portable feed bunks (PFB) delivered by BSHR. Four replicates of each treatment were completed, with four samples per replicate were collected. Treatments were blocked by week and analyzed by proc mixed and pdiff (SAS, 2002). The second objective was to calculate the impact of FW on nutrients consumed compared to amounts supplied. The third objective was to calculate the economic impact caused by FW and the amount of additional feed required to replace lost nutrients. FW was 12.1% and 19.2% DMB respectively for BU and BSHR ($P<0.0001$) when fed on snow. Forage placed into PFB had 0% waste. More fine material (78.5%) was lost ($P<0.0001$) with the BSHR feeding system than the BU (46%). CP losses were 23.3% and 21.5% compared to physical losses of 12.3% and 19.2% respectively for the BU and BSHR. Losses of Ca, P, Mg, K and Na were also greater than the physical feed loss. Ration CP content was reduced from the delivered feed at 11% DMB to 8.4% and 8.6% when waste was considered with the BU and BSHR respectively. Over a 175 d feeding period, replacing nutrients lost in the FW with additional forage and additional equipment operating time increased winter feed costs by C$28.52 and C$56.52 per head for the BU and BSHR respectively.

Key Words: snow, feed waste, cows

62 A temporal characterization of the rumen epithelium response to dramatic shifts in dietary fermentable carbohydrates. M. A. Steele*, O. AlZahal, S. E. Hook, S. Greenwood, and B. W. McBride, *University of Guelph*, *Guelph, ON, Canada*.

The rumen epithelium performs a vital role in whole-animal energy metabolism through the absorption and the metabolism of volatile fatty acids (VFA). In spite of this, very little is known about how the rumen epithelium responds to dramatic shifts in dietary carbohydrates and the resulting microbial products. The first objective of this study was to temporally characterize how shifts in dietary carbohydrates influence rumen pH and epithelial ketogenesis. The second objective was to temporally quantify mRNA expression levels of ketogenic enzymes in rumen papillae. To meet these objectives, four mature, rumen fistulated dairy cattle were utilized to facilitate continuous rumen pH recording on a weekly basis. The cattle were maintained on a control (CON) diet prior to transitioning to an acidosis (AD) diet, which was fed for three weeks (weeks 1-3). The cattle were then switched back to the original CON diet for three additional weeks (weeks 4-6). A mixed model with repeated measures was used to contrast ruminal pH, blood metabolites and mRNA expression data between and within treatments. Mean ruminal pH was depressed ($P<0.01$) and SARA was diagnosed during the first week of the AD diet however pH was not significantly different from the CON during the second and third week on the AD diet, indicative of improved VFA clearance from the rumen. Plasma BHBA levels were elevated ($P<0.01$) when cattle were fed the AD compared to the CON diets, suggesting increased ketogenesis in the rumen epithelium. The expression of HMG-CoA Synthase mRNA increased during the first week of the AD diet ($P<0.05$) however was down-regulated 2.0-fold ± 0.08 ($P<0.01$) by the third week. Acyl-CoA Synthase mRNA expression was also decreased 1.8-fold ± 0.11 ($P<0.01$) by the third week of the AD diet. To our knowledge, this is the first in-vivo study to demonstrate that rumen epithelial metabolism adapts to shifts in the form of dietary carbohydrates.

Key Words: rumen epithelium, acidosis, ketogenesis

63 Fertility of Alpine goats following oestrus synchronisation with CIDR and artificial insemination with cryopreserved semen. M.-E. Marier*[1,2], F. Castonguay[3], M. Theriault[3], D. Cinq-Mars[2], C. Lessard[1,2], and J. L. Bailey[1,2], [1]*Centre de recherche en biologie de la reproduction*, [2]*Département des sciences animales, Université Laval*, *Québec City*, [3]*Dairy & Swine Research and Development Center, AAFC*, *Lennoxville*.

