from temperature and relative humidity records three days prior to TD. The first model that lacked the effect of heat stress included fixed effects of herd-test date, age at calving class, frequency of milking, and DIM x season class, and random genetic additive (regular breeding value) and permanent environmental effects. The second model that accounted for heat stress included two additional random regressions on degrees of heat stress (t=max[0,THI-72]), one for additive genetic (heat breeding value) and one for permanent environmental effect. Breeding values (BV) were computed by BLUP90IOD. Correlations involved sires with at least 300 daughters in regions being compared. When heat stress was ignored, the correlations of regular BV between NE and SE were 0.86. When the heat stress was considered, the correlation increased by 0.01. The correlation between heat BV for NE x SE was 0.72. Heat stress effect as applied explains only a fraction of differences in sire ranking between SE and the NE. The real impact of heat stress may be higher because THI as used accounts only for a fraction of variability due to heat and low correlations are in part due to limited accuracies.

Key Words: Genetic evaluation, Heat stress, Genotype x environment interaction

164 Estimation of genetic parameters of test day milk yields for Holsteins in Khorasan province of Iran. J. Eslami[1], H. Farhangfar*[2], and H. Naeemipour[2], [1]*Zabol University*, *Zabol, Iran*, [2]*Birjand University*, *Birjand, Iran*.

In this research a total of 72187 monthly test day mil yields obtained from 8652 first lactation Holsteins calved from 1993 to 2003 in Khorasan province of Iran was used to estimate genetic parameters using single trait, repeatability and random regression test day animal models. In the random regression test day model orthogonal legendre polynomials of 4th order was used to take account of additive genetic and permanent environmental variation during lactation among individual animals. Heritability estimates of test day milk yields ranged from 0.11-0.25 and 0.10-0.24 for single and random regression test day models respectively. In the repeatability test day model the heritability estimate of monthly test day milk yields was found to be approximately 0.16. The results obtained showed that the second part of the lactation course was more heritable than the first part of the lactation. Repeatability of test day milk yields was 0.64. Genetic correlations among adjacent test day milk yields were high and decreased as the interval between them increased. The genetic correlations between months 1 and 10 and between months 9 and 10 were the lowest and highest respectively.

Key Words: Genetic parameters, Test day models, Random regression

165 Studies on drops of PTA from first to second crop for final score in Holsteins. V. Koduru*[1], I. Misztal[1], S. Tsuruta[1], and T. J. Lawlor[2], [1]*The University of Georgia*, *Athens*, [2]*Holstein Association USA Inc.*, *Brattleboro, VT*.

Drops of PTAs for final score from first to second crop of daughters have been reported for Holstein sires. The objective of the study was to investigate whether the causes of these drops were different distributions of grade and registered animals in the subsequent crops. The PTAs were estimated from 2 datasets: data A (5,993,207 animals with classification year up to 2001) and data B (6,606,175 animals with classification year up to 2005). For the sires born between 1993 and 1996 (N=145) PTA drops were calculated as difference between PTAs estimated from data B (second crop) and PTAs estimated from data A (first crop). The basic single trait (ST) animal model included effects of herd-year-season-classifier (HYSC), age-year, stage of lactation-year, animal genetic, permanent environmental and residual effects. Modifications to the ST model included reduced weights for grade records and treating HYSC as random. A two trait model treated records of registered and grades as separate with animal effects considered correlated or not. The last model corresponded to separate evaluations for grade and registered cows with heritability of 31% for registered and 17% for grades, and the correlation between their additive effects was 77%. Separate analyses used data adjusted for heterogeneous herd variances. The mean and SD of first crop and second crop PTAs estimated with the basic ST model using unadjusted data, were 2.2 and 0.7, and 1.5 and 0.6 respectively. Mean difference of PTAs estimated with ST model was 0.69 and the drops were in the range of -2.1 to 0.3, with more drops (94%) than gains. Drops with the modifications to the ST model were 81% or higher. With a multiple trait model, the percentage of drops was 89 for registered and 80 for grade when genetic effects were assumed correlated, and 86 and 69 when they were not. The adjustment had little effect on the results. Drops of PTA from first to second crop for final score are mostly due to factors other than changing fractions of grades and registered.

