litter number born alive (NBA) of 9 different cross-bred classes of Large White (LW) and Pietran (Pt) pigs, to estimate classical heterosis and determine the presence of epistasis via recombination loss.

51,180 records of LW and Pt pure and crosses were taken from a database provided by JSR Genetics Plc. NBA estimates for 9 types of cross (pure LW & Pt, F1, and backcrosses 1, 2 & 3) were made using a full linear mixed model with parity, serve number, mating method (AI or natural) and type of cross as fixed effects. An alternative reduced model was fitted with LW fraction, heterosis and recombination loss included as covariates. The fitted values obtained from the reduced regression model were compared to cross type estimates from the factor model. The regression model was also run using an extended dataset including records from 95 animals of the same LW fraction but different cross types.

Regression co-efficients of heterosis, recombination loss and LW fraction on NBA; and NBA means (under LW fraction = 1) and estimated differences from the mean across all LW fractions are shown in the table.

Regression estimates indicate a significant heterotic effect on NBA. Recombination loss effects appear large, suggesting strong additive x additive epistatic effects but large standard errors mean they can only be determined as significantly different to zero using the extended data. The reduced regression model provided a similar pattern of responses to the full model.
NBA means and estimated differences

LW fraction	Factor	Regression	Extended
1	8.449	8.347	8.411
0.9375	0.249	-0.216	-0.280
0.875	-1.151	-0.340	-0.450
0.75	0.434	-0.317	-0.461
0.5	0.805	0.821	0.832
0.25	-0.808	-0.354	-0.480
0.125	-0.468	-0.396	-0.478
0.0625	-0.467	-0.281	-0.312
0	-0.056	-0.075	-0.038
Regression Estimates			
LW Fraction	-	0.075 (0.19)	0.038 (0.19)
Heterosis	-	1.717 (0.44)	1.701 (0.44)
Recombination Loss	-	-5.819 (3.09)	-7.014 (2.96)

Key Words: Heterosis, Litter Size, Pigs

146 Blup with SAS. Z. Zhang*, *Cornell University*, *Ithaca, NY*.

The SAS procedure Mixed and statistical models with genetic correlated random effect are intensively and independently used in biological research. The limitation factor for the joint application is the complexity to construct variance of genetic correlated random effect among individuals. A computer program LORG in the form of SAS macro is presented to facilitate the joint applications. The macro automatically constructs a SAS dataset that defines the variance structure of genetic correlated random effect. The SAS dataset can be imported by SAS procedure Mixed with the option of GDATA or LDATA. The macro is flexible enough to allow users to select type of pedigree to calculate probability of identity by decent and fit multiple traits and multiple genetic correlated random variables. The use of the macros is demonstrated through an illustrative example on simulated data.

Key Words: Mixed Model, SAS, Pedigree

Dairy Foods: Products and Processing

147 Development of cold resistant strains of bifidobacteria by natural selection. S. Ibrahim*, *North Carolina Agricultural and Technical State University*, *Greensboro*.

Recent studies have shown the health benefits associated with regular consumption of dairy food products containing bifidobacteria. Because they provide a very favorable growing environment, dairy products have been the preferred medium to reintroduce viable populations of bifidobacteria into the GI tract. To provide health benefits, bifidobacteria must remain viable in large numbers in the carrier food. Consequently, it is important to establish the survival and viability of these cultures when subjected to refrigerated storage. The objectives of this study were to investigate whether the survivability or resistance of bifidobacteria in cold storage could be improved by natural selection and to test a cold resistant strain for β-galactosidase activity and autoaggregation behavior. Twenty-nine different bifidobacteria cultures were propagated in TPY broth. Strains were transferred daily for 29 weeks into fresh TPY broth and incubated at 37C. Natural selection of the bacteria was achieved by making daily transfers of the cultures into fresh TPY and by lowering the growth temperature two degrees every week. Growth was monitored by measuring the optical density (O.D.) at 610nm. Results indicated that all 29 strains were able to grow at lower temperatures (<37 C) and achieve high cell density. However, only 10 of the strains were able to survive growth temperature below 20 C and maintain high cell density (O.D. > 0.90). Five strains were able to survive temperatures below 15 C and had high cell density (O.D. > 0.80). Two strains were able to grow at 7 C and reached high cell density (O.D. >0.80). The β-galactosidase activities of these strains were similar to the wild strains and showed a marked ability to autoaggregate in TPY. These results suggest that some strains of bifidobacteria are cold resistant and that their growth can be further improved through by a natural selection process that favors the growth of cold resistant bacteria. These findings further suggest that bifidobacteria can survive and thrive in limited time cold storage, which supports their use in dairy products as a health promoting probiotics.