The demand for goat milk by Canada's manufacturing industry far outweighs that produced by its dairy herd. In contrast, France has been proactive in improving the genetic make-up and productivity of their herd using artificial insemination (AI). Our goal is to encourage AI in Canada by developing a protocol based on that used in France but modified for Canada's industry, where sponges are no longer available. A total of 48 female Alpine goats under an artificial photoperiod regime were assigned to 3 treatments (n=16 goats/treatment; 8 adult and 8 yearling) during the non-breeding season (spring): NAT+AI – females were inseminated with frozen semen 12 h after natural oestrus; CIDR+AI - oestrus was synchronized with CIDRs (progesterone-releasing device) and females were inseminated with frozen semen 43 h after CIDR removal; CIDR+buck - oestrus was synchronised with CIDRs and females were placed with bucks 24 h after CIDR removal. For CIDR groups, females were treated with CIDRs on Day 0, injected with eCG+cloprostenol on Day 9, and CIDRs were removed on Day 11. Semen straws from the same lots were used for both AI groups, and sperm parameters (computer-assisted sperm motility, viability, DNA stability, and % acrosome reactions) were analysed to assess the relationship with fertility. Data were analysed by PROC LOGISTIC with SAS. Overall birth rate was 25% for NAT+AI, which was inferior to the 63%, and 100% for CIDR+AI and CIDR+buck, respectively ($P<0.05$). Female age did not affect fertility. Post-thaw semen analyses were not predictive of fertility. This study demonstrates that AI with frozen semen yields satisfactory fertility in adults and yearlings in the non-breeding season with oestrus being synchronised by a CIDR-based protocol. While natural mating yields the best fertility, the 63% obtained with AI allows a much faster genetic improvement.

Key Words: goat, CIDR, AI

Graduate Student Paper Competition: National ADSA Dairy Foods

64 Growth of *Lactobacillus casei* at 8°C in Cheddar cheese extract requires supplementation. W. S. Tan*[1], M. F. Budinich[1], R. Ward[2], J. R. Broadbent[2], and J. L. Steele[1], [1]*University of Wisconsin*, *Madison*, [2]*Utah State University*, *Logan*.

Flavor development in ripening Cheddar cheese is a complex microbial and biochemical system that is difficult to study in its natural form. Therefore, we developed a model system, Cheddar cheese extract (CCE), derived from the aqueous phase of ripening Cheddar cheese to study the complex interactions between the cheese microbiota, the conditions present in the cheese (e.g. composition of the microbiota, substrates present, NaCl concentration, temperature, pH, and organic acids) and flavor development. Previous studies in our laboratory have demonstrated that CCE supports the growth of strains of *Lactobacillus casei* at 37°C from

10^4 to 10^8 CFUs/ml. However, when we attempted to repeat this CCE growth experiment at 8°C, the final cell density was 10^6 CFUs/ml. When growth experiments were done at 8 and 37°C in MRS, no significant differences were observed in the final cell densities obtained. These results suggested that CCE was lacking an essential nutrient for growth of *Lb. casei* strains in CCE at 8°C to the levels observed at 37°C. To identify the lacking nutrient, CCE was supplemented with various media components present in MRS or a chemically defined media formulated for *Lb. casei*. These results indicated that addition of tween 80 to CCE allowed for growth of *Lb. casei* strains at 8°C to levels similar to that observed at 37°C. To determine if a similar growth enhancement would result from the addition of milk fat, 1% (v/v) milk fat was added to CCE and growth studies were conducted at 8°C. Milk fat was capable of enhancing the growth of *Lb. casei* strains at 8°C in CCE, but not to the same level observed with tween 80. Future studies will include the membrane fatty acid analysis of *Lb. casei* strains growing in CCE with and without milk fat supplementation at different incubation temperatures. These results suggest that milk fat plays an essential role in the growth of *Lb. casei* in ripening Cheddar cheese. Therefore, CCE with 1% milk fat will be use as a cheddar cheese model system to further understand the interactions within the cheese aqueous phase and flavor development in Cheddar cheese.

