gain weight (average = +4.25% BW) or fed below NRC requirements (nutrient restricted; NR) to lose weight (average = -6.8% BW) from day 30-125 of gestation. On day 126 of gestation NR cows were realimented so as to achieve the same BW and BCS as controls as d250 of gestation. Parturition occurred naturally. Pulmonary arterial pressure of 15-mo-old steers from C or NR cows were measured before slaughter (values ranged from 40-114 mmHg). Hearts were collected from steers, separated into right and left ventricles, atria, and septa and weighed. Ventricle thickness was recorded. Right ventricle mRNA from high PAP (n=4; 2 C and 2 NR) and low PAP (n=4; 2 C and 2 NR) were used for Affymetrix bovine gene chips (contains 25mer probes per gene) screening. Gene chip data was analyzed by two-way ANOVA. Right ventricular weight (corrected by total body weight; r^2=0.76; $P < 0.05$) and thickness (r^2=0.53) were correlated with increased PAP. Screening of steer right ventricles from low PAP and high PAP control fed steers revealed that 177 genes were differentially expressed. Right ventricles from NR low PAP steers revealed 42 differentially expressed genes (≥2 fold) when compared to C steers. Our study suggests that maternal NR programs gene expression in the fetal heart possibly affecting sensitivity of the steer heart to stress by 15 months of age. Differential programming of right ventricular gene expression in the fetus during early gestation may be detrimental to animal health, particularly at high altitude. Supported by NIH INBRE 1P20RR16474.

Key Words: Brisket disease, Gene expression, Undernutrition

W29 - See abstract number 77.

Dairy Foods: Cheese, Products, and Processing

W30 Probiotic properties of the *Candida kefyr* isolated from kefir. S. J. You[1], J. K. Cho[1], C. G. Ha[2], C. H. Kim[1], and K. C. Heo*[1], [1]*Hankyong National University*, *Anseong, Gyonggi, Republic of Korea*, [2]*Hanyang University*, *Ansan, Gyonggi, Republic of Korea*.

In this study, *Candida* sp. was isolated from Kefir grains and tested as a potential probiotic. The isolated strain was identified as *Candida kefyr* with 99.8% identity to the species of *C. kefyr* by a sugar fermentation test kit. The yeast strain was higher in amylase activity compared with its phytase, cellulase and xylanase activities. The growth curve of the isolated strain reached a peak at 30h incubation with 1.4×10^{10} CFU/ml. Because probiotic organisms should be acid and bile tolerant, qualitative analyses were carried out using the isolated strain. After exposure to acidic condition(pH2), the strain was able to grow in PD medium up to $1x10^8$ CFU/ml compared with 8×10^9 CFU/ml at pH 5. Irrespective of the presence of bile acid, growth was observed in the strain cultured in medium containing 1.0% bile salt. Especially, *C. kefyr* showed high heat stability in which the microbial counts of the strain was 37.5% at 60°C incubation compared with those at 30°C incubation. *Candida kefyr* was grown in PD medium containing 13 antibiotics with 5 different addition levels and it was mostly not inhibited by 11 antibiotic agents which belong to tetracycline groups. The results indicated that the isolated *C. kefyr* from Kefir grains could be a useful probiotic for animal production due to its strong resistance in acid and thermal conditions and antibiotics.

Key Words: Kefir, *Candida Kefyr*, Probiotics

W31 Volatile fraction of Sicilian Pecorino cheese: Comparison of raw and pasteurized milk cheese. T. Rapisarda[1], S. Carpino*[1], G. Azzaro[1], and G. Licitra[1,2], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A. Catania University*, *Catania, Italy*.

SPME coupled to gas chromatography/mass spectrometry/olfactometry was used to identify and compare the relative amounts of the volatile compounds of raw (RM) and pasteurized Pecorino (PM) cheese from animal on pasture. Cheese samples were analyzed at 4 days, 1, 3, 6, 9 and 12 months of ripening. The majority of volatile compounds were more abundant in RM cheeses. Volatile compounds related to the families of free fatty acids, fatty acid esters, aldehydes, alcohols, ketones and sulfur compounds were detected in RM and PM Pecorino cheese profiles. Acetic acid and hexanoic acid, 2-butanol, 2,3-butanediol and ethoxy propanol, diethyl acetal, phenyl ethyl alcohol and ethyl dimethyl thiazole, hexanoic acid 1-methylpropyl ester and methyl nonanoate, 1-octen-3-one, diethyl methyl pyrazine and sulfur compounds like thiophene and dimethyl trisulfide were exclusively detected in RM cheeses likely due to the pasture diet and to the wild microbial communities presented in raw milk. Only a few exclusive compounds were detected in PM cheeses: benzaldehyde, benzaldehyde-4-methoxy, 2-undecanone, showing that milk pasteurization might determine lower levels of volatile compounds. Other relevant volatile compounds: (E)-2-nonenal, (Z)-2-nonenal and decadenal derived from oxidation of insaturated fatty acids in plants and monoterpenes: (Z)-linalool oxide, nerol oxide, (E)-limonene oxide and isogeraniol derived from secondary plant metabolites, were detected only in RM cheeses. The greater presence of these volatile compounds in RM cheeses suggests that the influence of pasture and indigenous microflora of milk was reduced by the pasteurization process. In general, raw and pasteurized Pecorino cheeses volatile profiles increased for intensity and number of compounds with aging, with RM cheeses always showing richest volatile profiles at all different ages. Peculiar odor notes for raw milk Pecorino cheeses were green, hay, mushroom, nutty, garlic and floral, produced, respectively, by aldehydes, ketone, pyrazine, sulfur compound and terpene.

Key Words: Pecorino cheese, Raw/pasteurized milk, Volatile compounds

W32 Characteristics of reduced fat milks as influenced by the incorporation of folic acid. K. Achanta, C. A. Boeneke*, and K. J. Aryana, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Milk and milk products serve as a beneficial source for folic acid fortification due to the presence of folate binding proteins which seem to be involved in folate bioavailability. Folic acid fortification plays an important role in the prevention of neural tube defects such as spina bifida and ancencephaly, heart defects, facial clefts, urinary abnormalities and limb deficiencies. Though milk is not a good source of folic acid, fortification could help in the prevention of the above mentioned defects. The objective of this study was to examine the physico-chemical characteristics of reduced fat milks fortified with folic acid. Reduced fat milks were prepared using 25, 50, 75 and 100% of the recommended dietary allowance of 400 micrograms of folic acid. Treatments included addition of folic acid at these levels before and after pasteurization. Color, pH, fat , protein, viscosity, folic

acid concentration, folate binding protein concentration, folate binding protein profile, standard plate count and coliform count were determined on days 1, 7, 14 and 21. A consumer acceptance test was conducted on day 7. Data were analyzed using the General Linear Model with repeated measures in time by the Statistical Analysis System. Significant differences were determined at $P < 0.05$ using Tukey's Studentized Range Test. There were no differences in the electrophoretic mobility of folate binding protein in samples. The concentration of folic acid was significantly higher in reduced fat milks fortified with folic acid after pasteurization. The consumer panelists found no significant differences in flavor, appearance and texture of folic acid fortified reduced fat milks compared to control. Fortification of reduced fat milks with folic acid can be accomplished without adversely affecting product characteristics.

Key Words: Milk, Folic acid, Folate binding protein

W33 Removal of cholesterol from Blue cheese by crosslinked β-cyclodextrin. H. Y. Kim, H. Y. Bae, S. Y. Kim, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was carried out to determine the cholesterol removal rate and resulting changes in sensory aspects and fatty acid and amino acid productions in reduced-cholesterol Blue cheese, made by cream separation followed by 10% crosslinked β-cyclodextrin (β-CD) treatment, ripened for 8 weeks at 10°C, and stored for 4 weeks at 4°C. The cholesterol removal from the cheese was 92.8%. The TBA value was significantly increased up to 6 week ripening and maintained thereafter in both treatments. The production of short-chain fatty acids (FFAs) significantly increased during the ripening and storage periods up to 10 weeks and slightly decreased thereafter in both control and β-CD-treated cheeses. During ripening and storage periods, the production of total amino acids increased significantly. The quantity of short-chain FFAs and total amino acids released between treatments during ripening was not different. In rheological properties, brittleness score was significantly different between control and cholesterol-reduced cheese at 8 and 12 week ripening and storage. In sensory analysis, appearance, flavor, taste and texture properties were not significantly different between control and cholesterol-reduced Blue cheese after 8 week ripening and 4 week storage periods. In addition, overall acceptability in the cholesterol-reduced cheese was closely similar to that in control. On the basis of our results, we conclude that the crosslinked β-CD-treated cream Blue cheese showed a sufficient cholesterol removal rate and no adverse changes in sensory characteristics.