Key Words: Final score, Holstein, PTA

Dairy Foods: Cheese I

166 Textural and rheological properties of cream cheese: effect of cream mix homogenization pressure and incubation temperature. M. Brighenti*[1], S. Govindasamy-Lucey[2], J. J. Jaeggi[2], K. Lim[2], M. E. Johnson[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Wisconsin Center for Dairy Research*, *Madison, WI*.

The objective of this study was to determine the impact of cream mix homogenization pressure (HP) and incubation temperature (IT) on rheological and textural properties of cream cheese. A central composite experimental design and response surface methodology were used for data analysis. Cream cheeses were manufactured using different HP (100, 122, 175, 228, and 250 Bar) during the first stage of homogenization, while the pressure of the second step was constant (50 Bar). The IT used were 20, 21, 23, 25, and 26°C. Curds were stirred at pH 4.7. Storage modulus (SM) values at 8°C were obtained by small amplitude oscillatory tests. Hardness was determined by texture profile analysis (TPA). A trained sensory panel used spectrum descriptive analysis to determine: firmness, stickiness, and difficulty to spread. Cream cheeses were analyzed 2 and 4 weeks after manufacture. For most samples, significant (P<0.05) differences were observed for hardness between 2 and 4 weeks, suggesting that there were changes in the structure of cream cheeses during storage. In most cases, samples became harder. Increasing IT significantly (P<0.05) decreased SM, hardness (TPA), and sensory firmness and difficulty to spread, while it increased stickiness. This effect may be due to an increase in hydrophobic interactions at higher IT that may cause contraction of the casein particles, which could reduce the contact area and decrease

the number of interactions between caseins. Although HP alone did not have a significant (P>0.05) impact on these parameters, there was a significant interaction between HP and IT. At low IT, higher HP caused SM, TPA hardness, firmness and difficulty to spread to increase and stickiness to decrease, while at high IT, an increase in HP had the opposite effect. This study showed that the selection of IT and HP can help develop a product with the desired functionality.

Key Words: Cream cheese, Texture

167 The effect of high pressure processing on the salt distribution in Turkish white cheese. N. Koca*[1,2], R. Raghupahty[1], V. M. Balasubramaniam[1], and W. J. Harper[1], [1]*The Ohio State University*, *Columbus*, [2]*Ege University*, *Izmir, Turkey*.

Recently, the research on high pressure processing (HPP) of cheese has focused on the acceleration of cheese ripening and inactivation of microorganisms. The salt distribution in cheese is a very important parameter for its ripening and microbiological quality. The objective of this study was to determine the effect of HPP on salt distribution in white cheese. White cheese samples were produced by using a 1% mixture of mesophilic (*Lactococcus lactis* and *Lc. cremoris*) and thermophilic (*Streptococcus thermophilus, Lactobacillus bulgaricus* and *Lb. helveticus*) cultures. Cheese blocks (6x7x10 cm^3 and 390±10 g) at the pH of 4.9 were suspended in brine (14g NaCl $100g^{-1}$ water) at 22±1°C for 3 and 6 hours. After removing residual surface salt by wiping, the blocks were vacuum packaged in a high barrier pouch. Samples were subjected to HPP at 50,100, 200 and 400 MPa and 22±2°C for 5 and 15 minutes. Control (0.1MPa) was vacuum packaged as well. Whole cheese blocks were then sampled in external, middle and internal zones after keeping at 4°C for around 3 hours. Salt and moisture contents were determined with a 926 Chloride Analyzer and a vacuum oven, respectively. The salt in moisture values (SM) of external zones for 3 and 6 hours ranged from 3.73 to 4.08 g/100 g and from 4.93 to 5.30 g/100 g respectively while those of middle zone ranged between 0.46-0.71 g/100 g and 0.72-0.80 g/100 g, respectively. The SM values of the internal zones were the same as that of unsalted cheese. No significant difference in salt distribution was observed between control and pressure treated cheeses for both salt concentrations. Additionally, time of pressurization had no effect on salt distribution. Only a significant difference was found in the values of salt and SM of the middle zone of the cheeses salted 3 hours, which could be attributed to sampling difficulties due to textural differences. Results showed that HPP at 50, 100 and 400 MPa for 5 and 15 minutes had no effect on salt distribution in white cheese. Additional study is needed to determine how texture differences resulting from HPP affect salt diffusion during the ripening period.