Key Words: Cheddar cheese, *Lactobacillus casei*, milk fat

65 Structure-function relationship of exopolysaccharides from lactic acid bacteria in fermented milk. M.-C. Gentès*[1,2], D. St-Gelais[2], and S. L. Turgeon[1], [1]*STELA Dairy Research Centre and Institute of Nutraceuticals and Functional Foods, Laval University, Quebec city, Quebec, Canada, G1K 7P4*, [2]*Food Research and Development Centre, Agriculture and Agri-Food Canada, St-Hyacinthe, Quebec, Canada, J2S 8E3*.

Exopolysaccharides (EPS) produced by lactic acid bacteria (LAB) can be used as stabilizers in fermented milk. Literature indicates that their properties to bind water and modulate viscosity are not correlated to EPS concentration but to their structure and interactions with milk compounds. In order to produce fermented milk with desirable rheological properties, it is essential to know their structure-function relationship. The aim of this work was to evaluate the gelation profile and the rheological properties of reconstituted skim milk (RSM) made with LAB producing different EPS. Three *Streptococcus thermophilus*: ST1 (EPS-), ST2 (neutral ropy EPS+), ST3 (charged ropy EPS+) and four *Lactobacillus delbrueckii* ssp. *bulgaricus*: LB1 (EPS-), LB2 (neutral nonropy EPS+), LB3 (charged nonropy EPS+), LB4 (neutral ropy EPS+) were compared. Each strain was grown at 42°C in RSM at 12% (DM) until pH reached 4.6. Glucono-delta-lactone (GDL) was used as control. Analysis of variance, according to completely randomized design, was applied to determine the effect of EPS on rheological properties. Significant differences were tested at $P \leq 0.05$. Whey retention (centrifugation: 210 x *g*), firmness (TA-XT2 texture analyser) and apparent viscosity at $10s^{-1}$ (rheometer) were significantly higher in RSM with ropy strains. Gel formation (elastic modulus: G′>1Pa) was observed from pH 5.6 to 5.2 for all strains while ST3 formed gel at pH 5.0. Casein aggregation seemed to be affected by the EPS produced by ST3. EPS- strains, GDL and ST3 had similar G′ (242Pa) at 10Hz while for others, the G′ was significantly lower (135Pa). For LB3, the G′ was intermediate (178Pa). This work showed that casein aggregation during gel formation and rheological properties of fermented milk are modified by the type of EPS produced by LAB.

Key Words: exopolysaccharide, structure-function relationship, rheological properties

66 Modifying whey proteins to improve heat stability and clarity. K. N. Ryan*, B. Vardhanabhuti, and E. A. Foegeding, *North Carolina State University, Raleigh*.

Heat-induced aggregation, resulting in excessive turbidity, phase separation, or precipitation, limits the application of whey proteins in beverages. Whey proteins with increased heat stability, especially in the presence of salts, are desirable for existing meal replacement beverages and new beverage applications. Therefore, the objective of this research was to determine the factors that influence heat stability of unmodified and modified (mild heat treatment) whey proteins in the presence of salt in order to achieve maximum protein stability. Solutions containing 7% w/v whey protein isolate (WPI) or β-lactoglobulin (BLG), pH 7, were heated at 90°C for 10 min to produce "modified" proteins. Subsequently, unheated (native) and modified WPI or BLG were diluted to 3% w/v protein and underwent a second heating at 90°C for 5 min in the presence of 0-30 mM NaCl after pH was adjusted to 6.8. Sample turbidity was determined by optical density at 400 nm. Solution viscosity (shear rate sweep) and protein solubility (BCA assay) were determined. Surface hydrophobicity of proteins was measured using the fluorescent probe 1-anilinonaphthalene-8-sulfonic acid (ANS). Modified proteins produced solutions with significantly lower turbidity ($p \leq 0.05$) than their native counterparts, where a greater than 40% decrease in turbidity was observed at high NaCl concentrations. Modified samples with reduced turbidity also showed reduced viscosity as indicated by lower consistency coefficients when modeled using a power law model, with modified BLG showing a greater viscosity reduction than WPI. Solubility was close to two times greater for the modified proteins at 30 mM NaCl compared to native proteins. Surface hydrophobicity could not explain the stability of the modified proteins, suggesting another mechanism is responsible for greater heat and salt stability of the modified whey proteins. This research is important as it shows how modification of whey proteins results in higher solubility of proteins and reduced viscosity and turbidity of solutions containing salts, which is often desired in nutritional beverages.

