232 Alcohol stability of milk and its relation to milk and blood composition in Holstein dairy cows. Sasan Sobhani*, Reza Valizadeh, and Abbasali Naserian, *Ferdowsi University, Agriculture college, Animal Sci. Dep.,Mashhad, Khorasan, Iran.*

The alcohol test is used as the initial classification of milk in dairy farms. It is used as a measure of the natural PH of the milk: acidity, which produces instability of milk proteins to heat. In practical conditions the test could be also positive immediately after milking and therefore this milk maybe rejected by the milk processing industry. This study focuses on variations in some milk and blood composition in individual Holstein cows related to this test. Ten cows with alcohol positive milk and 10 cows with normal milk were selected randomly from a large commercial dairy farm. In the first stage milk and blood samples were taken from all cows. The second stage of this trial continued only with alcohol positive milk cows, and alcohol test were performed for their milk until their milk turned into normal state and then milk and blood samples were taken again. After chemical analyzing of the milk and blood samples, their means were calculated. Comparison of the means of alcohol positive milk cows with normal group showed that there were significant differences ($p \leq 0.05$) in milk pH, lactose and soluble calcium, magnesium, phosphorous, citrate and potassium and also in blood potassium, chlorine, glucose and pH. But there were not any difference ($p \leq 0.05$) in protein, fat, SNF, sodium, chlorine and urea of milk and blood calcium, magnesium, phosphorous, sodium and urea. Moreover, comparison of the means of alcohol positive milk cows with themselves after their milk turned into alcohol negative test showed that there were significant differences ($p \leq 0.05$) in milk pH, lactose and soluble calcium, magnesium, sodium and potassium and blood glucose and its pH. But there were not any significant differences in the other measured factors. Results show that low levels of blood glucose (39.8 mg/100ml) could be probably the original factor for the incidence of this problem, which require more investigations.

Key Words: Alcohol stability of milk, Milk and blood composition, Dairy cow

Dairy Foods Processing

233 Impact of a novel fat removal process on the fat removed from aged full-fat Cheddar cheese and the fat portion of reduced-fat Cheddar cheese. B. K. Nelson* and D. M. Barbano, *Northeast Dairy Foods Research Center, Cornell University, Ithaca, NY.*

A novel fat removal process was previously developed for the production of reduced-fat Cheddar cheese with typical Cheddar flavor. The physical process involved tempering shredded aged full-fat Cheddar cheese to a specified temperature and then centrifuging the heated shreds to remove fat. Conditions of 30°C and 23,500 × *g* for 5 min removed 50% of the fat. While the original intent of this investigation was to characterize the fat removed from the full-fat Cheddar cheese, properties of the fat portion of the reduced-fat Cheddar cheese and the aged full-fat Cheddar cheese were also determined. The fatty acid composition of the removed fat was significantly more unsaturated than the fat portions of the reduced- and full-fat cheeses. The triglyceride molecular weight distribution of the removed fat had significantly fewer triglycerides with carbon numbers from 46 to 52 and significantly more triglycerides with carbon numbers from 28 to 42 compared to the fat portions of the reduced- and full-fat Cheddar cheeses. Major differences were observed in the melting profiles of the removed fat and fat portions of the reduced- and full-fat Cheddar cheeses. Only 82.1% of the fat in the reduced-fat cheese and 92.8% of the fat in full-fat Cheddar cheese were liquid at 30°C, while 99.6% of the removed fat was liquid at the same temperature. The different properties of the fat removed from aged full-fat Cheddar cheese compared to ordinary milkfat namely more unsaturation and a lower melting point may prove to be useful in some food product formulations.