Key Words: Blue cheese, Crosslinked β-cycledextrin, Cholesterol removal

W34 Effect of crosslinked β-cyclodextrin treatment on cholesterol removal and chemical and sensory properties in Feta cheese. H. Y. Bae, H. Y. Kim, T. H. Jung, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was designed to examine the cholesterol removal rate and resulting changes in chemical, rheological and sensory characteristics in reduced-cholesterol Feta cheese. For cholesterol removal, separated cream was treated with 10% crosslinked β-cyclodextrin (β-CD) at 1,400 rpm, then blended with remaining skim milk and homogenized with 500 psi at 50°C. After 12 weeks of storage at 4°C, the cholesterol removal from the cheese was 90.2%. The TBA value was significantly lower in reduced-cholesterol cheese after 6 weeks of storage and thereafter, compared with that in control. The production of short-chain fatty acids (FFAs) significantly decreased during 12 weeks of storage and was markedly higher than control in reduced-cholesterol cheese in all periods. Most of rheological scores including cohesiveness, gumminess and brittleness were significantly higher in reduced-cholesterol cheese than those in control from 4 weeks until 12 weeks of storage. In sensory analysis, appearance, flavor, taste and texture properties were not significantly different between control and cholesterol-reduced Feta cheese during 12 weeks of storage. In addition, overall acceptability in the cholesterol-reduced cheese was highly similar to that of control in all periods. Therefore, the present study indicated that the crosslinked β-CD-treated Feta cheese showed over 90% cholesterol removal rate and no significantly adverse changes in chemical and sensory characteristics.

Key Words: Feta cheese, Crosslinked β-cyclodextrin, Cholesterol removal

W35 Changes of physicochemical and sensory properties of freeze-concentrated milk treated by ozone during storage. J. H. Hwang, S. J. Lee, S. H. Kim, J. Ahn, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

The present study examined the physicochemical and sensory properties freeze-concentrated milk treated with ozone treatment during storage. After the freeze-concentrated milk containing 27% of total solids was treated with 150 ppm of ozone for 5 min, 99% of microflora was eliminated, and the activities of protease, lipase and phosphatase were decreased to 93.3, 96.2 and 96.2%, respectively. When the freeze-concentrated milk was stored at 4°C for 18 days after ozone treatment, total bacteria count was initially 4.0×10^3 CFU/mL and reached 1.8×10^4 CFU/mL at 12th day, and increased up to 2.1×10^5 CFU/mL at 18th day. TBA absorbance of the freeze-concentrated milk was significantly lower than that of the evaporated milk at every storage period and increased proportionally to the storage periods. The production of individual free amino acids was similar to that of the evaporated milk samples. The amount of water soluble vitamins decreased proportionally to the storage periods and the higher amounts of vitamins were lost in the evaporated milk than in the freeze-concentrated milk. In sensory analysis, longer storage resulted in undesirable cooked flavor and color scores. Those scores were lower in the freeze-concentrated milk than in the evaporated milk. Overall acceptability was evaluated better with the freeze-concentrated sample than with the evaporated milk. Based on the above results, ozone treatment of the freeze-concentrated milk appeared to be an adequate process for pasteurization and enzyme inactivation with minimizing nutrient loss and keeping sensory quality during storage.

Key Words: Freeze-concentrated milk, Ozone treatment, Storage

W36 Effects of microencapsulated isoflavone and minerals in milk on serum and urinary calcium metabolism in ovariectomized rats. B. J. Jeon, N. C. Kim, K. H. Seon, H. S. Park, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was carried out to investigate the effects of microencapsulated water-soluble isoflavone and/or calcium and vitamin supplementation in milk on bone metabolism in ovariectomized rats. Thirty Sprague-Dawley rats of 6 week-old were divided into 2 groups (sham-operated and ovariectomized) and ovariectomized group was subdivided into 4

subgroups: 1) Sham, sham-operated and fed diet without supplement, 2) OVX1, ovariectomized and fed diet without supplement, 3) OVX2, ovariectomized and fed microencapsulated isoflavone added diet, 4) OVX3, ovariectomized and fed microencapsulated isoflavone, calcium, and vitamin D and K supplements added, and 5) OVX4, ovariectomized and fed calcium and vitamin D and K supplements added. Above supplements were consumed by dissolving in 1 mL milk. After 19 wk feeding, body weight gain and food intake efficiency ratio were significantly lower in Sham group than those in 4 OVX groups ($p < 0.05$). In blood analysis, the ratio of BALP (bone alkaline phosphatase) to TALP (total alkaline phosphatase) concentration was the lowest in OVX1 group (52.1%) and was the highest in OVX3 group (73.5%), which was supplemented with isoflavone, calcium, vitamin D and K. In addition, serum osteocalcin was the highest in OVX3 but not significantly different among OVX groups ($p > 0.05$). Serum calcium was higher in Sham group and OVX3 group such as 11.6 and 11.7 mg/dL compared with those in others ($p < 0.05$), while serum phosphorus concentration was not different among groups. In urine analysis, urinary deoxypyridinoline (Dpd) was relatively but not significantly lower in OVX3 group compared with those in other OVX groups. These results may indicate that isoflavone supplementation with calcium and vitamin D and K in milk enhances both bone forming and bone resorption processes in ovariectomized rats.

Key Words: Microencapsulated isoflavone in milk, Serum and urinary calcium metabolism, Bone forming process

W37 Effects of isoflavone fortified milk on bone mineral metabolism in ovariectomized rats. B. J. Jeon, N. C. Kim, K. H. Seon, H. S. Park, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was conducted to investigate the effects of microencapsulated water-soluble isoflavone and/or calcium, vitamin D and L supplementation in milk on bone loss in ovariectomized rats. Thirty Sprague-Dawley rats of 6 week-old were divided into 2 groups (sham-operated and ovariectomized) and ovariectomized group was subdivided into 4 subgroups: 1) Sham, sham-operated and fed diet without supplement, 2) OVX1, ovariectomized and fed diet without supplement, 3) OVX2, ovariectomized and fed microencapsulated isoflavone added diet, 4) OVX3, ovariectomized and fed microencapsulated isoflavone, calcium, and vitamin D and K supplements added, and 5) OVX4, ovariectomized and fed calcium and vitamin D and K supplements added. After 19 wk feeding, body weight gain and food intake efficiency ratio were significantly lower in Sham group than those in 4 OVX groups ($p < 0.05$). The lengths of femur and tibia were not significantly different among all groups, however, femoral weight was slightly but not significantly higher in OVX groups supplemented with isoflavone and/or calcium, vitamin D and K. Femoral BMD (bone mineral density) appeared to be greater in Sham and OVX3, which supplemented with microencapsulated isoflavone, calcium, vitamin D and K than those in other groups. BMD/body weight showed the similar trend to that of BMD. Among groups, no difference was found in bone strength including maximum energy and stiffness ($p > 0.05$). Trabecular bone areas (%) in tibia were slightly higher in Sham and OVX3 group. In histological bone tissue examination, Sham group showed that normal structure of bone tissue. On the other hand, OVX1 group, which was ovariectomized and no supplementation showed the reduced thickness, interconnection or number of trabecula and the destroyed bone matrix. Meanwhile, OVX2, 3, 4 groups increased thickness, number of trabecula compared to OVX1 group. The present study indicated that microencapsulated isoflavone and/or calcium, vitamin D and K supplementation in milk might have a potential role for preventing bone loss and enhancing bone sparing effects in ovariectomized rats.

Key Words: Isoflavone fortified milk, Bone mineral metabolism, Preventing bone loss

W38 Compositional differences between industrial sources of salty whey and sweet whey. K. Blaschek*, W. Wendorff, and S. Rankin, *University of Wisconsin*, *Madison*.