Key Words: whey protien, stability, modified

67 Evaluation of heated milkfat flavor profile and its effect on buttery flavor in cheese. E. L. Harvey* and S. A. Rankin, *University of Wisconsin, Madison*.

Milky and buttery flavor notes are highly desirable in many cheeses. Developing a simple means to potentiate these flavor notes would improve consumer acceptance of bland products such as low fat cheese. One mechanism for increasing buttery notes involves the thermal treatment of milkfat such as in ghee production. The objective of this work was to study the impact of heat treatment on the volatile and flavor profile of milkfat for flavor improvement of mild cheese. Milkfat was separated from pasteurized (87.2°C, 19s) 37% fat cream in a pilot-scale variable speed churn. Fresh butter samples were placed in glass vials with Teflon-lined closure and rapidly heated to 90, 120, 150 and 180°C by immersion in a mineral oil bath for 15 and 30 minutes. The volatile fractions of the heated samples were analyzed using SPME-GC/MS, and the results were compared with those of fresh butter. The heated samples contained numerous volatiles associated with the Maillard reaction and lipid oxidation products, including lactones, which are known to contribute to sweet milkfat flavors in dairy products. Trained descriptive panel assessments demonstrated relationships between heating and several sensory descriptors such as cooked and caramelized. To examine the application of heated milkfat flavor in mild cheese, salted curd of a fresh, acid-set cheese was combined, hooped, and pressed

(40psi, 1.5hrs) with fresh and heated (139°C ± 7°C, 5min) milkfat. A consumer panel (n=100) involving the three treatments was conducted to assess perception and intensity of the buttery notes in the samples. Statistical analysis (ANOVA) of the results showed that significantly (α=0.05) stronger buttery flavors were detected in the samples containing both heated and fresh added milkfat. Also, an increased overall flavor was recognized in the sample containing heated milkfat. This data indicates that incorporation of heated milkfat markedly enhances buttery notes in mild cheese. Producing cheese with heated butter flavor characteristics could have application in improving flavor performance in low fat cheeses.

Key Words: flavor, cheese, buttery

68 Are the physico-chemical properties of the casein micelle modified by ultrafiltration? M. A. Ferrer*[1,2], M. Alexander[2], and M. Corredig[2], [1]*University of Zulia, Maracaibo, Zulia, Venezuela*, [2]*University of Guelph, Guelph, Ontario, Canada*.

The aim of this work was to determine if concentration of milk using ultrafiltration (UF) (with no diafiltration) affects the structure of casein micelles once they are brought back to their original environment (pH and ionic strength) in milk. Despite the amount of information available on ultrafiltration of milk, no information is available on how (or if) ultrafiltration irreversibly modifies the properties of the micelles. Casein micelles were concentrated by ultrafiltration of skim milk to 2-fold (light UF) and 5-fold (high UF) casein volume fraction, and their light scattering properties were immediately observed by diffusing wave spectroscopy and dynamic light scattering. Casein micelles were then re-dispersed in their own permeates and dialyzed against raw skim milk. Scattering properties were then observed on all samples after 24h of equilibration. This allowed us to examine the stability of casein micelles (which underwent different UF treatments) under the same volume fraction and ionic conditions. The light scattering properties (size, ζ-potential and turbidity parameter) of casein micelles modified by "light" ultrafiltration (2-fold concentration) were not different from those of the skim milk control. However, the inverse of the transport mean free path, defined as the turbidity parameter, $1/l^*$, was significantly lower for the casein micelles modified by "high" ultrafiltration (5-fold concentration) compared to "light" UF and the skim milk control. Analysis of serums obtained by centrifugation of the samples revealed no differences in the soluble caseins profile, proving that ultrafiltration did not induce solubilization of caseins from the micelle structure. These results suggest that the process of ultrafiltration does have some lasting effects on the structure of the casein micelles. These changes are most probably due to variations in the mineral equilibrium of the casein/environment system during the UF process and not to the protein structure itself.

