed HP than LP. Textural analysis found that anhydrous milk fat (AMF) from HP was harder at both ambient and 10°C temperatures than AMF from LP. Diet of the cow can be used to modify the FA composition of the TG and PL components of milk lipids as an approach to enhance milk fat's potential role as a functional-food ingredient.

Key Words: Fatty acid, Milk fat, Palmitic acid

65 Influence of fatty acid chain length and unsaturation on mid-infrared milk analysis. K. Kaylegian* and D. Barbano, *Cornell University*, *Ithaca*.

The general influences of fatty acid chain length and unsaturation on mid-infrared (MIR) fat measurement in milk are known, and the focus of this study was to quantify these effects. The use of a Fourier transform (FT) MIR milk analyzer allowed the optical settings used to measure fat, lactose, and protein to be fine tuned. The first objective was to optimize the sample and reference peak wavelengths and bandwidths to minimize the influence of the other components, which was indicated by the size of the intercorrection factors. The bandwidth and the proximity of the peak wavelength to areas near intense water absorption had the largest effect on the intercorrection factors. The use of narrow bandwidths allowed movement of the peak wavelengths away from areas of intense water absorption and reduced the intercorrection factors. The second objective was to quantify the influence of fatty acid chain length and unsaturation on the measurement of fat B and fat A using an FT MIR milk analyzer with optimized virtual filters and an MIR milk analyzer with optical filters. Model milk emulsions were made with pure monoacid triglycerides (C14:0, C16:0, C18:0, and C18:1) and pasteurized skim milk to produce one series that varied only in mean chain length and another series that varied only in the mean degree of unsaturation. The MIR absorbance at the fat B sample peak wavelength increased with increasing chain length and decreased with increasing unsaturation. At the fat A sample wavelength, the absorbance decreased with increasing chain length and was relatively insensitive to changes in unsaturation. The changes in the difference between corrected MIR values for fat (B or A) and reference chemistry as chain length or unsaturation increased were similar to those observed for absorbance. The application of this data will be to explain the variation in the difference between MIR fat prediction and reference chemistry of natural milk, which changes in chain length and unsaturation simultaneously.

Key Words: Infrared milk analysis, Fatty acid composition

66 Binding of flavor compounds to native and denatured whey protein using headspace solid-phase microextraction. J. Kühn*[1,2], T. Considine[3], and H. Singh[1], [1]*Riddet Centre*, *Palmerston North, New Zealand*, [2]*Institute of Food, Nutrition, and Human Health*, *Palmerston North, New Zealand*, [3]*Fonterra Research Centre*, *Palmerston North, New Zealand*.

Whey proteins are known to bind flavor compounds of different chemical classes. These interactions can have a strong influence on flavor perception. In the present study, the binding of three flavor compounds, 2-nonanone, 1-nonanal, and *trans*-2-nonenal, to whey protein isolate (WPI) in aqueous solution was investigated. Since heat treatment is an important step during the processing of many protein containing foods, heat-denatured proteins are of great importance. The aim was to reveal how the unfolding and aggregation of whey proteins upon heat denaturation affect their binding affinity for flavors. The free flavor was quantified using headspace solid-phase microextraction (SPME) followed by gas chromatography (GC) and flame ionization detection (FID). At room temperature, the binding of WPI and the flavors investigated was strong and decreased in the order *trans*-2-nonenal > 1-nonanal > 2-nonanone. This finding is attributed to hydrophobic interactions only in the case of 2-nonanone, whereas the aldehydes, in particular *trans*-2-nonenal, may also react covalently. Heat denaturation (80 °C, 0-80 min) released protein-bound 2-nonanone. This may be explained with the aggregation of whey proteins upon heat denaturation, making the flavor binding sites inaccessible. The binding of 1-nonanal remained unaffected, suggesting covalent binding via the aldehyde function may not be influenced by protein aggregation. In contrast, the binding of *trans*-2-nonenal increased with increasing heating time, possibly due to chemical reaction with amino acid residues. The extent of binding was not influenced by the addition of flavor before or after heat treatment. We can conclude that heat treatment affects protein-flavor binding depending on the nature of the flavor compound, and may therefore notably influence the overall flavor profile of protein-based foods.

