In both studies, 5 kg of each sample were tempered for 18 h to a designated moisture level (i.e. 21, 24, 27, or 30% in Study 1 and 25% in Study 2). The micronized peas were collected at temperature range of 110 to 115C. In Study 2, the samples were stored at either 4C or room temperature for 0, 2, 4, and 6 wk. A 50 g sample of raw, tempered (Study 1 only), or micronized pea was used for LA, SG, and WEV analysis. The results in Study 1 indicated that WEV of micronized peas was significantly reduced ($P < 0.05$) by 48 or 54% and SG temperature was significantly increased by 6.1 or 6.6% as the tempering moisture was increased from 21 to 30%. However, at a tempering moisture greater than 24%, LA tended to decline thus suggesting that 24% moisture is optimal for micronizing peas without compromising its nutritive value. The results in Study 2 indicated that micronization conditions used in this study had no effect ($P > 0.10$) on LA in all 4 pea varieties regardless of storage conditions, except for RAD. Compared to raw peas, WEV of micronized peas at wk 0 was significantly reduced by 16, 24, and 16% ($P < 0.05$) for ACA, RAD, and CAR. SG temperatures were significantly increased by 5.4, 6.2. 7.4.and 10.8% ($P < 0.05$) for ACA, RAD, CAR, UNK, respectively. Overall, the results in two studies suggested that the nutritive value of peas for pigs could be enhanced through proper micronization technology.

Key Words: peas, micronization, nutritive values

1132 Evidence for oocyte penetration rate as an effective indicator of proven boar fertility. Ana Ruiz-Sanchez*[1], Rose O'Donoghue[1], and George Foxcroft[1], [1]*Department of Agricultural, Food and Nutritional Science, University of Alberta.*

The principal objective was to compare *in vitro* fertilization (IVF) techniques with routine semen evaluation characteristics as effective indicators of in vivo fertility. Six experimental boars (B-1, R-1, G-1, R-2, G-2 and Y-2) were collected twice a week during a period of 8 months, beginning at 7 months of age. The first sperm rich fraction of all ejaculates was evaluated using standard laboratory procedures for motility, morphology and concentration, diluted to 1.5 billion morphologically normal sperm in 50mL BTS extender, and used to breed approximately 60 gilts. At least seven times during the breeding period, specific aliquots from the first sperm-rich fraction were evaluated using established IVF procedures. Oocyte penetration rate (percentage of matured oocytes penetrated by at least one spermatozoon) was different among boars (P<0.0001) and positively correlated with conception rate (r^2=0.30; P<0.0005) and farrowing rate (r^2=0.21; P< 0.004). Because of a boar x time interaction for sperm motility (P<0.001) and percentage normal sperm (P<0.05) on the day of collection, these characteristics were not useful indicators of persistent differences in proven fertility among boars. In particular, compared to other boars, oocyte penetration rate for Boar G-1 was lower (45.5 v 89.9, 76.4, 77.3, 87.9, and 97.31 %; P<0.0001) and was associated with lower conception rate (75.1 v 92.3, 83.3, 93.1, 98, and 92.8 %; P<0.0001) and farrowing rate (73.7 v 92.3, 81.5, 92, 98, and 91.1 %; P<0.0001). However, ranges of motility of raw semen (90 to 80 %) and percent normal sperm (97 to 82 %) for boar G-1 was acceptable and similar to other boars. In conclusion, oocyte penetration rate may be more useful for predicting sperm quality and boar fertility than routine semen evaluation methods. Implementation of this in vitro technology should allow swine producers to detect the high fertility boars for use in more efficient AI programs.

Key Words: semen quality, In vitro fertilization, boar fertility

1133 Effects of removing pigs from pens and floor space allocation on growth performance post-removal in finishing pigs. J. M. DeDecker*[1], M. Ellis[1], B. F. Wolter[1], B. P. Corrigan[1], S. E. Curtis[1], E. N. Parr[2], and D. M. Webel[2], [1]*University of Illinois, Urbana, IL/USA,* [2]*United Feeds, Inc., Sheridan, IN/USA.*

Finishing pigs were removed from pens at different rates to determine the effects of pig removal and floor-space allowance on growth performance for the final 19 d of finishing. Thirty-two pens of crossbred pigs (n = 1664; 52 pigs/pen) were used in a randomized block design to evaluate four pig removal treatments: 1) 0% removed [Control], 2) 25% removed, 3) 50% removed, and 4) 50% removed and floor space/pig reduced to equal that of Control. Pens of pigs (mean BW = 114.9 ± 5.1 kg) were randomly allocated to treatment, and the heaviest animals were removed. Group size and floor space/pig for treatments 1, 2, 3, and 4 were: 52 and 0.65 m^2, 39 and 0.87 m^2, 26 and 1.30 m^2, and 26 and 0.65 m^2, respectively. Each pen contained a 6-place feeder (212 cm total trough space); however, only 3-places were accessible to pigs in Trt. 4. Pens of pigs with a 25 and 50% removal rate (Trt. 2 and 3) compared to Control had increased ADG (P < 0.001) and ADFI (P < 0.001), but similar (P > 0.05) gain:feed. Pens of pigs with a 50% removal rate and reduced floor space (Trt. 4) had higher (P < 0.01) ADG than Control, but similar (P > 0.05) ADG compared to the pens of pigs with a 50% removal rate (Trt. 3). No differences (P > 0.05) were observed among treatments for either morbidity or mortality. In summary, these results suggest that removing 25 or 50% of the heaviest pigs from within finishing pens increased the growth rate of remaining pigs and that the improvement in performance may only partly be due to increased floor space.

Treatment	1	2	3	4	SEM
ADG, g	668^c	836^a	813^{ab}	762^b	22.7
ADFI, g	2826^b	3145^a	3054^a	2891^b	44.5
G:F	0.22	0.27	0.24	0.26	0.013

^{a,b,c} Means with different superscripts differ P < 0.05

Key Words: Pigs, Pig removal, Floor space

Dairy Foods Chemistry

1134 Changes in fatty acid composition during yogurt processing and their effects on yogurt and probiotic bacteria in milk procured from cows fed with different diets. R. I. Dave*, N. Ramaswamy, and R. J. Baer, *Dairy Science College, South Dakota State University.*

Milk was collected from cow#s fed with four diets consisting control (C), C with 2% fish oil (FO), C with 1% each of fish oil and extruded soybeans (FOES), and C with 2% extruded soybeans (ES). Milks were processed and fermented with starter culture comprised of yogurt (*S. thermophilus* and *L. delbrueckii* ssp. *bulgaricus*) and probiotic (*L. acidophilus* and bifidobacteria) bacteria. Changes in fatty acid composition of yogurt mix and yogurt during manufacture and storage were monitored. Also, changes in viable numbers of starter bacteria were monitored in fresh yogurt and after 30 d storage. Milk fat of cows fed with C, FO, FOES, and ES diets was 3.31, 2.58, 2.94, and 3.47%, respectively. Milk, yogurt mix and yogurt from cows fed with FO or FOES diets showed 4-fold increase (P < 0.05) in the concentration of conjugated linoleic acid (CLA) and an increase (P < 0.05) in omega-3 fatty acids. Also, the same diet group products had increased concentration of transvaccenic acid (TVA). Unsaturated fatty acids were higher in the milk from cows fed with FO, FOES and ES diets compared to the C diet. The processing of milk (incorporation of milk powder and heat treatment at 85C for 30 min) did not have any effect (P > 0.05) on fatty acids composition, especially CLA, TVA or omega-3 fatty acids. Further, changes in fatty acids composition (as a result of change in diet) did not show any significant effects on the viable numbers of starter bacteria. Also, yogurt bacteria were > 10^7/ g and probiotic bacteria were > 10^5/ g at the end of 30 d storage periods. Fermentation with yogurt and probiotic bacteria and storage did not alter (P > 0.05) the CLA, TVA or omega-3 fatty acids. Thus, probiotic yogurt made from milk with increased CLA and TVA be produced by changing the diets of cows, and it could offer health benefits to consumers.