Key Words: casein micelle, light scattering, ultrafiltration

69 Isolation of a whey fraction rich in α-lactalbumin from skim milk through microfiltration. B. Holland*[1], J. Kacmar[2], and M. Corredig[1], [1]*University of Guelph, Guelph, ON, Canada*, [2]*NCSRT, Raleigh, NC*.

Currently microfiltration is used extensively in the dairy industry for removal of bacteria and spores from raw milk, and to concentrate proteins for preparation of milk protein and whey protein concentrates and isolates. The objective of this work was to be able to isolate a high purity α-lactalbumin rich stream from pasteurized skim milk through only filtration techniques. The microfiltration system used for isolation was a pilot plant scale novel Purposep™ filtration system (NCSRT. inc, North Carolina). Various filters and operating conditions were tested, and the amount of whey protein transmitted in the permeate was quantified using high performance size exclusion chromatography and calibration curves using previously purified –whey proteins. The CONSEP™ RC 100 membrane filter cartridge used was regenerated cellulose (RC) and had a 100kDa MWCO (molecular weight cut-off). Final conditions were 26°C with a TMP (trans-membrane pressure) of 186 kPa (27psi). These were found to be optimal for the isolation of α-lactalbumin to levels of up to 90% of total protein. This would be sufficient for use in human baby milk powders as they require only 80% purity. DSC tests confirmed that the protein is still in a state close to native and is not further damaged (after pasteurization) by the filtration process. This process results in a very high value product with minimal inputs as the skim milk can go on to be used in many processes, most notably for cheese making.

Key Words: ultrafiltration, α-lactalbumin, whey protein

70 Production efficiency of a serum protein (SP) reduced micellar casein concentrate (MCC) produced with polymeric spiral-wound microfiltration (MF) membranes. S. L. Beckman*[1], J. Zulewska[2], M. Newbold[1], and D. M. Barbano[1], [1]*Cornell University, Ithaca, NY*, [2]*University of Warmia and Mazury, Olsztyn, Poland*.

The purpose of this research was to determine the process necessary to create a 95% SP reduced MCC using polymeric spiral-wound MF diafiltration. Separation of micellar casein and serum proteins by MF is an emerging process that could be used to produce a range of protein ingredients for use in both dairy and non-dairy foods and beverages. Pasteurized (79°C, 18s) skim milk (3 lots) was microfiltered at 50°C [about 3× concentration] using a 0.3µm polyvinylidene fluoride spiral-wound membrane bleed-and-feed 3-stage process, using 2 diafiltration stages, where the retentate was diluted 1:2 with reverse osmosis water. The measured CN content of the MF permeate was 0.02%, so there was not a large loss of CN in the permeate. MF retentate TP content decreased progressively with stage, 7.58, 6.27 and 5.55%. These decreases were larger than expected, given the concentration factors were not different, 2.79, 2.82 and 2.90 for the 3 stages, respectively showing an apparent loss of protein in the system. This disappearance may be due to adsorption of protein to polymeric components of the MF system or the imbalance between actual concentration factor and the diafiltration factor used for water addition. Flux increased progressively with stage, 15.7, 24.3, and 35.1 kg/m^2 per hour, indicating that membrane fouling decreased with stage. The SP removal was determined by Kjeldahl [SP times the mass of permeate divided by the mass of SP in the skim milk]. Theoretical SP removal for this process is 68, 22 and 7% for the 1st, 2nd and 3rd stages, respectively with a total removal of 97%. Based on the Kjeldahl, 38.6, 20.8 and 11.0% of skim milk SP was removed in the 1st, 2nd and 3rd stages, respectively for an overall SP reduction of 70.4% compared with 90 to 95% reported for ceramic MF. Therefore, the membrane was partially blocking the passage of SP. The percentage of starting SP for each stage that passed through the membrane was 39, 34 and 27%, respectively. To achieve a 95% serum protein reduction in MCC it is estimated that an additional 5 diafiltration stages would be necessary.