Salty whey is currently underutilized in the dairy industry because of high salt content and increased processing costs. Salty whey accounts for 2-5% of the whey generated during cheese manufacture. Since relatively little information is available on the composition of salty whey, this study was conducted to determine the range of analyses from commercial cheese plants. Gross compositional differences in percent protein, salt, solids, and fat between sweet whey and salty whey from various dry-salted cheeses from 8 commercial plants were determined. Differences between individual whey protein compositions were also determined using SDS-PAGE. Total solids, fat, and salt content were significantly greater in the salty whey as compared to the corresponding sweet whey. True protein was significantly reduced in salty whey. Individual whey proteins analyzed include lactoferrin (LF), bovine serum albumin (BSA), immunoglobulin G (IgG), β-lactoglobulin (β-LG), and α-lactalbumin (α-LA). Salty whey showed an increase in LF content and a decrease in α-LA and β-LG content when compared to sweet whey. Salty whey may be a source of LF, potentially increasing its value to whey processors. However, the compositional assessments show that salty whey is a highly variable waste stream from the commercial cheesemaking process.

Key Words: Salty whey, Lactoferrin, Whey proteins

W39 Effect of protein-to-fat ratio of cheese milk on the composition and yields of Cheddar cheese. T. Guinee*, E. Mulholland, J. Kelly, and D. O'Callaghan, *Moorepark Food Research Centre, Teagasc*, *Fermoy, Co. Cork, Ireland*.

The effect of protein-to-fat ratio (PFR) of cheese milk on the composition and yield of Cheddar cheese was investigated. Six cheesemaking trials, each with 4 different milk PFRs randomly selected from 24 target values in the range 0.70 to 1.15, were undertaken. The mean protein content of the cheese milks was 3.66 ± 0.1% (w/w). Cheese manufacture was standardized for starter-to-protein ratio (0.38 kg/kg protein), rennet-to-protein ratio (317 chymosin unit/kg protein), firmness of gel at cut (40 Pa), pH at set (6.55-6.6), pH at whey drainage (6.15) and pH at curd salting (5.25). The PFR values were divided into three groups (low, LPFR: 0.7 to 0.85; medium, MPFR: 0.88 to 1.0; and high, HPFR: 1.0 to 1.15) for statistical analysis using one-way analysis of variance (ANOVA). Linear regression analysis of the data was used to establish potentially significant relationships between the PFR of the cheese milk and the response variables such as cheese moisture and yield. Increasing the PFR significantly ($P < 0.05$) increased the levels of cheese moisture, protein, Ca and P, but significantly reduced the levels of moisture-in-non-fat substances, fat-in-dry matter and salt-in-moisture. The actual yield (Y_A) of the LPF cheese (11.73 kg/100 kg cheese milk) was significantly higher than the yield of the MPF (10.78 kg/100 kg) or HPF (10.33 kg/100 kg) cheeses. Y_A decreased linearly with PFR at a rate of of - 0.49 kg/100 kg cheese milk for every 0.1 unit increase in PFR. Cheese yield was also expressed as normalized yield, Y_{AFPRM}, which was defined as kg cheese per 100 kg milk with reference levels of fat (4.1%, w/w) and

protein (3.7 %, w/w). In contrast to actual yield, Y_{AFPRM} increased significantly with PFR by 0.14 kg/100 kg milk for every 0.1 unit increase in PFR. The mean Y_{AFPRM} for the LPF cheese (10.74 kg/100 kg milk) was significantly lower than for the MPF cheese (10.91 kg/100 kg milk) which in turn was lower than for the HPF cheese (11.19 kg/100 kg milk). Consistent with the trend for Y_{AFPRM}, the mean percentage milk fat recovered in the HPF cheese (88.3) was significantly higher than for the MPF (87.7) or LPF (86.5) cheeses.

Key Words: Protein-to-fat ratio, Milk, Cheddar cheese

W40 Utilization of lactoperoxidase system and/or microfiltration for manufacture of Cheddar cheese from raw milk. Y. Amornkul* and D. Henning, *South Dakota State University*, *Brookings*.

The objective of this study was to evaluate the application of microfiltration (MF) and/or the raw milk lactoperoxidase system (LP) to improve the safety of raw milk cheeses. For this purpose, *Escherichia coli* K12 was selected to be added to raw milk for studying survival as a nonpathogenic surrogate organism for pathogenic *E. coli* and *Salmonella* spp. Five replications of 6 treatments of Cheddar cheese were manufactured. Each replication involved separation of skim and cream and microfiltration of a portion of the skim with 1.4 µm pore size. Cheese milks were then prepared by blending skim and cream portions and proceeding with the treatments. The 6 treatments included: cheeses made from pasteurized milk, raw milk, raw milk inoculated with *E. coli* K12, raw milk inoculated with *E. coli* K12 + LP activation, raw milk inoculated with *E. coli* K12 + MF, and raw milk inoculated with *E. coli* K12 + MF + LP activation. *E. coli* counts were done at 1, 14, 30, 60, 90, and 120 days of ripening time. Results indicate that there was a significant ($P < 0.05$) decrease in *E. coli* populations in all cheeses during ripening. However there was a large variation in the counts among replications during ripening. In addition, no significant ($P > 0.05$) effect of treatments on *E. coli* populations in cheeses during ripening was observed. Also results based on the percent decrease of *E. coli* K12 during ripening, the decrease in *E. coli* population was similar among treatments. These results suggest that survival of *E. coli* K12 present in cheeses depends on the microenvironment (pH, aw) rather than the treatments given to the milk used for manufacturing cheese. Hence it is inferred that if we can lower the *E. coli* counts in the cheese milk, we will lower the number of *E. coli* in the cheese. Application of MF, LP and MF+LP led to an average percent reduction in *E. coli* counts by 75, 85, and 95% respectively. Hence, utilization of MF in combination with LP activation can be an effective technique in reducing the counts of *E. coli* in raw milk cheeses.

Key Words: Raw milk cheese, Microfiltration, Lactoperoxidase

W41 Characterization of Queso Fresco cheeses manufactured in Mexico and the United States. D. L. Van Hekken*[1], M. H. Tunick[1], J. A. Renye[1], B. Vallejo-Cordoba[2], and A. F. Gonzalez-Cordova[2], [1]*USDA, ARS, ERRC*, *Wyndmoor, PA*, [2]*CIAD, A.C.*, *Hermosillo, Sonora, México*.

Queso Fresco is a fresh, high moisture, white, rennet-set cheese that is the most popular Hispanic-style cheese in the US and Mexico. Traditionally, Mexican Queso Fresco is made with raw milk although the use of pasteurized milk is slowly replacing this practice. In the US, the FDA mandates that cheeses, such as Queso Fresco, sold less than 60 d after manufacture must be made with pasteurized milk. Queso Fresco has not been studied extensively and it is not known if the pasteurized milk cheeses are different from the raw milk originals. In this study, the compositional (moisture, fat, protein, and salt) and physical properties (whiteness value, water activity, and pH) of Queso Fresco from 6 commercial cheese plants in Sonora, Mexico (4 using raw milk and 2 using pasteurized milk) were characterized and compared to 8 commercial US-made cheeses. In composition, raw milk cheeses were higher in moisture (58-60%), and lower in fat (20-24%) and protein (15-17%) than the pasteurized milk cheeses from Mexico and the US (47-52% moisture, 23-36% fat, and 18-24% protein); the US-made cheeses contained more salt than the Mexican-made cheeses (1.2-1.9% and 0.7-1.2%, respectively). In physical properties, all cheeses were bright white (whiteness L* values of 92-93) whereas raw milk cheeses had higher water activities (0.980 to 0.998) than the pasteurized cheeses (clustered near 0.975). The pH values of Mexican-made cheeses ranged from 4.8 to 6.0 whereas the pH values of US-made cheeses were above 6. The differences in manufacturing techniques, the unique microflora presence in the raw milk, and the excessive acid production in some of the cheeses contributed to the differences noted in composition and physical properties of the Queso Frescos. Establishing the basic chemical and physical properties of Queso Fresco is the first step in understanding the unique quality traits of this cheese and identifies traits that need to be maintained in pasteurized versions.

Key Words: Hispanic, Cheese, Queso fresco

W42 Manufacture of fresh soft cheese (Domiati-type) from camel milk using ultrafiltration process. M. A. Mehaia*, *Qassim University*, *Buriedah, Qassim, Saudi Arabia*.

