

attainment and it's associated with long-term calf performance. Finally, studies by Meyer et al. ranked gestation length as the third most important factor affecting stillbirth rates in primiparous cows with dystocia scores of 3+ and third for multiparous cows for any level of dystocia. The same author also reported a significant decrease in stillbirth for longer gestations. This trait was then chosen in connection with its influence on newborn survival. Calves were measured for weight after birth. Immune function was evaluated through serum IgG levels between 24 and 78h of age. Serum IgG levels were determined by radial immuno-diffusion assay. Gestation lengths were recorded as part of the routine data collection. Results from a genome scan, are discussed. 182 microsatellites were chosen among 270 after sires genotyping. Spacing between markers ranged from 3.4 to 32.85 cM with an average of 15.93 cM. Interval mapping analysis was performed for all traits considered. Evidences for suggestive QTL ( $P < 0.05$ ) for IgG levels were found in at least one of the families at CHR2 (~72 cM) and CHR5 (~88 cM). Evidence for a significant QTL ( $P < 0.01$ ) for IgG level were found in CHR6 (~68 cM) in one family. Evidence for suggestive QTL ( $P < 0.05$ ) for birth weight were found in CHR2 (~24 cM) and CHR6 (~90 cM) in at least one family. Evidences for a suggestive QTL ( $P < 0.05$ ) affecting gestation length, were found in CHR9 (~100cM).

**Key Words:** QTL, Cattle, Health

**729 Stearoyl-CoA desaturase gene polymorphism and milk production traits in Italian Holsteins.** N. P. P. Macciotta<sup>\*1</sup>, M. Mele<sup>2</sup>, G. Pagnacco<sup>3</sup>, M. Cassandro<sup>4</sup>, G. Conte<sup>2</sup>, A. Cappio-Borlino<sup>1</sup>, and P. L. Secchiari<sup>2</sup>, <sup>1</sup>Dipartimento di Scienze Zootecniche, Università di Sassari, Sassari, Italia, <sup>2</sup>Dipartimento di Agronomia e Gestione dell'Agro-Ecosistema, Università di Pisa, Pisa, Italia, <sup>3</sup>Dipartimento di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare, Università di Milano, Milano, Italia, <sup>4</sup>Dipartimento di Scienze Animali, Università di Padova, Padova, Italia.

The Stearoyl-CoA desaturase (SCD) is a key enzyme for the lipid metabolism of ruminants, being able to introduce a double bond at the  $\Delta^9$ -position in a large spectrum of fatty acids. A polymorphism with two alleles (A and V) has been reported for the SCD locus in cattle, due to three single nucleotide polymorphisms that are in linkage disequilibrium. In this work, possible associations between SCD genotype and milk production traits in Italian Holsteins are investigated. Data were 5,097 test day records for milk, fat and protein yields, fat and protein contents, measured on 313 Italian Holsteins (2,2 lactations per cow). Data were analysed with a mixed linear model that included the fixed effects of herd, test date, genotype at the SCD locus, parity, lactation stage nested within SCD genotype

and the random effect of the animal plus the random residual. Parity, test date, herd and lactation stage affected significantly milk production traits, except for parity on fat content. A statistically significant effect of the SCD genotype was observed for milk yield, fat content and protein yield. In particular, VV cows had an average daily milk yield higher than AV and AA cows (kg/day 35.95, 34.59, 33.71, respectively;  $P < 0.01$ ), a lower fat content (gr. fat/100 gr milk 3.39, 3.51, 3.55, respectively;  $P < 0.05$ ) and a higher protein yield (kg/day 35.95, 34.59, 33.71, respectively;  $P < 0.01$ ). Differences observed among the three different genotypes tend to remain constant throughout the whole lactation. Although observed in a limited sample of cows, these results, together with the recently reported influence of the SCD polymorphism on fatty acid composition of carcass and milk fat in cattle, seem to suggest a possible role of the SCD locus as a candidate gene to be used in the genetic improvement of milk production traits in cattle via schemes of Marker Assisted Selection.

**Key Words:** Stearoyl-CoA Desaturase, Polymorphism, Milk Production Traits

**730 Effect of pregnancy on milk yield of Canadian dairy cattle.** S. Loker<sup>\*1</sup>, J. Bohmanova<sup>1</sup>, F. Miglior<sup>2,3</sup>, M. Kelly<sup>1</sup>, and G. Kistemaker<sup>3</sup>, <sup>1</sup>University of Guelph, Guelph, ON, Canada, <sup>2</sup>Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada, <sup>3</sup>Canadian Dairy Network, Guelph, ON, Canada.