Key Words: Cold Resistant, Bifidobacteria

148 A unique Japanese functional yogurt containing specific egg yolk immunoglobulin to suppress *Helicobacter pylori* in humans. A. M. Abdou*[1], K. Horie[1], N. Horie[1], Y. Kodama[2], Y. Hoshikawa[3], T. Yamane[4], A. Hansen[2], and M. Kim[1], [1]*Pharma Foods International Company, Ltd.*, *Kyoto, Japan*, [2]*Ghen Corporation*, *Gifu-City, Japan*, [3]*Glico Dairy Products Company, Ltd.*, *Tokyo, Japan*, [4]*Matsushita Memorial Hospital*, *Osaka, Japan*.

Health-conscious consumers increasingly looking for foods that promote good health and could reduce risk of diseases. Dairy products are excellent media to generate an array of products that fit into the current consumer demand. In particular; scientific and clinical evidence is mounting to corroborate the consumer perception of health from yogurt.

Hyperimmunization of hens could provide a convenient and economic source of immunoglobulin in their egg yolk (termed IgY). Accordingly, a novel approach in prevention and reduction of *Helicobacter pylori* (a gastro-duodenal ulcer pathogenic bacterium that infects over 50% of the population worldwide) has been achieved based on production of urease-specific IgY (IgY-urease) that prevent *H. pylori* colonization in the gastro-duodenal mucosa.

Specially designed yogurt containing 2 g IgY-urease egg yolk was produced commercially in Japan. IgY-urease activity showed stability in the product up to 7 d, and then decreased to 85% after 3 wk of storage. A clinical study was conducted to determine the effect of IgY-urease yogurt to suppress infection in humans. One hundreds seventy-four volunteers were screened using a 13C-urea breath test (UBT). Heavily infected volunteers with UBT values over 30 were selected (16 subjects) and recruited. Each volunteer consumed 1 cups of yogurt twice daily (4 g/ d egg yolk containing 40 mg IgY-urease) for 12 wk. Volunteers were tested after 4, 8 and 12 wk. UBT values significantly decreased after 8 and 12 wk. The study demonstrated that administration of a specially designed yogurt augmented with highly specific antibodies from egg yolk could effectively suppress *H. pylori* infection in humans.

Key Words: *Helicobacter pylori*, Egg Yolk Immunoglobulin, Functional Yogurt

149 Evaluation of process cheese food funtionality using various melt-tests. A. C. Biswas*[1], R. Kapoor[2], L. E. Metzger[2], and K. Muthukumarrapan[1], [1]*South Dakota State University*, *Brookings*, [2]*University of Minnesota*, *St. Paul*.