Manufacturing procedures and composition of fresh soft cheese (Domiati-type) manufactured from camel milk using ultrafiltration (UF) and traditional processes were investigated. Cheese yield, recovery of protein, fat and total solids, and sensory characteristics of the cheese manufactured with two starter cultures were also evaluated. UF process showed reduction rates of 88.5, 83.3, 88.4 and 85.9% in salt, calcium chloride, starter culture and rennet added, and 80% in processing time and 77% in milk used in processing, respectivily. The cheese manufactured by UF process was higher in pH and moisture contents, whereas the protein and fat contents were lower in cheese manufactured by the traditional method. Increment rates achieved by UF process were 45% in cheese yield, 40% in protein recovery, 42% in fat recovery and 40% in total solids recovery. For sensory characteristics, the mean scores for apperance, texture, flavour and overall acceptability of the cheese manufactured by UF process were significantly higher ($P<0.05$) than those scores recorded by the cheese manufactured by the traditional method. The UF process investigated in soft cheese has the potentiality for developing a cheese with good yield and acceptability from camel milk.

Key Words: Ultrafiltration, Domiati cheese, Camel milk

W43 Modifying the functionality of reduced-fat Mozzarella cheese by reduction of calcium level or by the addition of emulsifying salts during curd plasticization. J. A. O'Mahony, E. O. Mulholland, and T. P. Guinee*, *Moorepark Food Research Centre*, *Teagasc, Fermoy, Co. Cork, Ireland*.

The objective was to simulate the characteristics of low-calcium (18.8 mg calcium/g protein) reduced-fat Mozzarella cheese by blending emulsifying salts (ES) with hot plasticized curd containing a normal

level of calcium (28.8 mg calcium/g protein). Reduced-fat Mozzarella (RFM) with normal (NC) or low (LC) calcium levels were made on two separate occasions using chemical acidification of the cheese milk and plasticizing the curds (NC at pH ~ 6.0, and LC at pH 5.65) in hot water (80°C) to a curd temperature of ~ 59°C. Following plasticization, the hot molten NC Mozzarella curd was immediately blended with either trisodium citrate (TSC) or disodium phosphate (DSP) for 8 min at 59°C. TSC was added at levels (%, w/w) of 0 (NC), 0.5 (NCTSC0.5) or 1 (NCTSC1.0), and DSP at levels (%, w/w) of 0.5 (NCDSP0.5) or 1 (NCDSP1.0). The pH values of the ES-treated curds were reduced to that of the NC curd by the addition of lactic acid. The cheeses were evaluated after 12 d storage at 4°C. The mean moisture (%, w/w) and pH values of the LC and NC cheeses were 61.7 and 5.9, and 49.7 and 5.95, respectively. The addition of TSC or DSP did not affect the composition of the cheeses. The mean level of water-soluble N, as % total N, in the NCDSP1.0 cheese (9%) was notably higher than that in the other cheeses (1 – 3.6%). The mean firmness (force at 70% compression) of the cheeses decreased in the following order: NCTSC1.0 ≈ NC > NCTSC0.5 > NCDSP0.5 > NCDSP1.0 >> LC. The mean flowability of the heated cheeses, as measured by modified Olson and Price and Schreiber methods, increased in the following order: NC ≈ NCTSC0.5 < NCTSC1.0 ≈ NCDSP0.5 << NCDSP1.0 ≈ LC. The stretchability of the heated cheese, as measured by uniaxial extension at a fixed velocity, increased in the order NC ≈ NCTSC0.5 ≈ NCTSC1.0 ≈ NCDSP0.5 < NCDSP1.0 <<< LC. The results show that the functionality of low calcium RFM cheese could be partly imitated by blending 1% DSP with hot plasticized curd containing a normal calcium level.

Key Words: Reduced-fat Mozzarella, Calcium level, Emulsifying salts

W44 Impact of exopolysaccharide-containing base cheese on characteristics of reduced fat process cheese. S. Awad, A. N. Hassan*, and V. Mistry, *MN-SD Dairy Foods Research Center, Dairy Science Department*, *Brookings, SD*.

Fat reduction in cheese is associated with many textural and functional defects. The quality attributes of process cheese are greatly influenced by the composition and nature of base cheeses. The objective of this study was to evaluate textural, viscoelastic and functional characteristics of reduced fat process cheese made from exopolysaccharide (EPS)-containing Cheddar cheese. Reduced fat process cheeses were manufactured using a 50/50 mixture of young (2 days) and aged (6 months) reduced fat Cheddar cheeses made with EPS-producing or non-producing cultures. In addition, a full fat process cheese made with no EPS was also employed in this study. Moisture and fat were standardized to 40 and 32.5% for full fat cheese and 49 and 21% for reduced fat cheese respectively. Reduced fat process cheeses made from Cheddar cheese containing no EPS were firmer, and more chewy and gummy than those made from EPS-positive Cheddar cheese. Reduced fat process cheese manufactured from EPS-positive Cheddar cheese had lower viscoelastic moduli and increased meltability. Creep/recovery test showed that EPS-positive process cheese was more deformable and did not recover its original structure as much as the EPS-negative one did. Sensory results correlated well with instrumental data. The highest sensory scores were obtained when both young and aged cheeses contained EPS. Full fat cheese was harder, chewier, gummier and less deformable than reduced fat cheeses, which might be due to the lower moisture content in the former cheese. In conclusion, EPS-containing base cheese could be used to improve texture and functionality of reduced fat process cheese.

Key Words: Reduced fat process cheese, Exopolysaccharides, Texture and functionality

W45 Substituting aged cheese with exopolysaccharide-containing base cheese in making process cheese. S. Awad, A. N. Hassan*, and V. Mistry, *MN-SD Dairy Foods Research Center, Dairy Science Department*, *Brookings, SD*.

Young Cheddar cheese is characterized by excessive firmness, curdy and rubbery texture, poor meltability and lack of flavor. In a previous study, exopolysaccharide (EPS)-producing cultures improved melting, viscoelastic and textural properties of young reduced fat Cheddar cheese (Hassan et al., JDS 88: 4221-4227; Awad et al., JDS 88: 4204-4213). Since base cheese has a direct impact on the characteristics of process cheese, we hypothesized that the use of EPS-producing cultures in making base Cheddar cheese would allow the utilization of more young cheeses in making process cheese. Reduced fat process cheeses were manufactured using young (2-day) or 1-month old reduced fat Cheddar cheese made with EPS-producing or non-producing cultures. Moisture and fat of process cheese were standardized to 49 and 21%, respectively. Enzyme modified cheese (EMC) was incorporated to provide flavor of aged cheese. Exopolysaccharide-positive process cheese was softer, less chewy and gummy, and more deformable than the EPS-negative cheeses. Process cheese manufactured from EPS-containing Cheddar cheese exhibited lower viscoelastic moduli and softening temperature. The hardness, chewiness and viscoelastic moduli were lower in process cheese made from 1-month old Cheddar cheese than those in process cheese made from 2-day old cheese. Larger differences were observed between process cheeses made from 1-month old EPS-positive and negative base cheeses than those between process cheeses made from the corresponding young base cheeses. This could be because of more extensive proteolysis in the EPS-positive Cheddar cheeses than in the EPS-negative cheeses due to their higher moisture content. Sensory scores for texture of EPS-positive process cheeses were higher than those of the EPS-negative ones.

Key Words: Reduced fat process cheese, Exopolysaccharides, Texture and functionality

W46 Evaluation of isolated starter lactic acid bacteria in Ras cheese ripening and flavour development. S. Awad*, N. Ahmed, and M. El-Soda, *Department of Dairy Science, Faculty of Agriculture, Alexandria University*, *Egypt*.

Twenty six cultures of starter lactic acid bacteria isolated from Egyptian dairy products with or without added adjunct cultures of lactobacilli and micrococci were evaluated in experimental Ras cheese for flavour development. Chemical compositions of experimental cheeses were within the legal limit for Ras cheese in Egypt. All cultures used in this study had no effect on chemical composition of Ras cheese during ripening. Very significant variations in free amino acids, free fatty acids and sensory evaluations have been found among the cultures used in Ras cheesemaking. The levels of free amino acids and free fatty acids were correlated well with flavour development in Ras cheese. Six of the tested cultures produced acceptable flavour and texture of Ras cheese. The highest overall score of flavour intensity, flavour and texture acceptability were in cheese made using thermophilic lactic

culture in addition to adjunct culture of Lactobacillus helveticus, Lactobacillus paracasei subsp paracasei and Lactobacillus delbrueckii subsp lactis. This culture can be recommended for Ras cheese manufacture using pasteurized milk.