Key Words: Cheddar cheese, Fat

234 Milk pH as a function of carbon dioxide concentration, temperature, and backpressure in a heat exchanger. Y Ma* and D Barbano, *Cornell University, Ithaca, NY.*

Raw skim milk, with or without added CO_2, was heated, held, and cooled in a tubular heat exchanger (380 ml/min). The experiment was replicated twice and for each replication, milk was first carbonated at 4°C to contain 0 (control), 1200, and 2400 ppm added CO_2 using a continuous carbonation unit. After 1 d storage at 4°C, sub-portions of milk at each CO_2 level were heated to 40, 56, 72, and 80°C, held at the desired temperature for 30s (except 80°C, holding 20s), and cooled to 4°C. At each temperature five backpressures were applied: 10 (control, without added pressure), 20, 30, 40, and 50 psi. Backpressure was controlled with a needle value at the heat exchanger exit. Both the pressure gauge and pH probe were inline at the end of the holding section, just before the cooling section. Milk pH during heating depended on CO_2 level, temperature, and pressure. ANOVA analysis showed a significant three-way interaction of the above three factors. The pH of the control milk at both the entrance and exit of the heat exchanger at 4°C was 6.90. However during heating of control milk, pH decreased linearly as a function of increasing temperature but was independent of pressure (Table). The pH of milk with added CO_2 decreased with increasing CO_2 level and pressure (Table). For milk with added CO_2, at a fixed CO_2 level, the effect of pressure on pH decrease was greater at a higher temperature. At a fixed temperature, the effect of pressure on pH decrease was greater for milk with a higher CO_2 level. Thermal death of bacterial during pasteurization of milk without added CO_2 is probably due not only to temperature but also to the "invisible" decrease in pH that occurs during the process. Increasing milk CO_2 level and backpressure decrease the milk pH even further during heating and may further enhance the microbial killing power of pasteurization.

Table. Influence of CO_2 concentration, backpressure, and holding temperature on milk pH in the holding tube.

	Control	1200	ppm	CO_2	2400	ppm	CO_2
Holding temperature	10-50 psi	10 psi	30 psi	50 psi	10 psi	30 psi	50 psi
40°C	6.58	6.06	6.05	6.05	5.90	5.79	5.78
56°C	6.46	6.00	5.97	5.96	5.92	5.72	5.72
72°C	6.35	5.98	5.89	5.88	5.93	5.80	5.67
80°C	6.26	6.00	5.86	5.83	5.96	5.81	5.64

Key Words: Milk pH in Heat Exchanger, Carbon Dioxide, Pressure and Temperature

235 Determination of optimum sampling protocol before milk pick up from Ontario farms. V Servello, I McMillan, R Lencki, and A Hill*, *University of Guelph.*

The objective of this research was to assess the optimum sampling protocol to be followed when obtaining milk samples before pick up from Ontario farms. The study indicated that representative milk samples could be obtained after 2 minutes of agitation as opposed to the 5-minute agitation standard. This result was independent of farm-to-farm variations such as tank shape, size, percent fill, impeller size, rpm, temperature changes, and milk composition. The research involved creaming, intermittent agitation, agitation, and bottom vs. top sampling tests. Creaming tests, which assessed the creaming rate of raw milk for a 3-hour period, indicated that milk stays homogeneous during the first 40-50 minutes of setting. Intermittent agitation tests, which determined the agitation time required to obtain a homogenous milk sample after 1, 2.5 and 4 hr of creaming in full and half full tanks, indicated that if the milk is left to cream from 1 to 4 hours, a homogeneous sample could be obtained after agitating the milk for 2 minutes regardless of % fill variations. Agitation tests, which assessed the agitation time required to obtain a representative sample after 3 hours of creaming from 26 different tanks, showed that 2 minutes of agitation were required. Bottom vs. Top sampling tests, which compared the standard sampling procedure (Top sampling) with a sampling method that uses a device, which fits the outlet valve of a bulk tank (Bottom sampling), indicated that a homogeneous sample could be obtained after 2 minutes of agitation regardless of the sampling method used. On the basis of these results, the optimum sampling protocol recommended was to agitate the milk for 2 minutes every hour, and to take a sample before milk pick up after 2

minutes of agitation using the standard method or the bottom sampling method.