Key Words: High pressure processing, Salt distribution, Cheese

168 Isolation and purification of angiotensin-I-converting enzyme inhibitory peptides from Cheddar cheeses with the addition of probiotic *Lactobacillus casei* or *L. paracasei*. L. Ong*[1], N. Shah[1], and A. Henriksson[2], [1]*Victoria University*, *Werribee, Victoria, Australia*, [2]*DSM Food Specialties*, *NSW, Australia*.

Angiotensin-I-converting enzyme (ACE) increases blood pressure by converting angiotensin-I to angiotensin-II, potent vasoconstrictor and by degrading bradykinin, a vasodilatory peptide. ACE-inhibitory peptides have been isolated in various cheeses, released as a result of proteolysis during ripening. The objectives were i) to study the influence of proteolysis on the release of ACE-inhibitory peptides in probiotic Cheddar cheeses during ripening and ii) to isolate, purify and identify these peptides. Cheddar cheeses were made with starter lactococci and *Lactobacillus casei* 279 or *L. paracasei* LAFTI®L26. ACE-inhibitory activities of the water-soluble fraction of the cheeses were measured by spectrophotometric assay. Peptides were purified using reverse-phase HPLC and identified by automated Edman degradation protein sequencer and mass spectrophotometer. Presence of probiotic organism increased proteolysis in Cheddar cheeses during the nine months ripening at 4°C. The IC_{50} (concentrations of ACE needed to inhibit 50% of ACE activity) was highest after six months of ripening in the probiotic cheeses (0.23- 0.25 mg/mL) compared to nine months in cheeses without probiotic (0.28 mg/mL). The water-soluble extract of each cheese was subjected to several stages of chromatography fractionation. Inhibitory activity found in the crude fractions ranged from 0.1 to 0.8 mg/mL. The fraction with the highest activity was purified by a second stage chromatography. Various ACE-inhibitory peptides were found, which corresponded to the α_s-casein N terminal peptides, f(1-9), f(1-6), f(24-32) and β-casein N-terminal peptides, f(193-209) and f(191-209). Our results suggested that ACE inhibition in Cheddar cheeses was dependent on proteolysis. Probiotic organisms used in this study can be added successfully in Cheddar cheese in order to produce bioactive peptides.

Key Words: Cheese, Probiotic, Proteolysis

169 Effects of milk proteins and packaging on occurence of calcium lactate crystals in Cheddar cheese. S. Agarwal*, J. R. Powers, B. G. Swanson, S. Chen, and S. Clark, *Washington State University*, *Pullman*.

Calcium lactate crystals (CLC) in hard cheeses continue to be an expense to the cheese industry. Major causes of L(+) lactate crystals appears to be 1) increasing protein concentration in cheese milk, which increases cheese yield and 2) type of packaging, which influences serum calcium migration. The research investigates the effects of protein concentration and packaging on migration of serum calcium to the surface of cheese during storage and CLC occurrence. Total and soluble calcium, phosphorus, lactic acid and citrate were measured in cheeses made with skim milk (SM1, 3.14% protein) and skim milk supplemented with ultrafiltered milk (UF) (CSM1, 6.80% protein) or NFDM (CSM2, 6.80% protein). Vacuum and gas flushed cheeses were analyzed for total and soluble calcium, lactic acid and salt at four specific distances from the center of cheeses made from whole milk (WM1) and whole milk supplemented with UF (CWM1). Cheeses made from CSM1 and CSM2, had 26% higher total calcium (1367 mg/100g and 1375 mg/100g cheese, respectively), than cheeses made from SM1 (1066 mg/100g of cheese). At pH 5.2, soluble calcium in cheeses made from CSM1 and CSM2, (550 mg/100g and 558 mg/100g cheese, respectively) was 25% higher than cheeses made from SM1 (441 mg/100g of cheese). At week 10, higher (8%) total and soluble calcium were observed on surfaces of cheeses made from WM1 that were gas flushed compared to the center of the cheese blocks. In contrast, hardly any change was observed in vacuum packaged cheeses, showing that migration of serum calcium to the surface of cheeses was more prevalent in gas flushed cheeses. These results confirm that the risk of occurrence of CLC in cheese increases with concentration of milk proteins. Additionally, loose packaging enhances serum calcium migration to cheese surfaces, increasing the concentration of calcium ions and the risk of CLC.