Key Words: probiotics, CLA, yogurt

1135 Methods of milk storage and age of samples on milk components percentage, somatic cells count and urea nitrogen. P.M. Meyer*[1], P.F. Machado[1], A. Coldebella[1], C.H. Corassin[1], L.D. Cassoli[1], C.A. Oliveira[1], and P.H.M. Rodrigues[2], [1]*Clinica do Leite. Escola Superior de Agricultura Luiz de Queiroz/University of Sao Paulo, Brazil,* [2]*Faculdade de Medicina Veterinaria e Zootecnia, University of Sao Paulo, Brazil.*

A trial was conducted to evaluate if different storage methods and age of samples would affect the results of milk analysis. Milk was collected from a bulk tank, poured into 210 vials and preserved with bronopol. Samples were used in a completely randomized design with a 4X5+1 factorial arrangement of treatments. One factor was storage method: 1) refrigerated (R), 2) frozen (F), 3) stored at controlled temperature (CT) or 4) stored at variable temperature (VT) (room temperature and warmed up to 40C for 4 h/day). The other factor was age of samples: 3, 6, 9, 12 and 15 days after collection plus day 0 as control. Samples were analyzed for fat, protein, lactose and total solids (TS) (%), somatic cells count (SCC) (1000cells/mL) and milk urea nitrogen (MUN) (mg/dL). Analysis of variance was done considering the model for this design and subsequently, orthogonal contrasts and regression analysis up to quadratic effect were done. The orthogonal contrasts studied were: control (day 0) against all; cold vs. not cold [(R + F) vs. (CT + VT)]; R vs. F; CT vs. VT within each age. Somatic cells count was analyzed as log transformation (LSCC). Results showed interaction between storage method and age of samples for fat, protein, lactose, TS and LSCC, but not for MUN. Fat showed significant decreases in function of age for CT and VT and the slopes were -0.008 and -0.058%/d, respectively. There were significant linear effects through age for TS and slopes were respectively -0.007, -0.016, -0.013, -0.058%/d for R, F, CT and VT. There were also linear decreases in function of age for LSCC and the slopes were -0.01, -0.006, -0.069 and -0.226 for R, F, CT and VT, respectively. Financial support: FAPESP and CNPq (Brazil)

Key Words: milk composition, preservation, storage

1136 Environmental influences on bovine kappa-casein: Reduction and conversion to fibrillar (amyloid) structures. H. M. Farrell, Jr.*, P. H. Cooke, and E. D. Wickham, *USDA ERRC.*

The caseins of milk form a unique calcium-phosphate transport complex, which provides these necessary nutrients to the neonate. The colloidal stability of these particles is due primarily to kappa-casein. As purified from milk, this protein occurs as spherical particles with a weight average molecular weight of 400,000. The protein exhibits a unique disulfide bonding pattern, which (in the absence of reducing agents) ranges from monomer to octamers and above on SDS-PAGE. Heat treatment of the kappa-casein in the absence of SDS, prior to SDS electrophoresis, caused an apparent increase in the polymeric distribution (up to 60% high molecular weight polymers) presumably promoted by free sulfhydryl groups. To ascertain the role of the sulfhydryl groups, the protein was reduced and carboxymethylated (RCM-kappa). Surprisingly, the RCM- kappa-casein exhibited an increase in weight average molecular weight and tendency to self-association, when studied at 37C by analytical ultracentrifugation. Electron microscopy of the 37C RCM sample showed that in addition to the spherical particles found in the native protein, there was an equal concentration of fibrillar structures. The fibrillar structures were up to 400 nm in length. Circular dichroism (CD) and Fourier transformation infrared (FTIR) spectroscopies were used to investigate the temperature-induced changes in the secondary structure of the native and RCM-kappa-caseins. These studies suggest little change in the distribution of secondary structural elements during this transition with extended strand and beta turns predominating. Based on 3D molecular modeling considerations, there may exist a type of repeated sheet-turn sheet motif in kappa-casein, which may allow for the stacking of the molecules into the fibril structures. Previous studies on amyloid proteins have suggested that such motifs promote fibril formation. The results are discussed with respect to the role that such fibrils may play in the synthesis and secretion of casein micelles in lactating mammary gland.
II

Key Words: Milk Protein, Functionality, Structure

1137 Fatty acid profile of bovine, ovine, and caprine milks. J. Wojtowski, R. Dankow, and R. Skrzypek*, *Agricultural University, Poznan, Poland.*

The objective of our study was to compare the fatty acid composition of bovine, ovine, and caprine milks. The milks were from 60 Holstein x Black-and-White cows, 26 East-Friesian dairy ewes, and 14 White goats. All animals were fed with similar roughages and concentrates, and ewes and goats were housed in the same experimental farm and fed according to the identical pattern. The fatty acid profile of milk-fats was assayed, using the gas chromatography method (HP-5890). The bovine milk-fat contained less fatty acids composed of 12 or less carbons ($P \leq 0.01$), whereas this fat contained significantly more C16:0, and C18:0 ($P \leq 0.01$). In result of this, the differences in total saturated fatty acids contents between bovine and other two milk-fats were insignificant (bovine 70.9%, ovine 71.3%, and caprine 73.8%). The bovine milk-fat had a higher content of monounsaturated fatty acids than ovine milk-fat (27.0% vs. 23.3%; $P \leq 0.01$), whereas the caprine milk fat was intermediate (25.3%; $P \leq 0.05$ relatively to ovine milk-fat). Contrary to this, the content of polyunsaturated fatty acids was lowest in the bovine milk-fat (2.1% bovine vs. 3.4% ovine, and 2.9% caprine; $P \leq 0.01$). Significant differences among species ($P \leq 0.01$) were also found in the ratio of linoleic (18:2n6) : alpha-linolenic (18:3n3) acids. This ratio ranked as follows: ovine 2.3, bovine 3.2, and caprine 3.7. The richest source of alpha-linolenic acid was the ovine milk-fat (1.0% vs. 0.5% bovine, and 0.6% caprine; the differences relatively to the ovine milk-fat were significant at $P \leq 0.01$). Concluding, the amount and profile of polyunsaturated fatty acids in the investigated milks indicates that the ovine milk-fat has a superior nutritive value.