Key Words: Sampling Protocol, Milk sampling

236 Buttermilk fractionation by microfiltration. Harit K. Vyas*, Johanna C. Astaire, and Rafael Jimenez-Flores, *Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

Buttermilk contains milk fat globule membrane (MFGM) material that is rich in glycoproteins and various phospholipids and sphingolipids. These lipids have been shown to possess unique cell signaling activities, and may have potential uses as anticancer agents (Parodi, 1997). Crossflow microfiltration in constant transmembrane mode was used to concentrate MFGM material present in buttermilk. Experiments were carried out at both laboratory and pilot scale using 0.65 μm flat-sheet PVDF and 0.8 μm multi-channel tubular ceramic membranes, respectively. Diafiltration was done using deionized water vo1umes equal to 1, 2, 3, 4 and 5 times the original volume of buttermilk (i.e. 1, 2, 3, 4 and 5 X diafiltration). Permeates and retentates after each stage of diafiltration were analyzed for total solids, ash, proteins and fat content. The samples were also analyzed for the lipid and protein profiles and for the particle size distribution as well as observed under atomic force microscope. The retentates after 2, 3 and 5 X Diafiltration from pilot scale experiments were concentrated using 10 kDa spiral wound polysulfone ultrafiltration membrane and then spray dried. The total solids, protein, fat and ash decreased from 10, 3.7, 0.45 and 0.75 % wt, respectively, in the buttermilk to 0.7, 0.5, 0.069 and 0.05 % wt, respectively, in the 5X diafiltered retentate. The proportion of fat in the total solids increased in retentate with diafiltration due to the preferential removal of solids not fat. The fat proportion was highest (10% wt), double compared to that in the original buttermilk (5% wt), in the retentate after 3 X diafiltration. The fat in the retentate continuously decreased but increasingly became concentrated in the phospholipids and sphingolipids during diafiltration. After 5 X diafiltration the concentration of these lipids was highest. Atomic force microscopy suggested the presence of MFGM material mainly in the retentate besides in the buttermilk itself. However, a few of MFGM components were also noticed in initial permeate samples from the experiments using reconstituted buttermilk. Fat profile of different permeates also suggested the transport of some lipids through the membrane.

Key Words: microfiltration, fractionation, buttermilk

237 Skim milk fractionation by constant flux microfiltration. Harit K. Vyas* and Phillip S. Tong, *Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo, CA.*

Our primary objective was to characterize the fractionation of skim milk under constant flux microfiltration (MF). The fractionation experiments were carried out at the pilot scale with 0.1 μm multi-channel tubular ceramic membrane module using reconstituted skim milk. Skim milk was concentrated 2X (volume concentration ratio) followed by diafiltration using deionized water equal to two times the original volume of skim milk to further purify the casein rich stream. The casein rich stream was concentrated using 10 kDa polysulfone spiral wound ultrafiltration pilot plant and then spray dried. The MF skim milk permeate was ultrafiltered with diafiltration and the retentate rich in whey proteins was freeze dried. Samples of both of the dried products, skim milk and retentates and permeates at different stages of MF processing were analyzed for total solids, ash, protein and lactose content. Samples were also analyzed for their protein profile. Mass balance was determined for each constituent. After 2X concentration 50% of total lactose, 39% of total whey proteins and 38.5% of total minerals originally present in the skim milk permeated through the membrane. Retentate had 53.3% (DMB) proteins with the casein to whey proteins ratio of 87:13. After diafiltration this ratio was 93:7. No casein was detected in permeate at any stage of the MF process. The freeze dried whey protein concentrate contained 70% protein. These results suggest that casein enriched ingredients and purified whey protein streams can be produced directly from membrane processing of skim milk.