Key Words: Ras cheese, Lactic acid bacteria, Adjunct culture

W47 Utilization of lactoperoxidase system and/or microfiltration for manufacture of Cheddar cheese from raw milk: Proteolysis and sensory characteristics. Y. Amornkul* and D. Henning, *South Dakota State University*, *Brookings*.

The objective of this study was to evaluate the influence of microfiltration (MF) and/or the raw milk lactoperoxidase system (LP) on the proteolysis and sensory characteristics of raw milk cheeses. Five replications of 6 treatments of Cheddar cheese were manufactured. Each replication involved separation of skim and cream and microfiltration of a portion of the skim with 1.4 µm pore size. Cheese milks were then prepared by blending skim and cream portions and proceeding with the treatments. The 6 treatments included: cheeses made from pasteurized milk, raw milk, raw milk inoculated with *E. coli* K12, raw milk inoculated with *E. coli* K12 + LP activation, raw milk inoculated with *E. coli* K12 + MF, and raw milk inoculated with *E. coli* K12 + MF + LP activation. The cheeses were analyzed for changes in pH 4.6 soluble nitrogen (N), starter and non-starter lactic acid bacteria (NSLAB) populations from 1 day to 120 days of ripening. Starter and NSLAB populations were determined on M17 and acidified (pH 5.4) MRS agars respectively. Cheese samples were evaluated for sensory characteristics at 60 and 120 days by 8 trained panelists. Results of pH 4.6 soluble N (expressed as % total protein) were similar among treatments; however, it increased ($P< 0.05$) by 3 to 5 times during 120 days of ripening. While starter populations decreased ($P< 0.05$) during ripening, NSLAB populations increased ($P< 0.05$) during ripening. Rate of increase and total populations of NSLAB were influenced by treatments. Cheeses made from raw milk with/without LP had higher levels of NSLAB as compared to cheeses made from pasteurized milk, MF milk with/without LP. Sensory attributes of the cheeses indicate that cheeses did not differ in certain attributes such as acid taste, bitterness, curdiness, and mealiness. Other attributes such as sulfide and unclean, crumbliness, firmness, shortness, overall flavor, body and texture, and appearance were different among treatments. Overall sensory acceptability was higher for pasteurized or MF cheeses as compared to raw milk cheeses.

Key Words: Raw milk cheese, Sensory, Proteolysis

W48 Effect of the addition of *Lactobacillus reuteri* over the shelf life of Oaxaca-type cheese. M. Montero-Lagunes*[3], E. Paz-Gamboa[1], E. Herman-Lara[1], P. Valencia-Perez[1], and H. Garcia-Galindo[2], [1]*Instituto Tecnológico de Tuxtepec*, *Tuxtepec, Oax. Mexico*, [2]*Instituto Tecnológico de Veracruz*, *Veracruz, Ver. Mexico*, [3]*Campo Experimental La Posta*, *Veracruz, Ver. Mexico*.

The conditions of transport and storage in Oaxaca-type cheese cause the development of pathogenic bacteria like Salmonella spp. For this reason and in order to increase its shelf life, *L. reuteri* as probiotic bacteria was used. The cheeses were produced in triplicate with pasteurized milk at 63° C for 30 min and cooled to 35° C. Mesophilic culture of trademark EZAL was used as starter *L. reuteri* was added by aspersion to concentrations of 7.5, 10 and 12.5% to the cheeses after its manufacture, and a control without *L. reuteri* was produced. During the manufacture and storage of cheeses, viability of *L. reuteri* was determined. The proteolysis like bioquemical change was evaluated. Physicochemical analyses were determined according to AOAC, Mexican norms were used for the microbiological analysis. Results showed that *L. reuteri* survived well in the cheeses kept at 6° C for 20 days and remained between 1.08×10^6 to 1.29×10^6 cfu/g of cheese. No significant difference was observed between cheeses produced with or without addition of *L. reuteri* for fat and protein. However significant differences in moisture, protein and proteolysis between the cheeses added with 12. 5 % of *L. reuteri* were observed. Presence of coliforms, *Staphylococcus aureus* and salmonella were not detected in the obtained cheeses except at the control. Amount of fungi and yeasts stayed within the permissible values by the Mexican Official Norms. The results indicate that the addition of *L. reuteri* to 7,5 % showed an excellent viability during a time of storage of 20 days being able to be an alternative of production for this type of cheeses. This help to their life of shelf, overall will provide the most effective means to prevent growth of salmonella.

Key Words: Cheese, Shelf life, Probiotic

W49 Acceptability of cream cheese. M. Almena*, N. Losambe, and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Hot-pack cream cheese is an acid-coagulated cheese that is heated and homogenized during manufacture and contains stabilizers to increase spreadability and decrease syneresis. Cream cheeses made using more traditional technologies and ingredients have been gaining in popularity in the U.S. as a result of renewed interest in artisan and organic cheeses. The goal of this study was to explore the acceptability of a variety of commercially available plain cream cheeses. Three samples of cream cheese: a hot-pack style, an organic version, and an artisanal variety made without stabilizers, were evaluated by consumers enlisted at a coffee/bagel shop and a supermarket that specializes in natural/gourmet foods. One group of consumers (91) compared the hot-pack (HP) cheese containing stabilizers vs. the organic sample which also contained stabilizers; a second group (105) compared the HP-sample vs. the sample without stabilizers. Both groups were asked to select the favorite sample and to rank the overall acceptability, appearance, texture and flavor of the 2 samples using a 9-pt hedonic scale. Demographic data and cream cheese eating habits information were also collected. Data were statistically analyzed by ANOVA and Chi-square tests using SPSS. There was a significant preference overall for the hot-pack cream cheese. The HP-sample was preferred by 74% of the individuals when compared to the organic cheese and by 75% when compared to the artisanal cheese without stabilizer. The HP-cream cheese also scored significantly ($P < .05$) higher for all the characteristics when compared to the other 2 cheeses, especially vs. the artisanal sample without stabilizers. Chalky, dry, gritty and sour were the main dislike attributes identified for the artisanal cheese, while natural, not slimy, sharper and tangy flavor were the main positive attributes. Although the artisanal cheese without stabilizers received lower acceptability scores, consumers did not dislike the cheese but took exception to it's designation as cream cheese. No significant differences were found between genders in terms of preference for any of the products evaluated.

Key Words: Cream cheese, Acceptability

W50 Characteristics of Swiss cheese manufactured with adjunct *Lactobacillus* strains using low cooking temperature. N. A. Kocaoglu-Vurma*[1], W. J. Harper[1], M. A. Drake[2], and P. D. Courtney[1], [1]*The Ohio State University*, *Columbus*, [2]*North Carolina State University*, *Raleigh*.

The use of *Lactobacillus casei* as an adjunct culture is common for Swiss-type cheese manufactured in Switzerland, however, few published reports exist on adjunct use and none exist for adjunct use in U.S.-manufactured Swiss cheese. The objective of this study was to establish the effect of nonstarter *Lactobacillus* adjunct cultures on Swiss cheese characteristics. Selected nonstarter *Lactobacillus* strains isolated from commercial cheeses were utilized as adjunct cultures for cheese manufacture. Cheeses were manufactured using a commercial starter combination and one of three previously isolated nonstarter *Lactobacillus* strains, *L. casei* A26, *L. casei* B21, and *L. rhamnosus* H2. Control cheeses lacked the adjunct culture. Cheeses were analyzed during ripening for microbial and chemical composition. The use of adjunct cultures reduced the variability in total *Lactobacillus* counts compared to cheeses manufactured without adjunct addition. There were no significant differences in protein, fat, moisture, and salt contents. The pH of the mature cheeses ranged from 5.4 to 5.5, and free amino acid concentration ranged from 5 to 7 mmol/100 g cheese. Lactic, acetic, and propionic acid contents of cheeses were not significantly different after a 90-day ripening period. Citric acid was depleted in cheeses manufactured with adjunct *L. casei* strains by the end of warm room ripening. Based on electronic nose and descriptive sensory analysis, cheeses made with adjunct *L. casei* A26 were most similar to the control cheese in development of particular flavor attributes.