Key Words: Ruminants, Milks, Fatty acid profile

1138 Treatment of microencapsulated β-galactosidase with ozone: Effect on enzyme and microorganism. H. S. Kwak*, J. B. Lee, and J. Ahn, *Dept. Food Science and technology, Sejong University.*

The present study was designed to examine the effect of ozone treatment in microencapsulated β-galactosidase on inactivation of the enzyme and sterilization of microorganism. The efficiency was the highest as 78.4% when the ratio of polyglycerol monostearate (PGMS) was 15:1. Activities of lactase remaining outside the capsule were affected by ozone treatment. With the increase of ozone concentration and duration of ozone treatment, the activity reduced significantly. In sensory aspect, with 2% microcapsule addition, no significant difference in sweetness was found compared with a market milk during 12 d storage. Above result indicated that the additional washing process of lactase was not necessary to inactivate the residual enzyme. In a subsequent study, the vegetative cells of microorganisms were completely killed with 10 ppm for 10 min treatment by ozone. The present study provides evidence that ozone treatment can be used as an inactivation and a sterilization process. In addition, these results suggest that acceptable milk products containing lactase microcapsules made by PGMS can be prepared with ozone treatment.

Key Words: Ozone treatment, Lactase microencapsulation, Milk

1139 Cholesterol removal of Cheddar cheese by β-cyclodextrin. H. S. Kwak*, C. S. Jung, S. Y. Shim, and J. Ahn, *Dept. Food Science and Technology, Sejong University.*

This study was carried out to find a cholesterol removal rate, and changes in flavor, fatty acid and bitter amino acid productions among 3 different treatments of cholesterol reduced cheese. The cheeses were made by 3 different treatments as followings: 1) Control (no homogenization, no β-CD), 2) Trt A (1000 psi milk homogenization, 1% β-CD) and 3) Trt B (cream separation following by 10% β-CD, mixed with skim milk at 1000 psi homogenization). The curds of Trts A and B were softer, more brittle and elastic than that of control during cutting and cheddaring. The cholesterol removals of the cheese were 79.30% (Trt A) and 91.22% (Trt B). The production of short-chain fatty acids (SCFA) increased with storage time in all treatments. The releasing quantity of SCFA was different among treatments at 3 and 7 mo ripening. Not much difference was found in volatile compounds production. In bitter-tasted amino acids, Trts A and B produced much higher than control. In sensory analysis, texture score of control Cheddar cheese significantly increased, however, those in Trts A and B decreased dramatically with

ripening time. Based on our results, we may suggest that homogenization and β-CD treatment resulted in the cholesterol removed Cheddar cheese and a rapid cheese ripening.

Key Words: Cholesterol removal, β-cyclodextrin, Cheddar cheese

1140 Microencapsulated iron for milk fortification. H. S. Kwak*, K. M. Yang, and J. Ahn, *Dept. Food Science and Technology, Sejong University.*

This study was designed to examine the microencapsulation efficiency of iron and to measure the stability and bioavailability of iron microcapsules in milk during storage. Coating material was PGMS and ferric ammonium sulfate was selected as a core material. The highest efficiency of microencapsulation was 75% with 5:1:30 ratio (w/w/v) as coating to core material to distilled water. Iron release was 15% when stored at 4C for 30 d, and temperature below 20°C did not adversely affect iron release in milk during storage. *in vitro* study, only 3-5% of iron was released in simulated gastric fluid with low pH (3,4,5 and 6). Comparatively, iron release increased dramatically from 12.3% (pH 5) to 95.7% (pH 8) for 40 min incubation in simulated intestinal fluid. In sensory analysis, metallic flavor, color and overall scores were significantly different among commercial market milk, capsulated iron added milk, and uncapsulated iron added milk at 3 d storage. The present study provides evidence that emulsifiers can be used as an effective coating material for iron microencapsulation.

Key Words: Microencapsulation, Iron, Milk

1141 Protein profile and other characteristics of sheep milk. L. Basiricò[1], D. Giontella[1], F. Librandi[1], N. Lacetera[1], B. Ronchi[1], U. Bernabucci*[1], and A. Nardone[1], [1]*Department of Animal Production, University of Tuscia, Viterbo, Italy.*

Information about protein fractions of sheep/s milk and their variations are limited. The objective of this study was to evaluate changes of protein fractions and other milk characteristics in Sardinian ewes. Thirty-five lactating ewes, which lambed in the period of 8 to 12 December, were selected and monitored from 70 to 200 DIM. Diet was based on pasture, ryegrass hay (on an ad libitum basis) and concentrate (0.6 kg/d). Milk yield was recorded and milk samples were taken at 2 wk intervals. Milk samples were analyzed to determine fat and protein percentages, pH, titratable acidity (°SH/50 ml), freezing point and somatic cell counts (SCC). Skimmed milk was analyzed to determine protein profile and urea concentration. Proteins were separated by SDS-PAGE and quantification of the electrophoretically separated proteins was done by densitometry using bovine serum albumin as external standard. Protein fractions were expressed in g/L. Protein profile of milk showed significant changes during lactation and with the increase in SCC. Concentrations of αs1-, αs2-, β- and κ-casein decreased ($P \leq 0.01$), and γ-casein, proteoso peptone, IgG and TCP increased ($P \leq 0.01$) with DIM. Time-related changes of protein fractions would indicate an impairment in cheesemaking properties of milk with advancing of lactation. Concentrations of αs1-, αs2- and β-casein decreased ($P \leq 0.01$), γ-casein increased ($P \leq 0.01$), and κ-casein did not change with increasing SCC in milk. These results confirm the high susceptibility of αs- and β-casein to proteolytic breakdown. Changes of protein fractions indicated an impairment of cheesemaking properties of sheep milk mainly due to stage of lactation and SCC.

Key Words: Sheep, Milk, Protein fractions

1142 Effect of seasons and breeds on composition and some physico-chemical properties of goat milk. Sophie Turcot*[1], Daniel St-Gelais[1], and Abdelghani Ould Baba Ali[2], [1]*Food Research and Development Centre, Agriculture and Agri-Food Canada, St-Hyacinthe, Quebec,* [2]*Laiterie Tournevent Inc., Drummondville, Quebec, Canada.*

In this study, the composition and the physico-chemical properties of milk from five different goat breeds (Toggenburg, Saanen, Alpine, LaMancha and Nubian) were compared. To reduce environmental effects (diet, climate, etc.), the milk from the five breeds was obtained from one producer (farm) in Quebec. Throughout one year, the milk for a given breed was always obtained from the same individuals. For summer, autumn and spring season; milk for every goat breed was sampled three times. Results indicated that seasons and breeds affected significantly ($P \leq 0.05$) the composition and the physico-chemicals properties of goat milk. For all goat breeds, components were higher in autumn. Moreover, the Nubian milk had the highest fat (3.6%), proteins (4.0%), caseins (2.8%) and ash contents (0.76%) than other goat milks (2.7, 3.3, 2.3 and 0.67%, respectively). Reverse-phase HPLC analysis indicated that goat milk was rich in β-casein (between 45 to 56% of total caseins) and poor in α_{s1}-casein (8 to 16%). However, the Nubian milk had the lowest β-casein content (42%) and the highest α_{s1}-casein (26%). For all goat breeds, buffering capacities, hydration of casein micelles and rennet coagulation properties of milk were higher in autumn whereas the casein micelle size was smaller. Results demonstrated that Nubian and Toggenburg milk had different physico-chemical properties probably associated with their specific composition. Variation in composition and physico-chemical properties of goat milk observed during seasons and between goat breeds should be taken into consideration to produce high quality goat dairy products.