Key Words: Calcium lactate crystal, Cheddar cheese, Packaging

170 Qualitative analysis of Sicilian traditional cheeses microstructure by scanning electron microscope (SEM). L. Tuminello*[1], M. Caccamo[1], and G. Licitra[1,2], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A. Catania University*, *Catania, Italy*.

Nine traditional Sicilian cheese varieties, five pressed and four pasta filata cheeses, at the best commercial representative ripening age, were analyzed by SEM. The cheeses had different peculiar shapes and hardness. They were cylindrical for the pressed cheeses (Sicilian Pecorino P.D.O., Maiorchino, and Tuma Persa hard cheeses, Piacentinu Ennese semi-hard cheese, Fiore Sicano soft cheese), parallelepiped for the pasta filata hard cheeses (Ragusano P.D.O. and Palermintano), pear like surmounted by a short neck with a ball head for the semi-hard pasta filata cheese (Provola dei Nebrodi), and disc like for the other fresh soft pasta filata (Vastedda del Belice). The sampling was done using a cheese trier by extracting a cheese core; three rectangular strips (approximately 1 x 3 x 8 mm) were cut from the medial region of each core and were prepared according to McManus et al. (1993) procedure. Samples were then dried in a critical point drying apparatus, mounted on aluminum stubs, sputter coated with gold-palladium for 15 s, and observed by SEM at 15 kV. A series of sequential images, from two fields, were recorded at 500X and 1000X magnification. As expected, significant differences on the cheeses microstructure between the pressed and pasta filata cheeses were detected. Differences were observed also within each of the above cheese categories. The pressed cheeses showed a protein matrix sponge-like structure permeated by a well distributed system of empty spaces that were originally occupied by fat globules and whey. Casein micelles join each other to form clusters and strands with no defined orientation. These amorphous texture of Sicilian pressed cheeses have been observed also in other pressed cheeses. Pasta filata cheeses showed a fibrous structure (long fiber) as a result of curd stretching. Stretching transforms the amorphous 3-dimensional protein matrix into a network of parallel-aligned protein fibers. Casein molecules interact and bind each other to form a long sheaves uniformly oriented in one direction.

Key Words: Sicilian cheeses, SEM, Microstructure

171 Impact of milk lactose reduction on the chemical, textural and shredded cheese quality of mozzarella. C. Chen*, A. Bostley, J. Jaeggi, K. Lim, and M. Johnson, *Wisconsin Center for Dairy Research*, *Madison, WI.*

For mozzarella, the primary texture attributes related to acceptable shredding are firmness and adhesiveness. The firmer and less adhesive the mozzarella, the higher the Shred Grade (an indicator of shredded cheese quality). Our goal was to manufacture a firmer more shreddable cheese using a reduction in milk lactose as a control point for acidity development and solublization of colloidal calcium phosphate (CCP). LMPS Mozzarella: pasta filata (PF) and non-pasta filata (NP), were manufactured using milk with lactose reduction (RL) or without (control). Milk lactose levels were reduced by ultrafiltration and diafiltration to a ratio of 0.60 lactose:casein. Cheese pH and insoluble calcium levels were measured at 1, 7, 14, 28 and 56 d. Cheeses were shredded using an Urschell CC-D. Texture attributes, as determined by descriptive sensory analysis, and Shred Grade were determined periodically through 56 d of aging. No differences were observed between treatments in the rate of acid production during cheese making, however, the RL cheeses had a higher pH throughout aging. RL NP cheeses had more insoluble calcium, a firmer and less adhesive texture and a higher Shred Grade. PF mozzarella exhibited no difference between control and RL treatments in insoluble calcium levels, texture or shredded cheese quality. The different outcomes between mozzarella styles can be attributed to when acidity was developed. For PF mozzarella, acidity is developed in the cheese making vat. During plasticizing, brining and early refrigeration there are minimal changes in pH. For NP mozzarella, the majority of the acidity develops during pressing, cooling and early refrigeration. During this time, sugars are fermented, pH drops and CCP solubilizes. Because the RL treatment has a lower concentration of residual sugars, the process ceases earlier, resulting in a higher pH and more insoluble calcium. Reducing lactose as a means of improving shreddability is most effective in cheeses where acidity is developed during pressing.