Key Words: Swiss cheese, Adjunct culture, *Lactobacillus casei*

W51 Hydrolysis of caseins in Cheddar cheese: Effects of temperature and coagulants. P. J. Joseph*[1], D. J. McMahon[1], J. R. Broadbent[1], and C. J. Oberg[2], [1]*Utah State University*, *Logan*, [2]*Weber State University*, *Ogden, UT*.

Functional attributes of Cheddar cheese used in a wide variety of food products are critical to its applications and consumer acceptance. Functionality in turn is determined largely by the extent of hydrolysis. The objective of this study was to investigate the influence of coagulants and ripening temperature on the proteolysis in cheese, particularly the hydrolysis of large and hydrophobic peptides. Triplicate 400-kg batches of Cheddar cheese were made in open vats using *Lactococcus lactis* as starter with additional Lac- *L. lactis* and *Lactobacillus helveticus* adjunct cultures. Chymosin and *Cryphonectria parasitica* rennet, individually and combined (61/39%) were used as coagulants at 1X and 4X levels. Each of the above treatments were ripened for 6 months at 40 and 55°F. Proteolysis was monitored by RP-HPLC on a C8 Brownlee column with a Beckman Gold system. Trifluoroacetic acid (0.1%) and acetonitrile (80%) were used as the mobile phase, with the concentration of acetonitrile being raised from 40 to 60% over 30 min. Peptides over 3 kDa in size, and eluting at elution times ranging between 25 and 35 min were monitored. Changes in the peptide profiles over this time range occurred between 1 week and 2 months in cheeses at both 40 and 55°F. Total peak areas reduced between 2 and 4 months, indicating that these observed peptides may have gone from being relatively hydrophobic to hydrophilic, thus loosely binding with the column and eluting earlier. Cheeses having higher level of coagulant (4X) and at 55°F had ~90% of the intact caseins and large peptides hydrolyzed in 2 months. Chymosin, *C. parasitica* rennet and their combination did give peptide profiles that were apparently different at 2 and 4 months. These results suggest that higher levels of coagulants used in combination in cheese ripened at 55°F will hydrolyze large hydrophobic peptides that may play a role in functionality.

Key Words: Cheese ripening, Accelerated aging, Proteolysis

W52 Effect of sodium gluconate on the solubility of calcium lactate. C. Phadungath* and L. E. Metzger, *MN-SD Dairy Foods Research Center, University of Minnesota*, *St. Paul, MN*.

The typical concentration of calcium and lactate in Cheddar cheese are in excess of the solubility of calcium lactate at 4°C. Consequently, it is not surprising that calcium lactate crystals (CLC) are a common defect in Cheddar cheese. One approach in preventing CLC is to add sodium gluconate to cheese. Sodium gluconate can increase the solubility of calcium and/or lactate in the serum phase by forming metastable complexes with one or both of the calcium and lactate ions, and removing one or both of the calcium and lactate ions from being available for the formation of CLC. The solubility of anhydrous calcium lactate has been reported to be 3.38 and 6.41 g /100 g of water at 4 and 24°C, respectively, while the typical concentration of soluble calcium and lactate in the serum phase of Cheddar cheese is 1.06 g and 3.73 g /100 g water. The objective of this study was to determine if sodium gluconate could increase the solubility of calcium and/ or lactate. Seven calcium lactate solutions (5.31% calcium lactate) with seven level of sodium gluconate (0, 0.5, 1, 1.5, 2, 3, and 4%) were made in triplicate. The solutions were stored at 4°C for 21 days, and then were visually inspected for CLC formation. Subsequently, they were filtered at 4°C to remove CLC and the supernatant was analyzed for lactic acid and gluconic acid by HPLC and for calcium by Atomic Absorption Spectroscopy. The visual inspection demonstrated that CLC were formed in the solution with 0% gluconate after the first day of storage and CLC continued to accumulate over time. A minute amount of CLC was also visible in the solution with 0.5% gluconate after 21 days of storage, while CLC were not visible in the other solutions. The HPLC results indicated that there was a significantly ($P<0.05$) higher concentration of lactic acid in the filtrate from the solutions containing added gluconate. The calcium concentration was also significantly ($P<0.05$) higher in the filtrate from the solutions containing added gluconate. Therefore, it is apparent that sodium gluconate can significantly increase the solubility of calcium lactate.

Key Words: Calcium lactate crystals, Sodium gluconate

W53 Influence of adjunct cultures and accelerated ripening on texture and melting properties of Cheddar cheese. T. C. Rasmussen*[1], D. J. McMahon[1], J. R. Broadbent[1], and C. J. Oberg[2], [1]*Utah State University*, *Logan*, [2]*Weber State University*, *Ogden, UT*.

Changes in cheese physical properties during aging are related to proteolysis by coagulant and culture enzymes. Storage temperature also affects rate of aging. Cultures are important for flavor development, but less is understood about their role in textural and melting properties. Our objective was to make cheddar cheese using different cultures, to age it at 5 and 13°C, and measure physical properties over 6 months. Cheese was manufactured using *Lactococcus lactis* starter culture either alone or combined with one or both of lac- *Lc. lactis* or *Lactobacillus helveticus* adjunct cultures. Three replicates of cheese were made using 1500 lb milk. Cheese composition was 35.5±1.0% moisture, 52.5±2.5% FDB, 1.65±0.05% salt, and pH 5.2±0.1. All cheeses were initially stored at 5°C, then half were moved to 13°C after 21 d. Texture

profile analysis (TPA) was performed using 25% and 60% compression and melting measured using a Meltmeter at 65°C. After 2 months, differences in cheese properties were observed based on cultures and storage temperature. Cultures used had more effect on hardness and cohesiveness, while storage temperature had a large impact on adhesiveness. Using 25% or 60% compression produced different TPA values, especially when the cheese fractured during compression. At 25% compression, after 2 months, the cheeses made using *Lb. helveticus* had the highest hardness (av. 2365 g versus 1853 g), while the cheese stored at 13°C had more adhesiveness (av.18.3 versus 11.8). At 60% compression, the control cheese stored at 5°C had the highest hardness, as it was the only cheese that did not fracture during compression. Cheeses stored at 13°C melted faster (1.39 versus 1.29 mm/s) and further (82.5% versus 75.5% height reduction) than those stored at 5°C. Adding either adjunct cultures or raising the storage temperature can accelerate the aging of cheese thus changing its textural and melting properties. Loss of a fracture point during TPA using 60% compression is a characteristic of cheese ripening.

Key Words: Proteolysis, Hardness, Fracture

W54 Effects dietary supplementation of unsaturated fat, vitamin E, and sorbitol on fatty acid concentrations in milk and the properties of Cheddar cheese. F. Parada-Rabell*, M. L. Eastridge, C. J. Kuo, V. Alvarez, A. Todd, C. V. D. M. Ribeiro, and J. Engel, *The Ohio State University*, *Columbus*.

Feeding unsaturated fat alters the fatty acid profile of milk. Research has shown that dietary supplementation of soybean oil will alter the fatty acid profile in milk but not in the same manner as when feeding fish oil. Data are limited on fatty acid composition in milk when a combination of soybean and fish oils are fed. There is some evidence that increasing dietary concentration of vitamin E may affect fatty acid composition of milk, especially when feeding unsaturated fat. Even though sorbitol is being used in commercial feed, limited published data are available as to its effect on milk composition. Four lactating Holstein cows were used in a Latin square design for 3 wk periods, with milk collection occurring during wk 3 for composition analyses and production of cheddar cheese. Cows were fed 4 diets: 1) control diet (CNTL; 500 IU vitamin E), 2) 2% fish oil, 0.5% soybean oil, and 500 IU of vitamin E (FSO), 3) 2% fish oil, 0.5% soybean oil, and 2000 IU of vitamin E (FSOE), and 4) 1% sorbitol (SORB, dry form; 500 IU vitamin E). Cheese yield was lower for the diets containing oil (7.8% versus 9.6%). Moisture and solids concentrations were similar among the cheeses. Crude protein concentrations (40.8, 49.2, 50.2, and 43.1%, dry basis, respectively) tended to be lower for cheeses made from cows fed the control diet. Fat concentration tended to be lower in cheese from cows fed the FSOE diet (44.1, 31.2, 29.2, and 44.0%, dry basis, respectively). Regarding texture profile analysis, cheeses made from cows fed the FSOE and FSO diets were harder than those from CNTL and SORB (13.4 and 15.7, versus 5.8 and 6.6 kgf, respectively). Oil supplemented diets resulted in lower proportions of palmitic, stearic, linoleic, and saturated fatty acids and higher proportions of unsaturated fatty acids in milk. FSOE resulted in the highest proportion of unsaturated fatty acids in milk. These results suggest that milk from cows fed fish-oil diets will likely have less fat content, and thus the characteristics of the cheese, such as yield, texture, and protein-fat ratio, will be altered.