Key Words: microfiltration, micellar casein concentrate

71 Retention of vitamin D fortified emulsions in bench-top cheese. M. Tippetts*[1,2], S. Martini[1,2], C. Brothersen[2,1], and D. McMahon[1,2], [1]*Utah State University*, *Logan*, [2]*Western Dairy Centrer*, *Logan, UT*.

The objective of this research was to evaluate the retention of vitamin D in bench-top cheese by using different delivery matrices. Vitamin D was incorporated in the cheese using a 5% oil-in-water emulsion. Emulsions were formulated with different emulsifiers (non-fat dairy powder, whey protein concentrate, calcium and sodium caseinates) in triplicate to determine the efficiency in vitamin D delivery. The oil phase was composed of 50:50 wt% of vitamin D and soybean oil; the water phase consisted of 2 wt% protein in a 0.01M Na2HPO4-7H2O buffer (pH 7). The amount of each emulsifier added varied according to protein content. The oil and water phases were homogenized using a high shear force for 1 min at 18,000 rpm and then passed through a microfluidizer (2,500psi). Vitamin D dissolved in medium chain triacylglycerides (Continental Custom Ingredients; 40,000 IU/mL) was used as a control. Bench-top cheese was made in triplicate with pasteurized (72 °C 15 s) whole (non-homogenized) milk. For each sample, 200 µl of vitamin D emulsion or 125 µl pre-emulsified vitamin D (control) was added to 200 ml of milk (250 IU per gram of curd). Each fortified milk solution was prepared in 250 ml polycarbonate Nalgene centrifuge bottles. Glucono-delta-lactone (2% w/v) and double strength rennet diluted to 1.8 rennet units per ml with cold water (0.2% v/v) were added to each. Mixtures were incubated 30 min at 35°C for coagulum formation, then coagulum was cut and centrifuged at 1000 x g at 25 °C for 30 min. The curd and whey were measured and 100 g of whey and 5 g of curd were retained and frozen for vitamin D analysis (O'Neil Laboratories). Results from this research show that the retention of vitamin D in the curd was 98.4 ± 0.2% for the samples formulated with non-fat dairy powder, 97.1 ± 0.5% for samples with calcium caseinate, 98.1 ± 0.1% for samples with sodium caseinate and 97.1 ± 0.2% for samples with whey protein. These values were significantly higher than the ones obtained for the control delivery matrix (93.3 ± 0.7%). These results suggest that using an oil-in-water emulsion is a better delivery matrix than using the vitamin D dissolved in medium chain triacylglycerides.

Key Words: vitamin D, cheese, retention

72 Low fat Mozzarella cheese with improved baking and melting properties. R. Wadhwani* and D. J. McMahon, *Utah State University*, *Logan*.