Pregnancy has been reported to have a negative impact on milk production in dairy cattle. A suitable method for estimating the effects of pregnancy is required before pregnancy can be properly accounted for in genetic evaluations. In this study, two models were used to account for pregnancy in seven Canadian dairy breeds. The first model represented pregnancy effects with days open, studying the impact of increased days open on the shape of the lactation curve. The second model measured the impact of the stage of pregnancy on milk production. Milk production for cows with short days open tended to drop significantly in the last part of lactation, while cows with longer days open had proportionally higher milk yield. Using the second model, milk yield declined in all breeds in the study after 4 months of pregnancy (from -0.5 kg/d in first parity Jerseys to -1.3 kg/d in third parity Holsteins). While the pattern of decline in milk yield using both models generally followed the results of other studies, the effect of days open from the first model seemed to be confounded with the production level of the cows. Stage of pregnancy provided a more realistic estimate of the effect of pregnancy on milk production, especially when adjusted for stage of lactation.

**Key Words:** Pregnancy, Days Open, Genetic Evaluation

## Dairy Foods: Products and Processing

**731 Kinetics and properties of plant  $\beta$ -galactosidase extracted from durian seeds (*Durio zibethinus*) and its utilization on ice milk production.** E. E. El Tanboly\*, National Research Center, Dokki, Cairo, Egypt.

$\beta$ -galactosidase ( $\beta$ -gal) was partially purified 2.16-fold with a total yield of 21.32% of the original activity by sequential use of ammonium sulfate precipitation and gel filtration through Sephadex G-200 from durian seeds (*Durio zibethinus*). The  $\beta$ -gal activity was linear with time up to 20 min and still constant thereafter. A progressive increase

in activity of the purified  $\beta$ -gal was observed up to 60°C accompanied by a decrease thereafter. An energy of activation of 3.04 Kcal/mole for the enzyme activity was derived from the Arrhenius plot. The purified  $\beta$ -gal started losing activity above 40°C when incubated at different temperatures for 10 min and became completely inactivated at 80°C. The optimum pH was 3.0. Michaelis-constant ( $K_m$ ) value of 1.42 mM and a maximum velocity ( $V_{max}$ ) of 3.3  $\mu$ moles/ml/min.  $Fe^{+++}$ ,  $Zn^{++}$  and  $Cu^{++}$  strongly inhibited the enzyme. However, the enzyme was partially inhibited by  $Mg^{++}$ ,  $Ca^{++}$  and  $Mn^{++}$ . The use of a plant  $\beta$ -gal in ice milk production was studied. Different concentrations of  $\beta$ -gal;

11.2 (TI), 22.4 (TII) and 33.6 (TIII) units/ml were added to fresh pasteurized milk, and a control with no  $\beta$ -gal. The results indicated that there is a direct of the increase of proportional of the increase of plant  $\beta$ -gal activity level to the level units to the hydrolyzed lactose, specific gravity and weight per gallon of ice milk. On the other hand, increasing  $\beta$ -gal decreased the overrun values. This can be attributed to the decrease in the amount of incorporation air. Organoleptic tests showed the highest value is recorded with TI (85.6%) this may be due to the increase in the sweet taste based on the hydrolysis of lactose by the  $\beta$ -gal, it could be said that the addition of  $\beta$ -gal to ice milk mixes increased the sweetness but properties of body and texture and appearance of the resultant ice milk slightly decrease.

**Key Words:** Durian fruit (*Durio zibethinus*),  $\beta$ -galactosidase ( $\beta$ -gal), Ice Milk

**732 Selenium supplementation of lactating dairy cows: effects on total selenium content and speciation in blood, milk and cheese.** R. H. Phipps<sup>\*1</sup>, A. S. Grandison<sup>1</sup>, A. K. Jones<sup>1</sup>, D. T. Juniper<sup>1</sup>, and G. Bertin<sup>2</sup>, <sup>1</sup>University of Reading, Reading, <sup>2</sup>Alltech (France), Paris, France.