Key Words: Fish oil, Sorbitol, Cheddar cheese

W55 On-farm extraction of proteins from raw whole milk. A. Chand*[1,2], J. E. Swan[1], and C. J. Fee[3], [1]*The University of Waikato*, *Hamilton, New Zealand*, [2]*Dexcel Limited*, *Hamilton, New Zealand*, [3]*University of Canterbury*, *Christchurch, New Zealand*.

The concept of 'on-farm processing of dairy proteins' directly from raw, whole milk was investigated. Extracting proteins from raw, whole milk is impractical due to high levels of fat (an individual cow's milk can contain up to 10% w/v fat). Producing high-value dairy proteins such as lactoferrin (LF) and lactoperoxidase (LP) generally requires extensive pre-treatment (e.g. centrifuging, precipitation, Ca^{2+} chelation, filtration etc) to remove fat and caseins, before LF and LP can be extracted by ion exchange chromatography. Raw, untreated whole milk was processed in the laboratory through a 5-cm high column packed with SP Sepharose Big Beads™ without exceeding the maximum backpressure at milk secretion temperature (35-37°C). Data indicated that more than 100 column volumes of raw milk could be loaded at 300 cm/hr before LF and LP breakthrough occurred. Laboratory single-stage stirred tank trials showed that cation exchangers could capture 90% (SP Sepharose FF™, average particle size 90 μm) or 66% (SP Sepharose Big Beads, average particle size 200 μm) of the initial LF within 30 minutes. Absorption rate was faster on Fast Flow. A Protein Fractionation Robot (PFR) prototype based on a single-stage stirred tank system was designed, built and coupled to an Automated Milking System (Dexcel Ltd, Hamilton). Freshly-obtained, raw, whole milk from 16 individual cows was diverted to the PFR for extractions. The average yields of LF and LP using Big Beads resin were 36% and 87% respectively. Economic feasibility studies showed that an on-farm system for extracting high-value proteins is viable, especially if the farmer is paid on total solids basis with a premium for specialty proteins. This technology provides opportunity for complete product traceability. It can potentially give much higher recoveries of proteins that are thermally labile and/or undergo rapid degradation when processed under standard factory conditions.

Key Words: On-farm, Protein extraction, Lactoferrin

W56 Effect of processing on the composition and structure of buttermilk and of its milk fat globule membranes. P. Morin*[1], R. Jiménez-Flores[2], and Y. Pouliot[1], [1]*Stela Research Group, INAF, Université Laval*, *Québec, Canada*, [2]*Dairy Products Technology Center, Cal Poly*, *San Luis Obispo*.

The effect of pasteurization of the cream on the composition and microstructure of buttermilk after pasteurization, evaporation and spray drying was studied. The composition of MFGM isolated from the buttermilk samples was also characterized. Pasteurization of the cream induced a higher lipids recovery in the buttermilk. Spray-drying of buttermilk was found to have major effect on its phospholipid content and composition. Phospholipid content of buttermilk decreased in a proportion of 38.2 and 40.6% for buttermilk from raw and pasteurized cream respectively. Pasteurization of the cream induced the highest increase of whey protein recovery in MFGM isolates compared to all other processing steps applied on buttermilk. A reduction in the phospholipid content was also found in the MFGM isolates following spray drying. Transmission electron microscopy of the microstructure of buttermilks revealed extremely heterogeneous microstructures and could not reveal any effect of the treatments.

Key Words: Buttermilk, Milk fat globule membrane, Phospholipids

W57 Yogurt manufactured with an immune enhancer. C. Olga and K. J. Aryana*, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Arabinogalactan stimulates the body's immune defense system and enhances production of natural killer cells which destroy invading microorganisms. In human studies arabinogalactan showed increased immune cell proliferation at a consumption level of 1.5 g per day. The objective was to study the effect of the immune enhancer arabinogalactan on the physico-chemical, microbiological and sensory characteristics of yogurt. Arabinogalactan was added during mix preparation at 0, 1.5, 3.0 and 4.5 g per 228 g (8 oz) cup of yogurt. Total solids in the control compared to the treatments were kept constant with nonfat dry milk. The attributes studied were apparent viscosity, syneresis, pH, L*, a*, b*, C*, h*, flavor, appearance and color, body and texture, and microbial counts. Incorporation of arabinogalactan at all levels significantly increased C*, a* and b* but significantly decreased L* and h* values. Product pH was increased by the incorporation of arabinogalactan at 4.5 g per 228 g yogurt. The incorporation of arabinogalactan at any rate in yogurts did not significantly affect flavor scores, appearance and color scores, body and texture scores, apparent viscosity, microbial counts and syneresis of the product.

Key Words: Immune, Health, Fermented

W58 Heart healthy fat free yogurt. C. Olga and K. J. Aryana*, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Cardiovascular diseases ranks as America's No. 1 killer, claiming the lives of nearly 39 percent of more than 2.4 million Americans who die each year. The objective was to study the effect of heart healthy nutrients on yogurt characteristics. Heart healthy plain yogurts were manufactured by incorporating heart healthy nutrients namely thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), folic acid, manganese and magnesium at 0, 30, 60 and 90% of their respective recommended dietary allowance (RDA). Fiber was incorporated at a constant rate of 2.2% w/w mix in all the treatments since the amount of fiber would directly affect characteristics, such as viscosity, flavor and syneresis. The total solids in the control (no fiber, vitamins or minerals) were kept equal with the other yogurts by adding non fat dry milk. Viscosity, syneresis, pH, color, microbial counts of the yogurts were determined and the sensory (flavor, body and texture, appearance and color) evaluation was conducted at days 1, 7, 21 and 34 after yogurt manufacture. Incorporation of the heart healthy nutrients at the 30, 60 and 90 % significantly decreased syneresis, pH, L*, a* values but significantly increased b* and C* values. Product viscosity was significantly increased by the incorporation of the nutrients at 60% of their respective RDA's. The incorporation of heart healthy nutrients at any rate in yogurts did not significantly affect flavor, appearance, body and texture, microbial counts and h* values of the product. Incorporation of heart healthy nutrients affected some characteristics of fat free yogurts.

Key Words: Heart, Health, Fermented

W59 Yogurt manufactured using a novel dietary fiber with several health benefits. B. Trammell, K. J. Aryana*, and C. Boeneke, *Louisiana State University Agricultural Center*, *Baton Rouge*.

A novel fiber is being marketed as a dietary fiber with excellent physiological functions. It combines the advantages of the water-insoluble dietary fiber (microcrystalline cellulose) namely; improvement in bowel movements, increase in amount of feces, prevention of colon cancer and the advantages of the water-soluble dietary fiber (resistant maltodextrin) namely; lowering level of serum cholesterol, improving glucose tolerance and improving intestinal flora. The objective was to study the effect of this novel fiber on the physico-chemical, microbiological and sensory characteristics of yogurt. The novel dietary fiber namely Ceolus™ Fiber DF-17 was incorporated at the rate of 0, 0.5, 1, 1.5%w/v yogurt mix. Product manufacture was replicated three times. The apparent viscosities of the control and yogurt with 0.5% fiber were not significantly different from each other but had significantly lower viscosities compared to yogurts with 1 and 1.5% fiber incorporated. The control had significantly higher syneresis than the treatments. Within the treatments as the amount of the fiber increased the syneresis significantly decreased. The control had a significantly higher lightness (L*) value and significantly lower a* value compared to yogurts with fiber incorporated at the rate of 1 and 1.5%. There was no significant treatment effect for flavor (p=0.6630) and appearance (p=0.7398). There was a treatment effect for body and texture (p=0.0083). The control was significantly lower than the 1 and 1.5% indicating that increase in fiber to 1.5% favors body and texture of the product. Incorporation of Ceolus ™ Fiber DF-17 did not adversely affect the flavor and appearance of the product. Ceolus™ Fiber DF-17 addition favorably affected the viscosity, syneresis, body and texture of the product. Ceolus™ Fiber DF-17 can be recommended for incorporation to as high as 1.5% w/v in yogurts. It is possible to enjoy the health benefits of Ceolus™ Fiber DF-17 in yogurt.