Key Words: Constant flux microfiltration, fractionation, skim milk

238 Effect of trans membrane pressure, cross flow velocity and pH on the permeate flux during selective concentration of skim milk components. M. Singh* and S.S.H. Rizvi, *Institute of Food Science, Cornell University, Ithaca NY 14853.*

The use of cross flow microfiltration (CFM) in the food industry is well documented. Yet, the effects of processing variables such as transmembrane pressure (TMP), cross flow velocity (CFV) and ionic environment of feed on permeate flux are not completely understood but are necessary for quantifying the process efficacy. CFM of skim milk was carried out at 9 different combinations of uniform-TMP (UTMP) and CFV, to quantify the effects of UTMP and CFV on permeate flux at pH 6.0 and 6.5. Pasteurized skim milk (200kg) preheated to 50°C was microfiltered using every combination (3 x 3) of CFV (5.3, 5.8, 6.3m/s) and UTMP (68.9, 103.4, 137.9kPa). The pH of skim milk was adjusted in process to 6.5 and 6.0 with glucono-δ-lactone to adjust the calcium concentration in retentate. As expected, increasing CFV from 5.3 to 6.3m/s at each UTMP resulted in improved flux in all experiments, with an average increase (at the start) of 24% and 31% at pH 6.0 and 6.5 respectively. High CFV combined with high TMP gave highest initial flux (81.7 and 68.6 $kgm^{-2}h^{-1}$ at pH 6.5 and 6.0 respectively) up to a CF of 3 to 4 but declined rapidly after 5x (51 and 48% respectively) and was finally reduced to 17 and 27% of original value at 8x at pH 6.5 and 6.0, respectively. Increasing UTMP at each CFV resulted in high initial flux, which was for example 74% higher at 137.9 than 68.9kPa at 5.3m/s and pH 6.0. In all experiments, the flux performance was reversed after 6-7x and the flux was 29% lower at 137.9 than 68.9kPa at 8x at 5.3m/s and pH 6.0. In every experiment, flux at each CF was higher at pH 6.5 when compared to 6.0 (difference being as high as 50% at the startup at 6.3m/s and 68.9kPa) due to solubilization of micellar calcium and severe fouling at lower pH. High CFV is always more desirable at each UTMP since higher flux was always obtained by using high CFV, which results in higher shear and prevents cake build up on the membrane surface. Higher TMP (137.9 vs. 68.9kPa) is advantageous initially with higher flux upto 6-7x but will result in severe fouling and a sharp drop in flux if the process is continued to higher concentrations (8-10x). Lower UTMP with high CFV is needed to achieve high CF (8-10x) of selected milk components during CFM.

Key Words: Permeate flux, Microfiltration, Skim milk

239 Effects of dairy process on insulin-like growth factor-1 (IGF-1) content and its concentration in several commercial dairy products. S. H. Kang*[1], J. W. Kim[2], J. Y. Imm[3], S. J. Oh[4], and S. H. Kim[2], [1]*Seoul Dairy Cooperatives,* [2]*Korea University, Division of Food Science,* [3]*Kookmin University, Dept. of Food & Nutrition,* [4]*Korea Yakult Co. Ltd.*

The objectives of this study were to examine the change of Insulin-Like Growth Factor-1 (IGF-1) content during dairy process including homogenization, pasteurization, concentration, spray drying, and fermentation and to examine IGF-1 content in commercial dairy products marketed in Korea. Milk was processed in Seoul Dairy Cooperatives. IGF-I content was determined by radioimmunoassay using 125I after acid-ethanol treatment. All the experiments were triplicated and the data were analyzed by the SAS system using a procedure of analysis of variance. There were no significant differences in IGF-1 content by homogenization (150 bar) and UHT pasteurization (130?, 2 sec), vacuum evaporation and spray drying. However, IGF-1 content significantly decreased from 53.0 17.1 to 3.8 3.2 ng/ml during 13 hr fermentation (pH of 4.06) with commercial starter culture. The mean IGF-1 content of commercial market milk, whole milk powder, skim milk powder, infant formula and sweet cheese whey was 46.2 15.0, 41.3 9.5, 55.8 13.3, 32.2 9.4 and 20.5 6.4 ng/ml, respectively. However IGF-1 content of yoghurts was relatively lower than that of other dairy products and ranged from 7.7 3.4 to 17.4 5.6 ng/ml. The results suggested that commercial dairy process except fermentation did not affect IGF-1 content in the products. The decreased IGF-1 content found in fermented products might be related to the ability of lactic acid bacteria to utilize IGF-1 or IGF binding-protein complex

Key Words: IGF-1, Dairy Products, RIA

240 Effect of meat process conditions on mechanical properties of heat cured whey protein-based edible films: a comparison to commercial collagen films. S.N. Simelane*, A.M. Booren, and Z. Ustunol, *Michigan State University*.