Forty-multiparous Holstein cows were used in a 16-wk continuous design study to explore the effects of two selenium (Se) sources, (selenized yeast from *Saccharomyces cerevisiae* CNCM I-3060 Sel-Plex<sup>®</sup> and sodium selenite ( $\text{Na}_2\text{SeO}_3$ )) and inclusion rate of selenized yeast on Se concentration and speciation in blood, milk and cheese. Cows received ad libitum a TMR with 1:1 forage to concentrate ratio. The four diets (T1-T4) differed only in source and dose of Se additive. Estimated total dietary Se for T1 (no supplement), T2 ( $\text{Na}_2\text{SeO}_3$ ) and T3 and T4 (selenized yeast) was 0.16, 0.30, 0.30 and 0.45 mg/kg DM, respectively. Whole blood and milk samples were measured at 28-d intervals. At each time point there were linear effects ( $P < 0.001$ ) of selenized yeast on whole blood and milk Se concentration. At day 112 the whole blood and milk Se values for T1-T4 were 177, 208, 248,  $279 \pm 9.4$  and 24, 38, 57,  $72 \pm 3.7$  ng/g fresh material, respectively. Furthermore comparable doses of selenite and selenized yeast indicate improved Se bioavailability (T2: 38 vs. T3: 57 ng/g fresh material) from selenized yeast. In blood, selenocysteine (SeCys) was the main species and was not markedly effected by treatment, while in contrast, the inclusion of selenized yeast resulted in a marked increase in selenomethionine (SeMet) concentration. In milk, Se speciation showed that there were no marked treatment effects on SeCys content, while Se source had a marked effect on SeMet. At day 112 the SeMet content of milk from T3 was approximately three times higher (111 vs. 36 ng Se/g) than T2, and the level increased further to 157 ng Se/g for T4. At study end, milk from T1, T2 T3 was made into cheese (Caerphilly). Se source had a marked effect on total Se, SeMet and SeCys content of cheese. Replacing  $\text{Na}_2\text{SeO}_3$  (T2) with selenized yeast (T3) increased the total Se, SeMet and SeCys content from 180 to 340 ng Se/g, 57 to 153 ng Se/g and 52 to 92 ng Se/g, respectively.

**Key Words:** Dairy Cows, Milk and Cheese, Selenium Speciation

**733 Effects of temperature and membrane pore size on fractionation of caprine milk proteins in developing infant formula analogs.** C. O. Maduko<sup>1</sup> and Y. W. Park<sup>\*2,1</sup>, <sup>1</sup>University of Georgia, Athens, <sup>2</sup>Fort Valley State University, Fort Valley, GA.

Denaturation of milk proteins during temperature treatment may cause a simultaneous change in permeate flux during subsequent membrane processing of the milk. Few studies have been reported on the modification of caprine milk proteins by membrane fractionation based on molecular size and temperature treatment to eliminate  $\beta$ -lactoglobulin (Lg) while retaining  $\alpha$ -lactalbumin (La) for infant feeding. The study was conducted to examine effects of temperature treatment and membrane pore size on the elimination of  $\beta$ -Lg and retention of  $\alpha$ -La, and subsequently determine these effects on the optimum permeate fractionation. Four batches (18.9 L each) of raw goat milk were collected, and 2 batches were pasteurized and immediately cooled to 4°C, and the other 2 batches were treated as raw milk. One batch of raw and pasteurized milks were frozen stored at -35°C for 2 days and the other batches were left at refrigeration (4°C). After separation of cream, all treated milk groups were underwent a two-step-cascade membrane separation by ultrafiltration to eliminate  $\beta$ -Lg from the whey fraction. The results showed that the frozen goat milk groups, either raw or pasteurized, showed the best membrane separation performance. The infant milk formula analog produced using the casein and optimum permeate (800/30kDa) fraction of these milk samples had the closest similarity to human milk with respect to the total protein content (1.3 g/100g),  $\beta$ -Lg content (1-2 %), and casein-lactalbumin ratio (0.6-0.7). Complete elimination of  $\beta$ -Lg in most permeate fractions of all 4 milk groups was observed, although the 800/30 kDa permeate fractions of frozen groups had small  $\beta$ -Lg content. It was concluded that membrane performance during ultrafiltration of caprine milk were affected by temperature treatment of the milk prior to membrane separation.