The melt characteristics of process cheese are an important functional attribute. However measurement and interpretation of cheese melt characteristic is difficult and a variety of methods can be used. The objective of this study was to evaluate and compare the meltability of process cheese foods (PCF) using various available meltability tests. The melt properties of 24 different PCF samples were analyzed using modified Schreiber test, melt profile analysis, meltmeter, and rapid visco analyzer (RVA). Total melt area was determined using modified Schreiber melt test at 90°C, softening temperature and time, cheese melting temperature and time, flow rate, and extent of flow were determined using melt profile analysis, melt/flow behavior was determined by meltmeter at 60°C, and hot apparent viscosity (HAV) and time at 5000 cP were determined using RVA melt test. There were high correlations between modified Schreiber melt area (MSMA) and RVA melt test (0.72, and 0.79 for HAV and time at 5000 cP respectively). In melt profile analysis cheese melting time and flow rate had a good correlation with other melt tests, (0.60 and 0.71 for MSMA, 0.60 and 0.62 for HAV, and 0.64 and 0.70 for time at 5000 cP respectively). The meltmeter data was not highly correlated (<0.46) with the data from the other melt tests. The results of this study indicate that in numerous cases the different melt tests are measuring similar cheese properties. Consequently, the preferred melt analysis technique for a particular application depends on equipment availability, personal expertise and time constraints.

Key Words: Process Cheese, Melt Analysis

150 Influence of brine concentration, brine temperature, and presalting on salt uptake by Ragusano cheese. C. Melilli[1], D. M. Barbano[2], M. Caccamo[1], G. Licitra*[1,3], and S. Carpino[1], [1]*CORFiLaC*, *Ragusa, Italy*, [2]*Cornell University*, *Ithaca, NY*, [3]*D.A.C.P.A., Catania University*, *Catania, Italy*.

Thirty 3.6-kg blocks of Ragusano cheese were made on each of 6 days. On 3 days cheeses were not presalted while on other 3 days were presalted (PS) prior to stretching. Blocks (15) were placed in 18% brine (18%B) and the other 15 into saturated brine (SB). For the 15 blocks within each of the 2 brine concentrations (BC), 5 blocks were placed in brine at 12, 5 at 15, and 5 at 18°C. A block was removed from each brine tank after 1, 4, 8, 16, and 24 d, to be analyzed. Moisture loss was higher for cheese in SB. More than 50% of the moisture loss occurred in the first 8 d of brining. Cheese kept in SB for 24 d had 2.6% more weight loss (i.e., moisture loss) than cheese kept in 18%B. This reflects an important loss of cheese yield when using SB. Cheese blocks were divided into equal portions P1 to P4, with P1 representing the exterior quarter and P4 the interior quarter of the block. PS increased the salt content of all 4 portions of the block equally (ca. 1%) before brining, but PS did not reduce subsequent uptake of salt from brine. After 24 d of brine salting, the PS cheese had 3.1% salt, while the cheese that was not PS had only 2.3% salt. The PS cheese had 1.5 to 2 times the salt content in P4 than cheese that was not PS. PS and lower BT reduced early gas formation. Total salt uptake from brine (g) was influenced by BC but not directly by BT and PS. Salt uptake was faster for cheese in 18%B than for cheese in SB. PS cheese achieved a higher total salt content in less time than cheese that was not PS. PS had the largest and most immediate impact on increasing salt content in P4. While 18%B had a faster rate of salt penetration into the block than SB, there may be other challenges in controlling microbial growth in 18%B. Thus, the combination of PS and BT (≤ 18°C) may be more effective in reducing early gas formation than using 18%B to increase the rate of salt penetration.

Key Words: Presalting, Brine Temperature, Brine Concentration

151 Flow cytometry enumeration of individual bacteria in bulk tank raw milk produced in Minas Gerais, Brazil. C. Fonseca, L. Fonseca*, W. Santos, and R. Rodrigues, *Laboratory of Milk Quality Analysis-DTIPOA, School of Veterinary Medicine, UFMG/FUNDEP*, *Belo Horizonte-MG-Brazil.*