Key Words: Goat milk, Composition, Physico-chemical properties

1143 Solution structures of casein peptides: contributions of terminal peptides to the associative behavior of alpha-s1 casein. Edyth L. Malin*, Harold M. Farrell, Jr., Eleanor M. Brown, and Edward D. Wickham, *Eastern Regional Research Center, ARS, U.S. Dept. of Agriculture.*

The N-terminal (f1-23) and C-terminal (f136-196) sections of bovine α_{s1}-CN-B were characterized under conditions that favored or prevented self-association to determine the contributions of each fragment to the potential for α_{s1}-CN interactions with itself or with other elements of the casein micelle. There was no evidence for conventional α-helix or β-sheet structures in NMR data for f1-23, and the peptide conformation was thermostable. However, f136-196 NMR studies indicated temperature sensitivity, as did near-UV and far-UV CD data, suggesting molten globule structure at higher temperatures for this fragment. CD results for f1-23 predicted 31% turns and 29% extended (β-sheet like), whereas CD for the larger peptide (f136-196) indicated 27% turns and up to 64% β-sheet. These results are compared with CD studies of intact α_{s1}-CN. Molecular modeling studies confirmed these estimates in both fragments and in the whole molecule. Recently recognized conformational elements, such as loops and polyproline II helix, are interpreted in accord with evidence regarding the nature of unordered conformations that suggest the possible function of α_{s1}-CN in facilitating casein-casein interactions.

Key Words: Casein micelle, Alpha-s1 casein, Casein peptides

1144 Validation of capillary electrophoresis for the ultra-rapid determination of inorganic phosphate and citrate in milk. Jesus M. Izco*, Monica Tormo, Phil S. Tong, and Rafael Jimenez-Flores, *Dairy Products Technology Center, Cal Poly University.*

The aim of this work is to optimize a Capillary Electrophoresis method for the ultra-rapid determination of citrate and inorganic phosphate in milk. The quantification of these compounds is very important because their distribution between soluble and colloidal phases of milk, and their interactions with milk proteins influence the stability and some functional properties of dairy products. Various parameters affecting analysis have been optimized, including capillary length, type, composition and pH of the electrolyte, and sample extraction. The separation was carried out on an uncoated capillary (50 cm, 75 μm I.D.) at -25kV for 2.5 min. According to pK_a values for citric and phosphoric acid, pH of the running buffer between 9.5 and 3.0 were tested in order to obtain all the possible ionized forms for both acids and to select the pH yielding the best separation. Ethanol, acetonitrile, sulfuric acid, water at 50C and at room temperature were tested as sample buffers (SB). Water at room temperature gave the best overall results and was chosen for further validation. The extraction time was checked and could be shortened to less than 1 min. Also, sample preparation was simplified to pipette 12 μl of milk into 1 ml of water containing tartaric acid as an Internal Standard, not being necessary further treatment. The linearity of the method was excellent (R^2>0.999) with CV values of response factors <3%. The detection limits for phosphate and citrate were 5.1 and 2.4 nM respectively. The accuracy of the method was calculated for each compound (103.2 and 100.3%). In addition, several commercial samples were analyzed and the results showed a deviation less than 5%

from values obtained when analyzing the samples by official methods. Also, to study the versatility of the technique, other dairy products such as cream cheese, yogurt or Cheddar cheese were analyzed. Accuracy was similar to milk in all products tested. Because of the speed and accuracy of this method, it is promising as an analytical quantitative quality testing technique.

Key Words: Capillary Electrophoresis, Milk, Phosphate and Citrate

1145 Effect of physicochemical parameters on peptide-peptide interactions in a tryptic hydrolysate from β-lactoglobulin. P.E. Groleau*, P. Morin, S.F. Gauthier, and Y. Pouliot, *Centre STELA, Universite Laval, Quebec, Canada*.

Previous work showed that decreasing to pH 4.0 a solution of tryptic hydrolysate from β-lactoglobulin (β-LG) reduced its solubility and resulted in peptide aggregation. The objective of this study was to characterize the changes in peptide solubility as affected by some physicochemical conditions. The turbidity of a 1% (w/v) solution of tryptic peptides from β-LG was measured at 500 nm under different physicochemical conditions: temperature of 5°C, 25°C, and 50°C; pH 3 to 10; in the presence of different salt concentration (0, 0.5 and 1M NaCl), denaturing and reducing agents (6M urea, 5% SDS or 5% β#mercaptoethanol). Results confirmed an increase of turbidity of the solution at pH 4, but also, a slight turbidity increase was observed at pH 8. The temperature and ionic strength dependency of the turbidity occurring at pH 4 indicates that hydrophobic interactions are involved in the aggregation process. Turbidity observed at pH 8 was decreased by 5% SDS and SDS-β#mercaptoethanol, suggesting that the aggregation may result from covalent interactions such as disulfide bonds. The peptides present in the precipitate at pH 4 were collected from RP-HPLC and analyzed by mass spectrometry and identified as β-LG 15-20, 41-60, 1-8, and β-LG 41-42 which is released by chymotryptic cleavage. These results suggest that a limited number of peptides species are involved in the aggregation process observed at pH 4.

Key Words: hydrolysate, peptide, turbidity

1146 Total radical trapping potential of whey based edible films containing spice oleoresins and antioxidants as determined by chemiluminescence. Z. Z. Haque*[1], P. Rantamäki[2], P. Marnila[2], and H. Korhonnen[2], [1]*Mississippi State University, MS State, MS 39762,* [2]*Food Chemistry, MTT Agrifood Research Finland, FIN-31600 Jokioinen, Finland*.

Edible films were cast using a commercial whey protein concentrate (WPC)(75% protein) and a pilot plant manufactured UF WPC (34% protein) from Ayrshire milk. A 1:1 ratio of dry sorbitol and commercially available spice oleoresins and water-soluble oleoresins (Kalsec, Kalamazoo, MI) were used with the WPC at a concentration of 0.3% (v/w) and films were cast using a standard method. Ascorbic acid was used at 0.1% w/w level, and BHT and BHA were also used at 50, 100 and 200 ppm levels. The residual total radical-trapping potential (TRAP) of the films was determined based on measurement of induction time and slope of luminescence peak during oxidation of samples of varying concentrations exposed to a free radical source with constant and known rate of free radical production under aerobic conditions. Luminol was used to induce chemiluminescence caused by radicals from pyrolisis of 2,2##azo-bis(2-amidinopropane)(ABAP). A luminometer was used to monitor the luminescence. Trolox, which binds 2 mol radicals per mol, was used as the reference antioxidant. Textural studies were with a Loyds Instrument. Though there were differences based on the type of WPC used, data showed significant differences in residual TRAP when the water-soluble oleoresins were used and this protective effect varied significantly amongst the oleoresins. Ginger showed the greatest scavenging ability at 6.7 mmol peroxyl-radical /g compared to 0.23 for the control film that had no spice oleoresin. Capsicum gave a value of 1.3 mmol under the same conditions. The tensile strength of the films were unaffected by the additives tested.