**Key Words:** Goat Milk Infant Formula, Ultrafiltration,  $\beta$ -lactoglobulin

**734 The effect of dry period duration and dietary energy density in early lactation on the rennet gelation properties of milk.** S. T. Butler<sup>\*</sup>, M. de Feu, B. O' Brien, and J. J. Murphy, Teagasc Moorepark DPRC, Co Cork, Ireland.

This study was carried out to examine the effects of omitting the dry period and altering the energy density of the diet during early lactation on the rheological characteristics of milk. Forty mature Holstein-Friesian cows were used in a completely randomized design with a  $2 \times 2$  factorial arrangement of treatments. Cows were randomly assigned to one of two dry period treatments (no planned dry period or standard 8 week dry period) and one of two nutritional treatments in early lactation (standard energy TMR or high energy TMR). Milk samples were collected at 2, 6 and 10 weeks postpartum. The concentration of fat, protein and lactose was determined in each sample. The rennet gelation properties were measured at 31°C using dynamic low-amplitude strain oscillatory rheometry. The elastic shear modulus,  $G'$ , was used as an index of gel firmness. Gelation time (GT; time taken for  $G'$  to reach a value  $\geq 0.2$  Pa), maximum curd firming rate ( $\text{CFR}_{\text{max}}$ ; maximum slope of the  $G'$ -time curve), and gel strength (GS;  $G'$  value at 50 minutes) were calculated. Data were analysed as a factorial design using the MIXED procedure of SAS. Protein concentration was increased by omitting the dry period (31.8 vs. 34.7 g/kg;  $P < 0.001$ ), but not by increasing diet energy density (32.9 vs. 33.7 g/kg;  $P = 0.2$ ). Fat concentration was not affected by duration of the dry period (39.3 vs. 41.5 g/kg;  $P = 0.1$ ), but was significantly reduced by increasing dietary energy density (43.1 vs. 37.7 g/kg;  $P < 0.001$ ). GT was not affected by either dry period duration or diet. Omitting the dry period increased  $\text{CFR}_{\text{max}}$  (2.58 vs. 3.60 Pa/min;

$P < 0.001$ ) and GS (69.4 vs. 90.5 Pa;  $P = 0.003$ ), whereas dietary energy density did not have an effect on either measurement. GS was correlated with  $CFR_{max}$  ( $r = 0.98$ ;  $P < 0.001$ ), and both variables were correlated with milk protein concentration ( $r = 0.71$ ;  $P < 0.001$ , and  $r = 0.73$ ;  $P < 0.001$ , respectively). The results indicate that omission of the dry period significantly increased milk protein concentration and improved the rennet gelation properties of milk, but that dietary energy density had little effect.

**Key Words:** Milk Processability, Dry Period, Rheology

**735 Rheological properties of rennet gels prepared with milk protein concentrates.** M. A. Ferrer<sup>\*1,2</sup>, A. R. Hill<sup>2</sup>, and M. Corredig<sup>2</sup>, <sup>1</sup>University of Zulia, Maracaibo, Venezuela, <sup>2</sup>University of Guelph, Ontario, Canada.

Milk protein concentrates (MPC) are value-added ingredients prepared by membrane filtration commonly employed in dairy processing. To understand the factors affecting the rheological behaviour of rennet-induced gels containing MPC, MPC (56%, 70% and 90% protein) dispersions were prepared in water at a final concentration of 5% protein and their gelation behaviour was tested using a controlled stress rheometer. The calcium to protein ratio and the soluble calcium were inversely proportional ( $p < 0.05$ ) to the amount of protein present in the MPC powders. The amount of casein-macropeptide (CMP) released during the enzymatic reaction was determined by RP-HPLC. The maximum amount of CMP released from the micelles was lower in MPC 90 and MPC 70 compared to MPC 56 and skim milk powder. These results can be explained by SDS-PAGE data that showed more  $\kappa$ -casein in the soluble phase of MPC90, and therefore less remaining in association with the micelles, relative to MPC 56 and skim milk. Because calcium plays a major role in rennet-induced gelation of casein micelles, we also studied gelation behaviour of MPC dispersions equilibrated to their original environment by extensive dialysis against milk. In all cases, when more free calcium was present in the dispersions, dialysis dramatically extended the gelation time and decreased the stiffness of the gels. It was also shown that dialysis of MPC dispersions against milk significantly increased the amount of non-micellar casein in the dispersions. These results indicate that the equilibrium between the soluble and insoluble ions is the determining factor affecting the renneting functionality of casein particles present in MPC.