Key Words: Fiber, Yogurt, Dairy

W60 Gross composition and nutrient profiles of Chinese yak (Maiwa) milk. J. Li*[1], Q. Sheng[2], M. Alam[1], X. Fang[2], and M. Guo[1], [1]*University of Vermont*, *Burlington*, [2]*Sanlu Group Co., Ltd.*, *Shijiazhuang, Hebei Province, P.R. China*.

Yaks are a major source of livelihood for the high landers where agriculture does not exist. This multipurpose animal has remained a subject of studies since the second half of 18th century. However, there is limited data available on the chemistry of yak milk in China. The objective of this study was to analyze the chemical composition and nutrient profiles of Chinese yak milk. Fresh milk samples from 7 mid-lactating yaks (Maiwa breed) in Hongyuan county of Sichuan Province in China were collected, pooled, lyophilized and stored at -20 °C before use. Gross composition (total solids, protein, fat, ash, and lactose), minerals, and profiles of fatty acids, amino acids and proteins of the milk samples were examined. The average values of gross composition were 14.35% total solids, 3.51% protein, 5.80% fat, 3.90% lactose, and 0.58% ash in the yak milk. The levels of Ca, Na, K, Mg, Zn, and Fe were 1149.4, 276.8, 1066.1, 105.3, 6.9, and 1.5 mg/L, respectively. Gas liquid chromatography analysis of milk fat showed that major fatty acids in yak milk were $C_{16:0}$, $C_{18:1}$, $C_{18:0}$, and $C_{14:0}$. There was a small amount (2.68 mg/g fat) of conjugated linoleic acid in yak milk. Results of amino acid analysis indicated that glutamic acid (183.79 mg/g protein) was the most abundant amino acid in yak milk. The mean values of lysine and methionine were 81.01 and 30.61 mg/g protein, respectively. The total essential amino acid percentage is 46.36% which suggests that the yak milk may be a good supply of essential amino acids. SDS-PAGE and densitometry results demonstrated that, similar to cow's milk, the major proteins in yak milk are caseins, which accounts for over 60% relative percentage of total proteins. The relative percentage of α-lactalbumin in yak milk was significantly lower ($P < 0.05$) compared to bovine milk. As information about yak milk chemistry is limited, especially in

China, more systematic studies in this area are needed in order to utilize this valuable resource.

Key Words: Chinese yak milk, Gross composition, Nutrient profile

W61 Development of a software program for goal oriented functional food formulation. Y. Yang*, S. Gokavi, X. Wu, and M. Guo, *University of Vermont*, *Burlington*.

Development of formulated functional foods is a complicated process that involves meeting many goals. Some of these goals may include matching the flavor and texture of other products of the same type, meeting regulatory requirements and compositional restrictions for appropriate quality and shelf-life, and meeting cost constraints. This process is referred to as goal oriented formulation. The objective of this study was to develop and test a computer program that uses a linear programming approach to aid in new product formulation to achieve required compositional goals. A computer program was designed to facilitate goal oriented formulation. The developed software has both formula and ingredient storage components. The entire USDA food composition database is available. The user entered formula specifications, such as amount of nutrients to be present in a particular formulation and the list of ingredients to be used in formulation. The user can also prepare a concise print out of the formulation that lists the amount of each ingredient to use plus any corresponding information and instructions. The software developed uses USDA data base for ingredients and their nutrient composition and can give several different recipes for one single product. One recipe can be selected based on its sensory qualities and cost of formulation. The developed software was found to be effective in determining the best recipe for a formulation, time saving, and easy to operate.

Key Words: Functional foods, Formulation, Software

W62 Organic butter and cheese: Preference, acceptability and consumer attitudes. M. Almena* and A. Howard, *University of Vermont*, *Burlington*.

Food acceptability is highly dependent by the sensory quality of the food, as well as social, cultural and economic conditions of the consumer. Consumers are willing to pay more for organic foods based on a number of preferences; however, the role of the sensory component is unclear. This study evaluated consumer sensory preference and acceptability of organic butter and cheeses (cheddar and cream cheese) comparing to their non-organic version. For each of the three products evaluated, two commercial samples (organic and non-organic) were tested using a face-to-face survey with consumers. A total of 85 individuals evaluated the butter samples and 91 evaluated the cheeses. Consumers were enlisted at a local coffee/bagel shop, as well as students from the University of Vermont. Overall acceptability and flavor of the products were evaluated using an increasing intensity 9-pt scale. In addition, the group of consumers evaluating cheese also scored the texture and appearance of the 4 samples. All the questionnaires included a section in which subjects were asked about demographic information and their purchase habits toward organic and dairy products. Data were statistically analyzed by paired t-tests, ANOVA and Chi-square tests using SPSS. There was a significant preference overall ($P = 0.015$) for the organic butter (65%) vs. non-organic (35%). Vermonters especially showed a greater preference for the organic product, and they also indicated to purchase organic butter more often than non-Vermonters (31% vs. 14%). For the cheese, there was a significant preference overall ($P = 0.001$) for the non-organic samples for both cheddar and cream cheeses. Only 20% of the individuals preferred the organic cheddar and 26 % the organic cream cheese. However, most of the individuals purchasing organic products noted that they rather would buy the organic cheeses even thought they preferred the non-organic product. No significant differences were found between genders in terms of preference for any of the products evaluated.

Key Words: Organic dairy products, Sensory, Acceptability

W63 Sensory evaluation of a novel ingredient produced from buttermilk. S. Jinjarak[1], P. Morin[2], A. Olabi[1], and R. Jimenez-Flores*[1], [1]*California Polytechnic State University*, *San Luis Obispo*, [2]*Laval University*, *Quebec City, Quebec, Canada*.

Buttermilk was concentrated by microfiltration (MF) and diafiltrated (DF) to half its original volume, and the resulting retentate was subjected to super critical fluid extraction (SFE). This process was applied to concentrate the phospholipids of the milk fat globule membrane. Chemical analyses were performed to determine protein, fat, lactose, solid, and ash content. Two types of models and statistical analyses were performed, first to compare four types of buttermilks with and without SFE treatment, and second, to compare the treatments (DF-SFE, MF-SFE, SFE, none) for whey buttermilk (WBM) and sweet cream buttermilk (CBM) only. For the first model, attributes generally related to defects such as cardboard, sour, rancid and salty properties were significantly different along with some appearance properties. SFE enhanced the quality of the ingredients by reducing the level of several undesirable attributes with only yellowness, viscosity and cooked aroma presenting significant differences. Lactose and ash content were significantly different with $p \leq 0.05$ and $p \leq 0.001$ respectively. As for the second model, yellow color was significantly different while several flavors were found to have more significant differences than appearance. The four treatments increased intensities of flavor attributes. MF and DF combined with SFE yielded higher mean scores over the other two treatments on cardboard flavor. Lactose was significantly different for CBM and WBM. Replicate effect was not significant for most attributes in both models. Grain, sweet, and buttery flavors were desirable factors and noted in all samples. The resulting ingredient had significant higher phospholipids, in particular sphingomyelin.

Key Words: Buttermilk, Sensory evaluation, Novel ingredient

Forages and Pastures: Grazing

W64 Effects of grazing management on pasture characteristics affecting sediment and nutrient loads in surface waters. M. Haan*[1], J. Russell[1], D. Morrical[1], D. Strohbehn[1], W. Powers[1], J. Lawrence[1], and J. Kovar[2], [1]*Iowa State University*, *Ames*, [2]*USDA-ARS*, *Ames, IA*.

To evaluate cattle grazing effects on the potential for sediment and nutrient loading of surface waters, forage cover, sward height, and mass and manure cover were measured in pastures with different grazing management systems. Six 12.1-ha cool-season grass pastures were