Low fat cheeses dehydrate too quickly when baked using a forced air convection that prevents proper melting on a pizza. Low fat Mozzarella cheeses were made using direct acidification with citric acid to pH 5.9, containing 1.5, 3.0, 4.5, or 6.0% fat. The cheese curd was salted and placed in a bowl chopper and 4.5, 3.0, 1.5, or 0.0% respectively, of melted butter was added along with glucono-δlactone. The curd mixture was comminuted, hooped, and pressed into a block using 100 kPa pressure. Cheese was analyzed for melting, texture, free oil, and performance when baked on a pizza at 250°C for 6 min in an Impinger oven after 15, 30, 60, and 120 days of storage at 5°C. All cheeses contained 5.5-6.0% fat and 52-53% moisture. Compared to the control cheese in which all 6% fat was from the curd, the treated cheese had higher stretchability tested using a fork test after baking the pizza. Melting also increased which was particularly evident after baking on a pizza. The control cheese remained in the form of shreds and did not melt, while the cheeses made with added butter melted and flowed together. The cheeses with added butter had higher free oil and less hardness, gumminess, and chewiness than the control. Low fat Mozzarella cheese with free oil availability during baking is very important for retaining moisture. This study helped in availing free oil in cheese using melted butter.

Key Words: Mozzarella, melting, baking

73 Effects of starch addition on a low-fat cheese model system. K. M. Larsen*[1,2], D. J. McMahon[1,2], and W. R. McManus[1,2], [1]*Western Dairy Center*, *Logan, UT*, [2]*Utah State University*, *Logan*.

Addition of starch to low-fat cheese has the potential to create discontinuities in the protein matrix and alleviate formation of a rubbery texture. The purpose of this research was to 1) determine if various starches are retained with casein when a rennet curd is formed, and to quantify the percentage of starch lost into the whey during syneresis, and 2) determine starch impact on microstructure of rennet-induced milk gels using laser scanning confocal microscopy (LSCM). Model low-fat cheeses were made by renneting and acidifying skim milk containing one of five starches at 0.5% (wt./vol). Starches used included modified waxy cornstarch (WC), waxy rice starch (RS), instant tapioca starch (IT), dextrin (D), and modified food starch (MF). Milks were heated prior to renneting to gelatinize starch. After curd formation, curd was cut and centrifuged at 25°C at 500 x g then 1,000 x g for 15 min each. Starch content in whey was determined by alcohol precipitation. Curd samples for LSCM imaging were fixed in osmium tetroxide. Acriflavin HCl at 2% in water was used to stain carbohydrate, and 0.01% Rhodamine B in water was used for protein. Curd yields were 18.9, 21.7, 14.0, 25.1, 21.2, and 13.4% for WC, RS, D, MF, IT and control cheeses, respectively. Apparent starch losses in whey were 0, 0.7, 15.4, 18.6, and 0%, from centrifuged curd containing WC, RS, D, MF, and IT, respectively. The proportion of carbohydrate observed in the curd structure with LCSM was related to the level of starch retention. There were differences in the distribution of starch between the protein matrix and the serum pockets depending on the starch used. The MF apparently interacts most strongly with the matrix, D interacts less, and WC, RS and IT are intermediate.

Key Words: starch, cheese, low-fat

Graduate Student Paper Competition: National ADSA Production Division Oral MS Competition

74 Effects of conjugated linoleic acid isomers on mammary gland development in BALB/cJ mice. J. M. Gloviczki*[1], J. Kraft[2], A. L. Lock[2], J. F. Trott[1], and R. C. Hovey[1], [1]*University of California*, *Davis*, [2]*University of Vermont*, *Burlington*.

Conjugated linoleic acids (CLA) are isomers of octadecadienoic acid that are present in ruminant-derived products. *Cis*-9, *trans*-11 (9,11) CLA is the most abundant, while the less abundant *trans*-10, *cis*-12 (10,12) isomer is a major constituent of mixed isomer supplements. Both isomers suppress mammary gland (MG) tumorigenesis *in vitro* and *in vivo*, whereas 10,12 CLA has been implicated as affecting the incidence of obesity and insulin resistance. Intriguingly, recent data indicate that a diet supplemented with 10,12 CLA stimulates MG tumorigenesis in transgenic mice overexpressing the ErbB2 oncogene. These conflicting data emphasize the need to further investigate MG development