Key Words: Whey, Edible, Film

1147 Anti-inflammatory factor in bovine colostrum. H Zhang, J. Guo, H. Guan, and L. Li, *Inner Mongolian Agriculture University, Huhhot, P.R. China*.

An anti-inflammatory factor (AIF) was isolated and purified from bovine colostrum using UF ion-exchange chromatography and gel filtration chromatography methods. The anti-inflammatory characteristics of AIF were evaluated. The results were: (1) AIF exerts remarkable anti-inflammatory effects on the rat footpad odema induced by carrageenin and formaldehyde, and can lower the PGE2 level in inflammatory footpad; (2) The optimal pathway for AIF action is IV injection, followed by subcutaneous injection (i.s.), intra-peritoneal (i.p.), and oral parenteral (o.p.) in the order of 67.95%, 61.81%, and 54.69% anti-inflammatory effect compared with IV injection (100%); (3) Through both oral administration and injection, AIF can considerably lower the permeability of mice capillary vessels. Based on the results of this study, it was proposed that the anti-bacteria and anti-inflammation system of colostrum is due to the intestinal local anti-infection effects of immunoglobulins/lactoferrin/lysozyme and lactoperoxidase combined with systemic anti-inflammatory effect of AIF. Therefore, colostrum offers external defense system against infection for neonates.

Key Words: Anti-inflammatory factor, bovine milk, anti-infection

1148 Molecular size and rheological characterization of whey proteins crosslinked by immobilized transglutaminase. V. D. Truong*, V. G. Janolino, G. L. Catignani, and H. E. Swaisgood, *Southeast Dairy Foods Research Center, North Carolina State University, Raleigh*.

Increasing utilization of whey proteins in various food systems has opened up a development opportunity in the dairy industry. To be competitive with other food ingredients, the functionality of milk proteins must be continually improved and designed for specific uses. Physical and chemical methods such as heat treatment and acid hydrolysis are commonly used. Enzymatic methods including transglutaminase are also utilized but the cost of continuous replacement of enzyme hinders its commercial application. A process by which microbial transglutaminase (mTG) immobilized on a glass bead matrix for limited crosslinking of whey protein isolate (WPI) has been developed in our laboratory. This study is a continued effort to characterize the properties of the crosslinked proteins. Large porous glass beads (CPG-3000) were used to immobilize mTG following the biotin-avidin procedure as previously reported. Immobilized mTG (4.9 units/ml beads) and 4% WPI in 50 mM sodium phosphate buffer, pH 6.0 containing 50 mM sodium sulphite and 5 mM calcium chloride (1 to 1000 v/v ratio of enzyme beads-WPI) were placed in a jacketed bioreactor. The reaction was carried out for 5 hrs at 40°C with continuous circulation. Aliquots were taken after 30, 60, 90 and 270 min for molecular weight analysis by laser light scattering technique and rheological characterization using a stress controlled rheometer. Molecular weights and gyration radii (R_g) of the treated WPI increased progressively with reaction time indicating a crosslinking reaction catalyzed by the immobilized mTG. Increased crosslinking of WPI was manifested with an increase in apparent viscosity and changes in gelation properties. The treated WPI exhibited lower gelling points and higher gel strength (increased storage modulus G'). Experiments are in progress to stabilize the enzyme activity for possible scale up of this technology of WPI modification.

Key Words: Whey protein functionality, Molecular size, Transglutaminase

1149 Assessment of hydrophobicity of adsorbed casein layers on latex particle and emulsion surfaces by fluorescence spectroscopy. Jiahong Su and David W. Everett*, *University of Otago, Dunedin, New Zealand*.

The hydrophobicity (HΦ) of sub-micron particles coated with an adsorbed layer of each of the four major caseins (α_{s1}-CN, α_{s2}-CN, β-CN, or κ-CN) was investigated by fluorescence spectroscopy using 1-anilinonaphthalene-8-sulfonic acid (ANS) as a probe. The particles were either 1) low-charge density, sulfated polystyrene latex particles (LP), 2) the same latex coated with isolated native milk fat globule membrane (MFGM) material, or 3) soy oil emulsion droplets (SO) of size 250-350nm and coated with MFGM. The emulsion was produced using a Microfluidizer^{TM} at 75MPa with 5% oil and 1% MFGM in 20mM

buffer, imidazole at pH6.7 or sodium acetate at pH5.5. Caseins were isolated by ion exchange chromatography and purified by dialysis. MFGM was isolated by cream inversion, casein micelles were removed by washing three times with 0.01M Tris, 2mM $MgCl_2$ and 0.15M NaCl at pH7.4, and centrifugation at 100,000×g for 50 min at 15°C. Relative Fluorescence Intensity (RFI) was measured at pH5.5 and pH6.7 in the buffers specified previously, and was related to HΦ. These were chosen to represent the pH of fresh milk (6.7) and cheese (5.5). All measurements were made at least in duplicate.
RFI of MFGM decreased by 9.9% at pH5.5 and did not change at pH6.7 when adsorbed onto latex particles compared to free in solution. Caseins both in solution and also adsorbed onto surfaces had less RFI at pH6.7 compared to pH5.5, more so for α_{s1}-CN, α_{s2}-CN, and β-CN. At pH5.5 the decrease in RFI for α_{s1}-CN when adsorbed onto LP, LP+MFGM and SO was 34±13%, 38±21% and 39±49% respectively. The corresponding changes for adsorption onto these three surfaces for α_{s2}-CN was 5.5±13% increase and 19±5% and 2±10% decrease. For κ-CN the increases were 38±35%, 11±27% and 48±46%. The changes for β-CN were 10.9±14.3% decrease, 35±17.4% increase, and there were no conclusive results for adsorption onto the SO surface. Addition of either trypsin or chymosin decreased the RFI for all adsorbed caseins at both pHs The order of increasing HΦ of casein when adsorbed onto a surface and at both pH values was β-CN < α_{s1}-CN < α_{s2}-CN < κ-CN, at variance with HΦ values when in solution. The ANS probe appears to bind differently to caseins when adsorbed. The results are consistent with κ-CN on the surface of caseins micelles interacting with fat globules coated with MFGM in cheese.