Key Words: Whey protein isolate, Flavor binding, Denaturation

67 Improving the texture of nonfat processed cheese for use in baking applications. C. A. Brickley*[1,2], S. Govindasamy-Lucey[3], J. J. Jaeggi[3], M. E. Johnson[3], P. L. H. McSweeney[1], and J. A. Lucey[2], [1]*University College Cork*, *Cork, Ireland*, [2]*University of Wisconsin*, *Madison*, [3]*Wisconsin Center for Dairy Research*, *Madison, WI*.

Nonfat cheese tends to have problems including poor melt, pale colour and chewy texture. Our objective was to develop a nonfat processed cheese (PC) suitable as a pizza topping. We proposed to overcome these problems by altering the properties of the cheese base and with the selection of suitable emulsifying salts (ES). Stirred curd cheese bases were made from skim milk by direct acidification using lactic acid to pH values 5.0, 5.2 and 5.4. Various levels of trisodium citrate (TSC) (0.5, 1, 1.5, 2, 2.5, 3 and 5%), disodium phosphate (DSP) or trisodium phosphate (TSP) (1, 2, 3 and 4%) were blended with nonfat cheese base during lab-scale processing at 1 d. Cheese, ES and water were weighed into a steel container which was placed in a waterbath at 98°C then stirred using an overhead stirrer for 9 min. Molten cheese was poured into containers, sealed and stored at 4°C for 7 d before being analyzed for pH, moisture, TPA hardness and adhesiveness, and extent of flow (EOF) using the UW Meltprofiler. During manufacture, the pH 5.2 and 5.4 curds were sticky. The pH 5.2 and 5.4 curds had a pale colour and pH 5.0 curd was white in colour. Total calcium contents were ~ 400, 185 and 139 mg/100g for pH 5.4, 5.2 and 5.0 cheeses, respectively. Addition of DSP resulted in a PC with lowest EOF and at ES levels above 2% crystal formation was apparent. PC manufactured from pH 5.0 curd and TSP showed reduced melt and increased stickiness whereas melt was significantly increased and stickiness was reduced in PC made with pH 5.4 curd base and TSP. However, the pH of PC made from the pH 5.4 cheese and TSP (1%) was > 6.20 and crystals were observed. Use of TSC increased EOF up to a maximum at 2% ES for all cheese bases. High levels of TSC (for pH 5.2 and 5.4 cheeses) resulted in increased stickiness. These initial trials suggest that the pH 5.0 cheese base was most promising for further research as it had a creamy colour, reasonable melt and it did not have high adhesiveness when TSC was used.

Key Words: Nonfat, Processed cheese, Emulsifying salts

68 Impact of mixtures of emulsifying salts on the properties of process cheese. S. Kaliappan*, M. E. Johnson, J. J. Jaeggi, and J. A. Lucey, *University of Wisconsin*, *Madison*.

Mixtures of emulsifying salts (ES) are often used in the manufacture of process cheese (PC). Although ES are known to stabilize PC by interacting with cheese components, such as, casein and Ca phosphate, their underlying mechanisms of interaction are still not clearly elucidated. Objective of this study was to investigate how binary ES

mixtures influence PC functionality. Three types of binary ES mixtures were prepared by combining trisodium citrate (TSC) with disodium orthophosphate (DSP), tetrasodium pyrophosphate (TSPP) or sodium hexametaphosphate (SHMP). For a total ES concentration of 3% (w/w), five different proportions (0.25:2.75, 0.875:2.125, 1.5:1.5, 2.125:0.875 and 2.75:0.25) of these mixtures were used. PC were made with constant pH (5.6±0.05) and moisture content (39.2±0.5%) using 4 month old natural Cheddar cheese as base. Functional and microstructural properties were studied using small amplitude oscillatory rheology, texture profile analysis (TPA), UW-Meltprofiler and fluorescence microscopy. The state of Ca and phosphorous (P) in cheese was determined by acid-base titration and by measuring the amount of insoluble Ca and P. The rheological parameter, loss tangent, and meltability increased while hardness (from TPA) decreased in mixtures that had high proportions of TSC or SHMP but the opposite trend was observed in mixtures that had high ratios of DSP or TSPP. The % insoluble Ca or P as % of total Ca or P increased with increasing amount of phosphate in mixtures of phosphate-based ES with TSC. Acid-base titration indicated that various types of Ca-phosphate interaction ocurred in cheese depending on the types of ES used. These results suggested that ES interacted with cheese components by several mechanisms, such as, dispersion of the original insoluble Ca phosphate, formation of new Ca salts and casein polymerization. A greater understanding of how ES mixtures influence cheese properties will help manufacturers to control the functional behavior of PC.