Our previous research has shown that heat cured whey protein isolate (WPI) based films had similar mechanical properties to collagen films. Therefore, the objective of this research was to determine if heat cured WPI-based edible films could withstand temperature, time and relative humidity (RH) conditions typically encountered in a meat process scheme. A whey-protein-isolate based film that can withstand meat processing conditions may provide the meat industry with an alternative to collagen films.

WPI (5%, w/w) was dissolved in distilled water; glycerol (3.3%, w/w) was added and pH adjusted to 8 with 2N NaOH. Solutions were heated at 90°C for 15 minutes while continuously stirred. Candelilla wax (CW; 0.8%, w/w) was added during heating to allow it to melt. Solutions were homogenized, degassed, cast on teflon plates and dried at room temperature (∼23°C) overnight at constant relative humidity. Films used were heat cured at 90°C, 12 h. Next, all films (WPI and collagen) were exposed to conditions typical of a Polish sausage processing scheme; 57°C/60min/36%RH - stage 1, 66°C/90min/60%RH - stage 2 and 77°C/30min/80%RH - stage 3. Samples were collected and tested at the end of each stage; films in stage 3 underwent the whole process sequentially.. Control samples did not undergo these processing conditions. Mechanical properties; tensile strength (TS) and elongation at break (%E) were tested using ASTM standard procedures.

TS of WPI-based control was lower than that of collagen; TS decreased gradually from stage 2 to 3 for both WPI-based and collagen films. WPI-based films were more flexible; evidenced by higher %E, and their flexibility increased between stages 1 and 2. Collagen films were less flexible but maintained their %E throughout all three process stages. Heat cured WPI-based films appear to withstand the conditions that would typically be encountered in meat processing.

Key Words: Whey, Edible, Collagen

241 Utilization of a milk fat globule membrane fraction in the manufacture of low-fat yogurt. Rodrigo Roesch*[1], Douglas Dalgleish[2], and Milena Corredig[1], [1]*The University of Georgia, Athens, GA, USA,* [2]*University of Guelph, Ontario, Canada*.

The presence of material derived from the milk fat globule membrane (MFGM) makes buttermilk (the byproduct of buttermaking) distinct from any other dairy product. The design of reduced-fat products presents challenges when trying to achieve sensory and texture characteristics similar to those of products with higher fat content. The MFGM (the membrane of fat globules in milk and cream) contains large amounts of protein and phospholipids. In particular, phospholipids are known for their health-enhancing properties and they are considered valuable nutritional and functional ingredients in many food products. The objective of this work was to determine if the MFGM present in commercial buttermilk had unique functional properties compared to sodium caseinate or to the buttermilk powder from which it originated. For this reason, a fraction of MFGM was prepared from buttermilk by microfiltration, and then added to skim milk to prepare low-fat yogurt. Samples were homogenized, poured into sterilized cups, heat treated at 90C for 10 min and then cooled to 43C. After cooling the samples were inoculated with commercial yogurt culture. Triplicate experiments were performed, and the rheological properties and microstructure of yogurt containing MFGM were compared to those of samples with added buttermilk powder and sodium caseinate. MFGM extracts had a positive effect on the rheological properties of the low-fat yogurt. When addition of MFGM isolate was compared to the addition of buttermilk powder, no differences seemed to be present in the viscoelastic properties of the samples when lactose in buttermilk powder was taken into consideration. Light scattering measurements of the yogurt mix showed that the addition of MFGM increased the number of particles > 1 μm present. In addition, confocal microscopy with a fluorescent dye (Biodipy#, Molecular Probes) showed differences in microstructure between control samples and yogurt containing MFGM. Results of this research support the potential utilization of MFGM isolates as novel ingredients in fermented products.