Key Words: Casein, Emulsion, Fluorescence

1150 Extraction of lipids from buttermilk using supercritical carbon dioxide.

Johanna C. Astaire*[1], Harit K. Vyas[1], and Rafael Jiménez-Flores[1], [1]*Dairy Products Technology Center; California Polytechnic State University, San Luis Obispo.*

Buttermilk contains the milk fat globule membrane (MFGM), a material that possesses several lipids known to function as intracellular signaling molecules. For example, certain sphingolipids contained in the MFGM influence apoptotic pathways in cancer cells. These anticancer properties make them good candidates for use as potential therapeutic agents, or health enhancing supplements. In order to purify these potentially beneficial lipids without the use of conventional lipid extraction solvents not generally recognized as safe, we employed supercritical fluid extraction (SFE) using carbon dioxide as the only solvent. SFE is a method that employs achieving a solvent's supercritical state by using temperature and pressure conditions above a solvent's critical temperature and pressure points; carbon dioxide is frequently used as the solvent. In this state the solvent possesses a gas-like viscosity, allowing it to easily infiltrate a variety of samples. When introduced to the solvent specific compounds are solublized, allowing them to be separated when the solvent is returned to ambient conditions. By optimizing conditions to remove nonpolar lipids with SFE we increased the purity of the MFGM lipids in our starting product; buttermilk powder, and microfiltered buttermilk powder processed to concentrate the MFGM were used. The conditions of extraction were 32 MPa, 333 Kelvin, and a constant flow rate of carbon dioxide at 25 g/min over two duplicate runs of 100 minutes. Thin Layer Chromatography (TLC) was used to obtain lipid profiles of the starting sample before and after extraction, and the product removed from the sample. The following solvent systems were used: petroleum ether:ethyl ether:acetic acid (85:15:1)(v:v) to analyze nonpolar lipids, and chloroform:methanol:water (65:25:4)(v:v) to analyze polar lipids (including the MFGM lipids). Standards were used to verify lipids present. The extraction process removed a fraction containing all nonpolar lipids, while the remaining sample retained all the MFGM polar lipids of interest.

Key Words: Buttermilk, Milk fat globule membrane (MFGM), Supercritical fluid extraction (SFE)

1151 Variability in atherogenic and thrombogenic potential of milk fat of standard and elevated *cis*-9, *trans*-11 CLA content.

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Many investigations have demonstrated the plasticity of milk fatty acid composition in response to dietary manipulation and a related area of recent focus is the effect of diet on milk fat content of CLA. In humans, dietary lipids are a factor known to contribute to coronary heart disease and the possible role of saturated and unsaturated fatty acids as well as specific fatty acids has been an active area of research. Several methods have been devised to indicate the healthfulness of dietary fats ranging from the simple polyunsaturated to saturated fat ratio to the more complete atherogenic and thrombogenic indices of Ulbricht and Southgate (The Lancet, 1991, 338:985-992) that are based on the content of specific fatty acids. The variation in these indices among individual dairy cows has not previously been evaluated. We analyzed the variation in atherogenic and thrombogenic indices in milk fat among 30 Holstein cows fed a control diet, a CLA-elevating diet, or switched between the two diets at 3 wk intervals for a total of 12 wk. We found the average atherogenic and thrombogenic indices for milk fat to decrease in response to a CLA-elevating diet (1.65 vs. 1.15 and 3.52 vs. 2.58, respectively), indicating a more desirable fatty acid composition. Examination of individual variation demonstrated an approximate 2-fold range in atherogenic and thrombogenic indices among cows within a treatment group, although we also observed a high degree of consistency among individual animals over time. Comparisons of individuals in the group that switched between diets indicated that some animals responded dramatically to dietary treatment while others responded very little. This study demonstrates that there is substantial animal-to-animal variability not only in *cis*-9, *trans*-11 CLA content, but also in the plasticity of milk fat and its atherogenic and thrombogenic potential.

Key Words: CLA, Atherogenic Index, Variation

1152 Thermodynamical Equilibrium between *cis*#9,*trans*#11 and *trans*#8,*cis*#10 Conjugated Linoleic Acid (CLA) Isomers in Butter and Ruminant Fats.

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Rumenic (*cis*-9,*trans*-11 C18:2) acid is the main CLA isomer in milk and ruminant fats. This fatty acid is partially isomerized into *trans*-8,*cis*-10 C18:2 acid when submitted to thermal treatment. Structure of the formed isomer was confirmed by mass-spectrometry of its 4,4-dimethyloxazoline derivative. The rate of isomerization was assessed by heating pure methyl rumenate. Usual anhydrous butterfat, high CLA butter (produced by feeding cows with sunflower oil), unrefined beef and deer tallows were heated at 200°C for 2, 4 and 6 hours under aerobic condition. Isomerization of rumenic acid were followed by gas-liquid chromatography analysis using a 120 m capillary column coated with 70 % equivalent cyanoalkylpolysiloxane material. Analysis shown that after 6 h at 200°C, about 60 % of rumenic acid was converted into *trans*-8,*cis*-10 C18:2.This study has shown that following thermal treatment, *trans*#8,*cis*#10 C18:2 acid became the second major CLA isomer in milk and ruminant fats.

Key Words: Conjugated linoleic acid, modified milk fat, thermal reaction

1153 Effect of flax oil emulsion processing conditions on the oxidative stability of omega-3 enriched milk beverages.

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Enrichment of milk with flax oil could provide adequate supply of omega-3 fatty acids without changing eating habits. However, flax oil is sensitive to oxidative degradation. Pre-homogenization of flax oil is proposed as a treatment to prevent oxidation. The purpose of this work was to determine the effect of processing conditions on the characteristics of flax oil emulsions and to measure creaming and oxidation stability of enriched milk. Flax oil emulsions were prepared in milk UF-permeate with sodium caseinate or whey protein isolate according to a complete factorial design. Processing variables were: protein concentration (1, 5%), oil volume fraction (10, 20%) and homogenization pressure (2000, 6000 psi). Emulsions were added to milk to reach 0.25% flax oil in the final product. Light reflectance profiles of milk samples were recorded after 2 weeks storage to determine the creaming index. High homogenization pressure and high protein content reduced droplet size of flax oil emulsions and improved creaming stability in milk. Milk samples were exposed to light and thiobarbituric acid reactive substances (TBARS) were monitored over a 40-hour period. The type of protein used to prepare flax oil emulsions had a strong influence on light-induced milk oxidation. After the exposition period, TBARS concentration in milks

enriched with casein and whey protein based emulsions averaged 7.2 and 4.0μmol/L respectively. Homogenization conditions leading to smaller droplet size increased final TBARS concentration in milk. This relationship suggests that increasing the emulsion surface area enhances susceptibility to oxidation. However, the improved stability observed with whey protein-based emulsions could not be attributed to oil droplet size. Droplet size was slightly lower in whey compared to casein-based emulsions. We conclude that the amino acid composition of the whey protein layer surrounding fat droplets is responsible for flax oil protection against oxidation.