**Key Words:** Milk Protein Concentrate, Rennet Gel, Ionic Equilibrium

**736 Rheological properties of whey protein dispersions in the presence of exopolysaccharides from *Lactococcus lactis* ssp. *cremoris*.** I. Ayala Hernandez<sup>\*1</sup>, A. N. Hassan<sup>2</sup>, and M. Corredig<sup>1</sup>, <sup>1</sup>University of Guelph, Ontario, Canada, <sup>2</sup>South Dakota State University, Brookings.

Exopolysaccharides (EPS) produced by some strains of lactic acid bacteria improve textural properties and increase water retention in fermented dairy products. The aim of this research was to study the characteristics of EPS produced by *Lactococcus lactis* ssp. *cremoris*, and to better understand how those polysaccharides interact with proteins in milk under different conditions. A highly ropy strain of *Lactococcus lactis* ssp. *cremoris*. (JFR1) was selected for this research,

and fermentations were conducted in ultrafiltration (UF) permeate with and without added whey proteins at 30°C under controlled pH and different fermentation times. The highest degree of ropiness and viscosity increase was obtained at pH values between 5.8 and 5.5 after 22 hrs of fermentation, and a significant loss of ropiness was observed after prolonged incubation. Rheological tests performed on the different fermented permeates confirmed the increase of viscosity correlated with the observed increase in ropiness. The molecular weights of the EPS obtained (determined by HPLC-MALS) are affected by the pH and the duration of the fermentation. A novel scanning electron microscopy technique confirmed whey protein-EPS interactions. This method covalently links milk proteins to the observation surface so that any non-interacting material can be washed out, and only interacting components are observed. Comparisons of fermentations performed with non-EPS producing strains on media with the same protein content helped to confirm the importance of the interaction of the polysaccharide with the protein to generate the viscosity increase. The results of this work suggest that the impact of EPS on the textural properties (ropiness and increased viscosity) of fermented products is determined not only by its molecular weight but also by its ability to interact with milk proteins.

**Key Words:** Whey Proteins, *Lactococcus lactis*, Exopolysaccharides

**737 The impact of preacidification of milk and fermentation time on the properties of yogurt type gel.** Y. Peng<sup>\*1</sup>, D. S. Horne<sup>2</sup>, and J. A. Lucey<sup>1</sup>, <sup>1</sup>University of Wisconsin, Madison, <sup>2</sup>Formerly of Hannah Research Institute, Ayr, Scotland.

The textural properties of yogurt are determined by the nature and type of casein interactions. To understand how the amount of insoluble Ca (CCP) associated with casein particles and fermentation time influence yogurt gels, we used a central composite experimental design and varied the initial milk pH and fermentation time (from the initial milk pH to 4.6). We hypothesized that varying the initial milk pH altered the amount of CCP and varying the fermentation time influenced the rate and extent of solubilization of CCP during the gelation process. Both of these factors could influence casein interactions and thereby alter gel properties. Milks were preacidified to pH values from 6.55 to 5.65 using glucono- $\delta$ -lactone and equilibrated for 4 h at 40°C before inoculation. Fermentation time was varied from 250 to 500 min by adding various amount of culture at 40°C. Gelation properties were monitored using dynamic oscillatory rheology. Microstructure was studied using fluorescence microscopy. Whey separation was analyzed at pH 4.6. The initial pH value of preacidification strongly affected the solubilization of CCP ( $P < 0.0001$ ). Storage modulus values at pH 4.6 were positively influenced by initial pH and negatively affected by fermentation time. Loss tangent maximum during gelation was positively affected by initial milk pH. Fermentation time positively affected whey separation ( $P < 0.0001$ ). Fermentation time significantly influenced the rate of CCP dissolution during fermentation as CCP dissolution was a slow process. Longer time resulted in greater loss of CCP at the pH of gelation. At the end of fermentation (pH ~4.6) virtually all CCP was dissolved. Preacidification of milk increased the solubilization of CCP, increased the loss of CCP crosslinks, and produced weak gels that had low storage modulus values. Long fermentation time allowed more time for solubilization of CCP during the critical gelation stage of the process and increased the possibility of greater casein rearrangements; both could have contributed to the increase in whey separation.

**Key Words:** Yogurt, Gelation, Whey Separation