Key Words: Yogurt, Milk Fat Globule Membrane

Forages and Pastures
Grazing Systems and Fiber

242 Soybean hulls as a supplement for stocker steers grazing annual ryegrass. J. A. Rush and S. P. Schmidt*, *Auburn University*.

Effects of nonstructural-carbohydrate and structural-carbohydrate supplements on the performance of stocker steers grazing cool-season forage were evaluated in a 3-yr replicated grazing experiment. Each yr, 45 crossbred beef steers (avg. initial BW 253 kg) were assigned randomly into one of fifteen 0.81-ha Marshall annual ryegrass (*Lolium multiflorum*) paddocks. The 15 paddocks were assigned randomly to one of five treatments: no supplement (NS), cracked corn (C), cracked corn with monensin (CR), soybean hulls (S), and soybean hulls with monensin (SR). Supplements were fed daily at 0.4% of mean BW; Rumensin-80® was added at 0.15% of supplement. Grazing began in Dec. or Jan. and ended in May each yr (average 136 d). There were differences ($P<0.01$) in gain response to treatments among years, but the treatment by year interaction was not significant ($P=0.40$). Steers fed supplements gained more over the entire grazing season (170 vs 161 kg) than those not receiving supplements ($P=0.06$), and cattle supplemented with soyhulls gained more (174 vs 165 kg) than those supplemented with corn ($P=0.03$). There was a significant ($P=0.04$) supplement x monensin interaction such that addition of monensin resulted in consistently greater gains for corn but not for soyhulls each year. Average forage height tended to be shorter ($P=0.12$) in non-supplemented paddocks compared with supplemented paddocks, but there were no differences across treatments in forage quality. These data are consistent with studies in which use of carbohydrate supplements with lower quality forages were evaluated, indicating that supplements containing readily degradable structural carbohydrates result in better forage utilization than supplements containing highly fermentable nonstructural carbohydrates.

Key Words: Stocker cattle, Ryegrass, Soybean hulls

243 The effect of an extruded-expeller soybean meal on milk production in grazing dairy cows. J.M. Hernandez Vieyra*, [1]*SOYTECH SA, Buenos Aires, Argentina*.

Argentine dairying is based on grazing alfalfa and other pasture crops plus supplementation with grains and byproducts. Pasture production and quality is higher during Spring, when is suspected that improving protein quality would not have any positive result. One hundred and thirty six first lactation Holstein cows averaging 75 days in milk (DIM) and 21.18 kg of milk were used in a 75 days repeated measurements experiment to determine the response to a high RUP source (SoyPlus, West Central Coop, Ralston, IA) in a typical commercial grazing dairy farm in Argentina. The study duration was from September 9 through November 11 (Spring). Cows were blocked by DIM and milk yield and randomly assigned to two treatments: Control (C) and SoyPlus® (SP). Cows strip grazed an alfalfa pasture and a winter oats pasture after each milking, and were located at both sides of the central path of the same plot, to ensure they received the same pasture quality. Strips of both pastures were moved daily, and strips sizes were determined in order to allow high pasture residual after grazing to guarantee cows ate pasture *ad libitum*. Alfalfa pasture and winter oats pasture had 23 and 18 %CP; 33 and 40 % NDF, respectively. Both groups received before milking, 8kg of a concentrate: C 53% high moisture corn (HMC) and 47% corn gluten feed (CGF) and SP 74% HMC, 13% CGF and 13% SoyPlus®. C and SP concentrates had 15.5 and 15.8 % CP, and 37.4 and 50.1 % RUP respectively. Milk yield was measured before blocking groups on August 23 (wk0), and during the trial on wk3, wk5, wk6, w11. Milk production at wk 0 was the same ($P< .98$) in both groups, when all cows received the same C diet. Milk yield was higher ($P<.01$) for SP during all the trial, being maximum on wk 6, about 100 DIM. Cows on SP produced significantly ($P<.01$) more milk than C, 26.59kg (SEM 0.46) vs 23.15kg (SEM 0.41), respectively. The addition of SoyPlus®