Key Words: Mozzarella, Insoluble calcium, Shredding

172 Influence of salt up take and aging temperature on chemical composition and on early gas defects in raw milk pasta filata Ragusano cheese. G. Licitra*[1,2], M. Caccamo[1], G. Marino[1], G. Tumino[1], and G. Farina[1], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A. Catania University*, *Catania, Italy*.

Fifty one 3.8-kg experimental blocks of Ragusano cheese were made. One block was analyzed at time 0 prior to brining, the other 50 blocks were submerged in a not saturated brine (18%) at 15°C and divided in two groups. One group (25) was left in brine for 6 d (GR6), the other group (25) for 12 d (GR12). A block of cheese for each group was sampled after brining. The remaining 24 blocks per group were left to ripen at a different temperature (12, 16, and 20°C), 8 blocks per treatment for 30d. Two blocks per treatment were removed for sampling at 15 and 30d of ripening. The last 6 blocks per treatment were split in 3 sub treatments and left to ripen at a 12, 16, and 20°C, 2 blocks per sub treatments for further 60d, and were sampled at 60 and 90d of ripening. Each block at sampling day, was weighed and divided in P1,P2,P3,P4 portions using a meat slicer (Melilli et al 2003). The trial was replicated three times. Across all treatments the GR12 cheeses had significant higher weight loss, lower moisture content and higher salt up take compared to GR6. The weight lost was significant higher for the ripening treatments at 20°C followed by the cheeses at 12°C and then the one ripened at 16°C. Opposite trend was observed for moisture lost during ripening with the highest differences for the portions P1 and P2. Gas production was measured by image analysis (Caccamo et al., 2004) to determine the percentage of surface area of the cheese slice occupied of gas holes. The cheeses ripened at 12°C for 90d presented the lowest percentage (ca 75%) of gas holes compared to those ripened at 20°C for 90d. Interactions were observed after 30d when cheeses were switched at different temperature. In portions P3 and P4 the only way to control gas production was by keeping the room temperature at 12°C for 90d. To control weight lost, lower gas holes and keep reasonable fermentation during Ragusano cheeses aging, the ripening room temperature should be set up between 12 and less than 16°C.

Key Words: Ripening temperature, Salt uptake, Raw milk pasta filata Ragusano cheese

173 Development of Pasteurized Process Queso Fresco. R. Muhar*, N. Y. Farkye, and A. Schaffner, *California Polytechnic State University*, *San Luis Obispo*.

The increase in Hispanic population in the United States, especially in California and increased consumer interest in Tex/Mex foods has increased the demand for Hispanic cheeses. The objective of this study was the development of a method for the manufacture of pasteurized

process cheese from Queso Fresco (QF) to help manufacturers salvage excess trimmings, out of spec cheese, etc. QF is a soft, unripened and non melting Hispanic cheese (containing 46.8% moisture, 27.2% fat, 18.5% protein, 2.8% salt and pH 6.5). Pasteurized process Queso Fresco (PPQF) was manufactured on 3 occasions from separate lots of QF (aged 5 d, 1 mo or 2 mo) using 3% sodium citrate or disodium phosphate as emulsifying salt and food grade citric acid for pH adjustment. Mean composition of PPQF was 46.8% moisture, 26.4% fat, 17.8% protein, 2.8% salt, and pH 5.6-7.0. Meltability (mm) and textural parameters (hardness, cohesiveness, springiness, gumminess and chewiness) of PPQF were determined by modified Olson and Price method and TA-XT2 Texture Analyzer, respectively. Meltability of PPQF was significantly ($P < 0.001$) influenced by the type of emulsifying salt and citric acid × emulsifying salt. There was positive correlation but insignificant effect of PPQF moisture, protein and fat on meltability. All texture parameters except springiness were significantly ($P < 0.05$) decreased with cheese age. All texture parameters except cohesiveness were significantly ($P < 0.05$) affected by emulsifying salt × citric acid ($P < 0.001$), moisture × pH ($P < 0.05$) and fat × pH ($P < 0.05$). PPQF hardness was significantly influenced by emulsifying salt ($P < 0.01$) and cheese moisture × protein ($P < 0.05$). In addition, PPQF hardness, springiness, gumminess and chewiness were significantly ($P < 0.05$) increased with decreased cheese pH. Results show that QF age influenced PPQF texture but not meltability. However, meltability and texture parameters of PPQF were influenced by type of emulsifying salt and pH adjustment of QF before processing.