Key Words: Process cheese, Functionality, Emulsifying salts

69 Improving texture and flavor of reduced fat Cheddar cheese using an exopolysaccharide-producing culture and ultrafiltration. P. Agrawal* and A. N. Hassan, *South Dakota State University*, *Brookings*.

The texture of reduced fat Cheddar cheese is typically rubbery, dry and grainy. In previous studies (Awad et al., JDS 88:4204-4213; Hassan et al., JDS 88:4221-4227), an exopolysaccharide-(EPS) producing culture improved textural, melting and viscoelastic properties of reduced fat Cheddar cheese. However, this EPS-positive cheese developed bitterness after 2 to 3 months of ripening due to increased residual chymosin activity. We hypothesized that the reduced amount of chymosin needed to coagulate ultrafiltered milk might result in reduced residual chymosin activity and bitterness in cheese. The objective of this study was to improve the texture and flavor of reduced fat Cheddar cheese using a combination of EPS-producing cultures and ultrafiltration (UF). Reduced fat Cheddar cheeses were manufactured with EPS-producing and non-producing cultures using skim milk or ultrafiltered skim milk (1.2 X) adjusted to a casein/fat ratio of 1.35. The EPS-producing culture increased yield, moisture in nonfat substance, and residual chymosin activity in reduced fat Cheddar cheese. In addition, EPS-positive cheese was softer, and less gummy and rubbery than the EPS-negative cheese. The viscoelastic moduli were higher in young EPS-negative reduced fat cheese than in the EPS-positive cheese. After 3 months of ripening, whereas the viscoelastic moduli increased in the EPS-positive cheese, they decreased in the EPS-negative cheese. The creep/recovery test showed that young EPS-positive cheese was less rigid and more deformable than EPS-negative cheese. Lower ($P < 0.05$) residual chymosin activity was found in cheese made from UF milk compared to that in cheese made from control milk. The low UF concentration level (1.2X) did not affect the textural characteristics of cheese. Panelists reported that UF-EPS-positive cheese was less ($P < 0.05$) bitter than EPS-positive cheese made from control milk. Using an EPS-producing culture improved the texture and UF at 1.2 X reduced bitterness of reduced fat Cheddar cheese, which has commercial implications in the manufacture of this type of cheese.

Key Words: Exopolysaccharides, Ultrafiltration, Reduced fat cheese

70 Ecology of psychrotolerant aerobic sporeformers present in dairy production systems. J. Huck*, B. Hammond, S. Murphy, and K. Boor, *Milk Quality Improvement Program, Cornell University*, *Ithaca, NY*.

The presence of psychrotolerant *Bacillus* species and related sporeformers (e.g., *Paenibacillus* spp.) in high-temperature-short-time pasteurized milks has emerged as a key hurdle in achieving fluid products with extended shelf-lives (>14 days). Pasteurization survival by sporeformers makes their presence in raw milk a major potential cause of milk spoilage. Utilizing a recently developed *rpoB* subtyping method to track sporeforming spoilage microbes through raw milk transport and receiving containers into packaged products, we have gained insight into the ecology and transmission of these microbial contaminants. Thirty-three raw milk samples were collected from all incoming bulk tank trucks over a two day period in two New York State fluid milk plants currently achieving shelf-lives >14 days. Thirteen additional samples were systematically collected from raw milk storage silos and packaged products. Pasteurized and heat-treated (80°C for 12 minutes) raw milks were held over shelf life at 6°C and plated at days 1,7 and 14. Day 14 standard plate counts (SPC) ranged from 140 to >6,000,000 CFU/mL. Ninety-three representative colony-types were isolated from day 14 SPC's and subsequently subtyped. This DNA sequence-based method allows sensitive identification and differentiation of sporeforming microbes isolated from dairy processing systems. Our results indicate the presence of 28 *rpoB* allelic types. The 4 predominant subtypes represent 19%, 8%, 4% and 3% of the total isolates recovered, of which 2 predominant *Paenibacillus* spp. subtypes can be tracked systematically from raw transport tanks into storage silos and into packaged products. The persistence and transmission of these thermoduric spoilage organisms suggests the need to improve our understanding of the ecology of psychrotolerant *Bacillus* species and related sporeformers throughout the dairy production chain. This new information will allow identification and elimination of bacterial niches that harbor these spoilage organisms, hence reducing the prevalence of milk contamination and improving product quality and shelf-lives.