Key Words: flax oil, fluid milk, oxidation

1154 Fe2+-induced cold gelation of whey protein: One strategy for increases iron bioavailability. G. Remondetto[1], E. Beyssac[2], and M. Subirade[1], [1]*Institut des nutraceutiques et des aliments fonctionnels, FSAA (Universite Laval),* [2]*ERT CIDAM, Faculté de Pharmacie, Universite d'Auvergne, Clermont-Ferrand, France.*

Today, more than 2 billion people worldwide are iron deficient. An interesting solution to this problem consists in fortifying foods with iron. But incorporating iron into complex systems can lead to its oxidization or precipitation and affect its bioavailability (Hurrell, 1998). Proteins, such as biopolymers, may form ordered networks (i.e., gels) that trap water molecules (Clark & Ross-Murphy, 1987). Among the proteins, whey proteins (sub-products from cheese manufacture) are extensively used in foods, because of their high nutritional value and their ability to form gels. In the traditional gelling process, an aqueous solution containing native whey proteins had to be heated to above 65oC. More recently, the gelling of whey protein at low temperatures was successfully carried out by adding Ca2+ to a preheated protein suspension (Barbut & Foegeding, 1993; Bryant & McClements; 2000). In a previous study (Remondetto et al., 2001), we developed and examined the cold-gelling process in the presence of iron. Depending on the conditions used, we were able to identify two types of gel formation (i.e., filamentous and random aggregate), each with its distinctive physicochemical properties. By characterizing the gelling processes using FTIR and rheological methodologies, we were able to establish the gelation mechanism of the different gel types (Remondetto & Subirade, 2002). The objective of this work was to analyze the impact of gel microstructures (i.e., filamentous vs. random aggregate) on iron release under gastrointestinal conditions. An in vitro dissolution apparatus was carried out using a technical standard of the USP (United State Pharmacopeia). Our findings show that the random aggregate gels release higher levels of iron than filamentous gels under gastric conditions; the opposite is observed under intestinal conditions. In conclusion, the results obtained suggest that the transport and protection of iron inside a filamentous protein network allow for more iron to be released at the intestinal level, under conditions that favor the presence of amino acids, and, thus, increases iron bioavailability.

Key Words: Protein, Cold gelation, Iron bioavailability

1155 Effect of heat treatment on carnitine in milk and model systems. C. R. Smith*, M. Cattie, and M. R. Guo, *University of Vermont, Burlington VT USA.*

Carnitine is widely used in formulations of sports beverages, infant formulas, and nutritional supplements. The principal function of carnitine (beta-hydroxy-gamma-trimethylaminobutyrate) is transport of long-chain fatty acids into the mitochondria for beta-oxidation. Carnitine is added to sports drinks as a putative enhancer of fatty acid oxidation, which is essential to endurance and strenuous sports performance. In infant formula, carnitine is supplied in bovine milk or added as a nutrient during manufacturing, as infants cannot synthesize adequate carnitine. In this study, the levels of carnitine in the samples (milk, beverages, infant formulas, and the model system) were analyzed by a colorimetric method. The effect of heat treatment on carnitine-fortified skim milk (20 mg/l) and pure solutions (100 mg/l), and the distribution of carnitine in skim milk were also investigated. The samples were heated at 63^{o}C for 30 min, at 70, 80, 90, and 100^{o}C for 10 min, and 121^{o}C for 12 min. Heat-treated skim milk samples were centrifuged at 45, 000 X g for 2 hours at 4^{o}C to obtain serum and pellet fractions. Analysis of sports drinks, milks, and infant formulas revealed carnitine levels that ranged between 3-49 mg carnitine/100ml. Carnitine in pure solution remained stable at all heat treatments. However, in carnitine-fortified skim milk, there was a steady decline in carnitine level with increasing temperature, reaching a total loss of 16% by 121^{o}C compared to unheated control. Approximately 98% of carnitine in skim milk and carnitine-fortified skim milk was recovered in the serum fraction. Further investigation is needed to determine the effect of heating conditions (i.e., pH/buffer) and interactions between carnitine and other components in foods.

Key Words: Heat treatment, carnitine, milk

1156 Effects of seasonal and regional variations in milk components on the buffering capacity of milk in California. A Harris*[1], P Tong[1], S Vink[1], J Izco[1], and R Jimenez-Flores[1], [1]*California Polytechnic State University.*

Milk samples from thirteen California dairy processing (cheese, fluid milk, butter and powder) facilities were examined over one year to understand seasonal and regional variations in buffering capacity. Total protein, casein, inorganic phosphate and citrate levels were analyzed to assess their impact on the buffering capacity. These components have been found to have the greatest impact on buffering capacity. Little seems to have been done to correlate those seasonal changes with seasonal differences in buffering capacity.
Samples from the 13 dairy facilities were taken two times per month. Individual samples, as well as combined monthly samples, were stored frozen and thawed prior to sampling for analysis. Composite monthly samples were analyzed for total protein and casein, while individual, biweekly samples were examined for phosphate and citrate. Citrate and phosphate concentrations were analyzed simultaneously using a rapid Capillary Electrophoresis method. Total nitrogen, non-casein nitrogen, and non-protein nitrogen were measured by Kjehldahl Nitrogen determination. Forward titration curves were obtained by acidification of milk to measure buffering capacity.
The lowest buffering capacity values were witnessed in samples during the September sampling (18.51 0.17 ml of titrant required to achieve pH 4.0). Maximum buffering values were reached in December (19.20 0.23 ml of titrant). These trends were also witnessed in casein, phosphate and citrate with citrate and phosphate values peaking earlier in the year than casein. It is likely that the variations in buffering capacity and the associated relationships to variability in milk composition can be traced back to known effects of feed, stage of lactation, breed and other dairy farm management practices.

Key Words: Buffering Capacity, Citrate, Phosphate

1157 Rheological characterization and comparison of derivatized whey protein ingredients. J.J Resch* and C.R. Daubert, *North Carolina State University, Department of Food Science, Raleigh, NC 27695-7624.*

The gelling ability of whey proteins provides important textural properties in many foods. However, because certain food products cannot be heated to the temperature needed for thermal gelation, cold-set gelation of whey proteins is advantageous for the food industry. A cold-gelling whey protein ingredient would also confer nutritional benefits not obtained from cold-gelling starches and hydrocolloids.
A derivatization procedure was developed for the production of a cold-gelling, whey protein isolate (WPI) ingredient, consisting of protein hydration, pH adjustment, thermal gelation, freeze drying, and milling. However, because freeze drying and WPI are expensive, commercial applications of this derivatized WPI ingredient may be cost prohibitive. Therefore, the derivatization procedure was modified by developing a spray drying operation to replace the freeze-drying step and was applied to whey protein concentrate (WPC) to create a more economical cold-set thickening ingredient. The objective of this study was to rheologically characterize the ingredients produced by the original and modified derivatization procedures and to make comparisons with other commercially available polysaccharide thickeners.
The resulting derivatized WPC powders, along with pre-gelatinized starch, guar gum, and xanthan gum, were reconstituted in water and evaluated through a range of rheological studies. The effects of temperature, concentration, pH, and shear on viscosity as well as the mechanical spectra were assessed to characterize the ability of the powders to function in food systems. The rheological characterization reveled the modified derivatization procedure yielded an ingredient capable of the same cold-set thickening and gelling ability over a wide array of environments as the original derivatized powder. The modified whey proteins

were also able to achieve, at higher usage levels, textural properties similar to several polysaccharide thickeners. Incorporation of spray drying created a more economical process for the production of a whey protein ingredient suitable for contributing viscosity and texture to a wide range of food systems.

Key Words: Whey protein, Cold-gelling, Spray drying

1158 Monthly and regional variation in nitrogen and protein distribution of milk in California manufacturing plants. Phillip Tong* and Sean Vink, *California Polytechnic State University*.

Good information concerning the protein content of milk is useful in discussions of milk pricing, manufacturing yields, and product composition control. The objective of this study was to generate information on the current composition of milk received at California dairy product manufacturing plants.
Thirteen plants from throughout California participated in the study which was undertaken from May, 2000 through April, 2001. Milk samples from all silos of milk received for a given day for a given plant were taken two times per month and blended in proportion to the amount of milk represented by each silo to make a pooled composite monthly sample. Each composite monthly sample was analyzed for total nitrogen, non-casein nitrogen, and non-protein nitrogen by Kjehldahl methods. Total protein, casein and casein as a percent of total protein were then calculated.