Key Words: Pasteurized process Queso Fresco, Metability, Texture

174 Effect of total calcium content, intact casein content, and pH on the functional properties of process cheese. R. Kapoor* and L. E. Metzger, *MN-SD Dairy Foods Research Center, University of Minnesota*, *St. Paul, MN*.

The objective of this study was to evaluate the effect of total calcium content, intact casein content, and pH on the functional properties of process cheese. Eight process cheese food (PCF) formulations with two levels each of total calcium content (Ca) (0.45 and 0.65 %), intact casein content (IC) (14 and 18 %), and pH (5.5 and 6.1) were manufactured on a small-scale using a rapid visco analyzer (RVA). All the eight PCF were formulated so that their total moisture, fat, and protein content were the same. Therefore, the only chemical properties that were different in the eight PCF were Ca, IC, and pH. All the PCF manufactured were analyzed for functional properties including un-melted texture and melted texture using texture profile analysis (TPA) and RVA-melt test, respectively. The mean values of TPA-hardness, RVA-hot apparent viscosity and time at 5000 cP ranged from 53 N, 360 cP and 12.35 min respectively for the PCF formulated to 0.45 % Ca, 14 % IC, and a pH of 5.5 to 117 N, 716 cP and 11.09 min respectively for the PCF formulated to 0.65 % Ca, 18 % IC, and a pH of 6.1. As IC of PCF increased, its TPA-hardness significantly increased ($P < 0.05$). Additionally, as Ca and IC of PCF increased, its RVA-hot apparent viscosity significantly increased ($P < 0.05$) and the time at 5000 cP significantly decreased ($P < 0.05$). Consequently, Ca, IC, and pH of a process cheese are critical chemical properties that determine the functional properties of the process cheese. This information will help process cheese manufacturers to appropriately balance these chemical properties during process cheese manufacture to produce process cheese with consistent functional properties.

Dairy Foods: Political, Economic, and Scientific Considerations of Milk Component Utilization

175 Withdrawn by author.

176 Status of milk component separation and utilisation in Europe. J. F. Kleibeuker*, *European Dairy Association*, *Brussels, Belgium*.

Milk has been an ingredient in food preparations for many hundreds, if not thousands, of years. This is because both the nutritional and taste contribution of milk as well as its funcionality in the physical structure of a broad range of preparations has been appreciated by consumers. In the development of the industrial production of food products, also a lot of work has been done on milk based ingredients. Separation of milk in various fractions allowed a further optimalisation of the contribution of milk based ingredients to food products quality. For more then 50 years, European dairy industies have worked on the development of a range of products such as casein, whey proteins, lactose and milksalts. A survey will be given of the present separation and modification techniques and of the market environment that stimulated the development of customer designed products.

Key Words: Milk ingredients, Market orientation, Market policies

177 Conditions of competition for milk protein products in the U.S. market. J. Coleman*, *U.S. International Trade Commission*, *Washington, DC*.

This paper draws from a Congressionally-mandated study by the U.S. International Trade Commission on conditions of competition for milk protein products in the U.S. market. This paper identifies recent trends in production and international trade in milk protein products. It describes how economic and non-economic factors (such as food regulations and standards) have impacted product development and international trade in milk components. The paper also discusses the major uses and applications for such products in processed food and pharmaceutical products.

Key Words: Milk protein, International trade, U.S. International Trade Commission