Key Words: *Bacillus*, Fluid milk, Molecular subtyping

71 Growth and enterotoxin production by *Staphylococcus aureus* in milk. N. M. Kauffman* and R. F. Roberts, *The Pennsylvania State University*, *University Park*.

A provision was added to the 2003 edition of the PMO allowing processing runs to exceed one day prior to cleaning. Growth and subsequent enterotoxin production by *Staphylococcus aureus* is of specific concern when extending processing runs, because of its association with mastitis infections in dairy cows. The optimum temperatures for staphylococcal enterotoxin (SE) production exist within the regeneration section of HTST pasteurization systems. During extended processing runs, *S. aureus* may have sufficient time to grow and produce SE in eddy regions, that could form during operation of this plate heat exchanger (PHE). The objectives of this study were to characterize strains of *S. aureus* isolated from mastitic cows and evaluate *S. aureus* growth and enterotoxin production in milk at various temperatures. Fifteen *S. aureus* strains previously isolated from mastitic

cows milk were characterized by growth on selective media, Gram stain, coagulase gene polymorphism, thermonuclease gene fragment amplification and activity on toluidine blue-o agar. SE production was evaluated using PCR and immunoassay. Growth and SE production in UHT milk were quantified at temperatures ranging from 21 to 45° C over 72 h. Two strains did not exhibit the expected coagulase gene polymorphism profile and were discarded from the study. Two of 15 strains were positive for toxin production. One expressed gene fragments for SEC and TSST-1 and one for SEA and SEC. SEC and SEA production by these two strains was confirmed by immunoassay. Two control strains and two SE-producing isolates were evaluated for growth and SE production. Strains grew at temperatures ranging from 21 to 45°C with an optimum at 40°C. The highest concentration of SE was produced at 31°C after 72 h incubation and the shortest time to SE production was observed at 40°C. Enterotoxin production data was used to estimate the amount of SE that might be produced in PHE as a function of processing time, temperature, eddy size and batch size. Preliminary calculations revealed production of SE during extended runs would not lead to human illness.

Key Words: Staphylococcus aureus, Staphylococcal enterotoxin, Extended run

72 Development of a novel immunoassay system for immunobiotics that modulate intestinal immunity through Toll-like receptor 2. M. Tohno*, T. Shimosato, Y. Kawai, T. Saito, and H. Kitazawa, *Graduate School of Agricultural Science, Tohoku University*, *Sendai, Japan*.

Studies on the biological functions of immunobiotic lactic acid bacteria (LAB) have contributed to their worldwide application as functional foods and supplements. The beneficial effects of activating intestinal immunity with LAB are very important, but the cellular and molecular mechanisms by which immunobiotics regulate intestinal immune homeostasis have not been elucidated. Recently, Toll-like receptor (TLR) 2 was identified as a specific receptor for bacterial cell wall components, although some of the biochemical and immunological mechanisms by which TLR2 recognize and respond to immunobiotic bacteria remain unclear. In the present study, we investigated the role of TLR2 in the modulation of intestinal immunity by immunobiotic LAB. First, we isolated a cDNA encoding TLR2 from swine Peyer's patches, which are considered to be a good model of the human intestinal immune system. The complete open reading frame of swine TLR2 contained 2358 bp, corresponding to a 785-amino acid polypeptide with a calculated molecular mass of 89.6 kDa. We then transfected mammalian cells with the swine TLR2 cDNA to develop an immunoassay for immunobiotic LAB. The swine TLR2-expressing transfectant was able to recognize not only yeast cell wall zymosan but also intact LAB, which resulted in the activation of nuclear factor-κB (NF-κB). Furthermore, high levels of TLR2 were detected in the follicle-associated epithelium of swine gut-associated lymphoid tissues, including membranous (M) cells and antigen-presenting cells such as dendritic cells. These findings indicate that TLR2-expressing cells in the gut-associated lymphoid tissues allow the host defense to respond to a variety of immunobiotic LAB. This finding may help clarify how LAB modulate intestinal immunity through TLR2, information that can aid in the development of immunobiotic foods.