Plant average crude protein (total nitrogen X 6.38) ranged from 3.19% to 3.40%. Plant average true protein ((total nitrogen - non-protein nitrogen) X 6.38), ranged from 3.00% to 3.20%. Casein as a percent of crude or true protein ranged from 76.8% to 77.9%, and 81.6% to 82.7%, respectively. Analysis of monthly variation in milk composition for all plants indicates that protein content was the lowest (approximately 3.2%) in the months of June through August) and the highest (approximately 3.4%) in the months of November through January. Although the number of plants in each region was small, the data indicate that Southern California region has lowest total crude protein and lowest casein as a percent of total protein compared to the other four regions (South San Joaquin Valley, North Central/Sacramento, North Bay Area). Casein as a percent of crude total protein averaged 76.8%, 77.1%, 77.1%, and 77.8% for South San Joaquin Valley, North Central/Sacramento, North Bay Area, respectively.

These results suggest protein content of milks received in California dairy manufacturing plants varied among regions and with time of year.

Key Words: California, milk, protein

Goat Species

1159 Use of 48-hour kid removal to decrease the post-partum rebreeding interval in meat does. C. M. Fletcher*, D. J. Jackson, and N. C. Whitley, *University of Maryland Eastern Shore*.

The objective was to examine the effectiveness of early kid removal in decreasing the post-partum rebreeding interval in goats. Boer and Boer crossbred meat-type does (n = 25) and bucks (n = 4) were used. Does had kidded in the Fall of the year and were allotted into two groups based on day of lactation and number of nursing kids. All does were housed together in a 67 m x 34 m dry lot pen, fed hay and a corn/soybean meal diet with water ad libitum. Does were injected intramuscularly with 7.5 mg PGF2α (Lutalyse, Pharmacia & Upjohn, Kalamazoo, MI; 1.5 cc) on approximately 28.1 $\pm$ 0.8 days of lactation (d = 0). At the time of injection, kids from thirteen does (treatment group) were moved to a nearby barn while kids from twelve does (control group) were left with their dams. Kids from does in the treatment group were returned on d 2, while kids nursing does in the control group remained throughout the duration of the experiment. At kid removal, bucks wearing marking harnesses were introduced and remained for 10 days. Females were checked for estrus twice daily and number of animals bred was recorded to determine days to first mating and percentage bred (number bred/number exposed x 100%). In a subset of does (8 control, 11 treated), a milk sample was collected at 47.1 $\pm$ 0.4 days after mating for pregnancy determination using a commercial bovine milk progesterone test (Target Rapid Progesterone Milk Test; BioMetallics, Princeton, NJ). Days to first mating was less ($P < 0.05$) for does whose kids were removed (1.5 $\pm$ 0.4 days) compared to control does (2.8 $\pm$ 0.4 days). In addition, by d 5, the percentage of does bred was greater ($P = 0.053$) for treated does (100 $\pm$ 0.1%) compared to control does (74.6 $\pm$ 0.1%). However, by day 10 of the experiment, all does had been mated. In the does tested, there was no difference in pregnancy rates, and the average was 73.7 $\pm$ 0.1%. In conclusion, early kid removal decreased the post-partum interval, but was not necessary for inducing post-partum mating during the breeding season. However, further studies are needed to determine if pregnancy rates could be increased.

Key Words: postpartum, doe, breeding

1160 Reproductive seasonality in Spanish and Boer x Spanish does in south Texas. M. A. Lerma*[1] and R. L. Stanko[1,2], [1] *Texas A&M University-Kingsville, Kingsville, TX,* [2] *Texas Agricultural Research Station, Beeville, TX*.

Seasonal breeding patterns of goat breeds is a major obstacle to increasing the intensity of meat goat production in temperate regions of the U.S. We conducted two experiments in TX (27° N latidude) to better define meat goat reproductive seasonality. In Exp. 1, Spanish (S, n=11) and Boer x Spanish F_1 (%B, n=5) does were monitored for estrous cyclicity over 400 d. Blood samples for progesterone (P_4) determination were obtained weekly, beginning at the vernal equinox (March 21) of Yr 1 through May 3 of Yr 2. Does were kept together in a 2 hectare paddock and had ad libitum access to native forage and sudan hay. Does were group fed daily .45 kg $\cdot$hd^{-1} of a commercial pellet (15% CP). Fence line exposure to a fertile buck began on April 26 of Yr 1. Does were anestrus prior to buck exposure. Days from buck exposure to elevated P_4 was similar ($P>0.1$) between S (44 $\pm$ 1) and %B (59 $\pm$ 20) does. A single estrous cycle was exhibited by 15/16 does followed by a summer anestrus period. Length of summer anestrus was similar ($P>0.1$) between S (77 $\pm$ 1 d) and %B (83 $\pm$ 6 d) does. A fertile buck was introduced on Oct. 1 for breeding. A subset (n=6) of S does were not exposed to the buck and continued regular estrous cycles until early-Feb. Mean Julian d to onset of anestrus was 40.5 $\pm$ 5.2 and continued throughout the experiment. In Exp. 2, 31 mature, anestrus does of S (n=21) and %B (n=10) genetics were used to evaluate summer breeding. Weekly blood samples were obtained from June 1 to Oct. 1. Does were allocated to fertile S (n=2) or Boer (n=2) bucks on June 22. Days from buck exposure to elevated P_4 and level of P_4 were similar ($P>0.1$) between S and %B does. Pregnancy rate (95 % vs. 100%) and % kid crop (200 vs. 210) were similar ($P>0.1$) between S and %B does, respectively. Seasonal anestrus is evident in TX meat goats; however, a male-stimulated, summer breeding season may increase production potential.

Key Words: Goat, Reproduction, Seasonality

1161 A model to test the effect of manipulating photoperiod on the liveweight gain of goats in southern Queensland, Australia. M Flint*[1] and P.J. Murray[2], [1] *School of Veterinary Science, The University of Queensland, St Lucia, Queensland 4072, Australia,* [2] *School of Animal Studies, The University of Queensland, Gatton Campus, Queensland 4343, Australia*.

In Australia irrespective of feed intake, goats undergo a period of growth stasis during winter. In feedlots, this results in loss of potential sales of goat meat to overseas markets. In a study using rats as a physiological model for goats, 56 sub adult rats (*Rattus norvegicus*) of the black and white hooded strain (starting weight 68.8 SD 16.8 g) were examined for liveweight gain (LWG) and feed intake over 42 days. The experiment compared combinations of two temperature and two light regimes; mimicking a constant summer temperature (26C) and a constant winter temperature (18C), and a diurnal 'summer' day length (12 hours of light per day) and a diurnal 'winter' day length (6 hours of light per day). With respect to LWG, we found that winter day length (winter day = 5.0 g/d vs summer day = 4.7 g/d LWG; P= 0.001) was more influential than winter ambient temperature (winter temperature = 4.9 g/d