Key Words: Immunobiotics, Lactic acid bacteria, Toll-like receptor 2

Graduate Student Paper Competition: National ADSA Production Division

73 Evaluation of feeding dried distillers grains plus solubles (DDGS) with corn silage or alfalfa hay as the primary forage source. D. H. Kleinschmit*, D. J. Schingoethe, A. R. Hippen, and K. F. Kalscheur, *South Dakota State University*, *Brookings*.

Nine multiparous (250 ± 6 DIM) and three primiparous (204 ± 6 DIM) Holstein cows were utilized in a 3 × 3 Latin-square design to evaluate the lactation performance of dairy cows fed a diet containing DDGS with either corn silage or alfalfa hay as forage. All cows were fed a total mixed diet containing corn silage (CS), 50% corn silage and 50% alfalfa hay (CSAH), or alfalfa hay (AH) as the forage source. All diets had a 50:50 forage to concentrate ratio and contained 15% DDGS in the concentrate mix. Diets were formulated to provide similar amounts of metabolizable protein but concentrations of CP increased when alfalfa was added. Dry matter intake (22.5, 23.5, and 20.5 kg/d for CS, CSAH, and AH, respectively) had a quadratic relationship ($P < 0.01$) with the addition of alfalfa. Yields of milk, 4% FCM, and energy-corrected milk (29.0, 30.7, and 31.0 kg/d) were similar for all diets. Feed efficiency (1.33, 1.39, and 1.54 kg ECM/kg DM intake) improved linearly ($P < 0.01$) with increased concentrations of alfalfa in the diet. Milk fat concentration (3.86, 3.72, and 3.58%) decreased linearly ($P < 0.01$) with addition of alfalfa, but this result was more drastic in primiparous cows than in multiparous cows. Differences in milk fat yield were not observed among diets. Milk protein concentration (3.32, 3.29, and 3.29%) and yield (0.90, 0.96, and 0.98 kg/d) were not affected by diet. Increasing the alfalfa content in the diets increased ($P < 0.01$) the concentration of milk urea nitrogen linearly due to greater concentrations of dietary CP. Ruminal molar proportions of acetate (63.4%), propionate (21.4%), and butyrate (10.1%) were similar across diets. Concentrations of ruminal ammonia were also similar (5.75 mg/dL). In conclusion, with the exception of a depression in milk fat content, replacing corn silage with alfalfa hay in diets containing 15% DDGS did not affect yields of milk and milk components, milk composition, and ruminal VFA and ammonia. The addition of alfalfa decreased DMI while maintaining milk production thus improving feed efficiency.

Key Words: Dried distillers grains plus solubles, Dairy cattle, Forage source

74 The effect of supplemental dietary forage on the concentration of phosphorus and nitrogen in feces of lactating cows. E. M. O'Rourke*[1], J. J. Michal[1], R. L. Kincaid[1], J. H. Harrison[2], and C. T. Gaskins[1], [1]*Washington State University*, *Pullman*, [2]*Washington State University*, *Puyallup*.

Sixteen multiparous Holstein cows were assigned to a study to determine if added dietary forage affected diurnal variation in the concentration of phosphorus (P) and nitrogen (N) in feces. At the start of the experiment, the cows averaged 262 DIM, 757 kg BW, and 37 kg daily milk yield. Dietary treatments were a control TMR consisting of 25% alfalfa haylage, 23% alfalfa hay, 10.3% whole cottonseeds, 7.3% wheat millrun, and 34.4% concentrate, and a treatment diet where cows were fed 2.27 kg alfalfa hay as a top-dress supplement to the