Brazil has a growing dairy industry, with annual production of 23 billion liters. To improve the milk quality and reach international standards, new laws are being gradually implemented in Brazil. The objective of the present work was to evaluate the microbial quality of the bulk tank raw milk produced in Minas Gerais, Brazil, and to compare the current findings with the legal requirements to be implemented on July 2005. From December 2003 to January 2005, 51,090 samples from thirteen dairy industries were evaluated for individual bacteria count (IBC). The dairies were located in the Minas Gerais State, whose production shares 30% of the milk produced in Brazil. The raw milk samples, preserved with azidiol (sodium azide, chloramphenicol), a bacteriostatic, were collected by the dairies and sent to the Laboratory for Milk Quality Analysis (DTIPOA/School of Veterinary Medicine/UFMG), not more than 72 hours after collection, in insulated boxes with reusable ice. The analyses were done by flow cytometry, with a BactoCount IBC (Bentley®), calibrated to obtain statistical transformation of IBC per mL to colony forming units per mL (CFU). Geometric and arithmetic means for microbial population were, respectively, 139,000 CFU/mL and 687,000 CFU/mL (standard deviation of 1,323,000). There was seasonal influence, with monthly geometric mean ranging from 59,000 CFU/ml during dry season to 390,000 CFU/mL during raining season, when hygienic conditions usually worsen. A total of 18.6% of the samples were in disagreement with the initial standard, which is 1,000,000 CFU/ml as geometric mean, and this was a result of improper hygienic milking, storage, and transportation of the milk. However, there was a decreasing tendency of counting during the evaluated period. The results show that, although the average quality of the milk produced in the state needs improvement, the majority of the dairy producers are in compliance with the new Brazilian regulations. Additionally, new studies will be necessary to evaluate the suitability of transformation of IBC to CFU.

Acknowledgements: FUNDEP/UFMG CNPq

Key Words: Milk Quality, Individual Bacteria Count, Bactocount

152 Pilot-scale production and characterization of liquid virgin whey protein concentrate. P. A. Marcelo* and S. S. H. Rizvi, *Cornell University*, *Ithaca, NY*.

The objective of this study was to produce liquid virgin whey protein concentrate (LVWPC) containing at least 90% whey protein (dry basis) and determine its physicochemical properties.
Virgin whey was harvested from microfiltration of acidified skim milk (pH = 6.1) prior to cheesemaking and concentrated to 60x by ultrafiltration and

diafiltration at 50°C using a two-stage pilot-scale process. The gross composition, viscosity and density of fresh LVWPC were determined and its pH monitored during storage at 4 °C. It was then freeze-dried and solutions containing 5-25 wt.% whey protein (WP) were prepared and their rheological properties were compared with those of WPC-80 and WPI. The temperature and enthalpy of denaturation of LVWPC proteins in 10 wt.% WP solutions were also measured using differential scanning calorimetry.

The LVWPC produced contained 26.3% total solids with 90.3 wt.% (db) WP. Its pH at 4°C was constant at 6.1 for 38 days. Its density and apparent viscosity at 20°C were 1.11 g/cm^3 and 11.7 mPa-s, respectively. The apparent viscosity of freeze-dried LVWPC solutions varied linearly with protein concentration up to 12 wt.% and exhibited close to Newtonian behavior up to 25 wt.%. The intrinsic viscosity was 3.32 cm^3/g. The activation energy of flow from 5 to 25 wt.% protein ranged between 15.77 and 17.84 kJ/mol, lower than those of WPC-80 and WPI. The average temperature and enthalpy of denaturation were 83.3°C and 10.04 J/g, respectively.

When WP is obtained as a by-product of cheesemaking, the series of processes that it undergoes cause fractional WP denaturation, which adversely affects the physicochemical properties and functionality of commercial WP products. The results of our study suggest that harvesting WP prior to cheesemaking and concentrating it by gentle membrane technology enabled the production of high-purity and essentially sterile LVWPC, a novel ingredient rich in native WP.

Key Words: Whey Proteins, Physicochemical Properties, Membrane Technology

153 Tangential microfiltration of skim milk for removal of *Bacillus anthracis* spores. N. Datta[1], P. Tomasula*[2], J. Call[2], and J. Luchansky[2], [1]*University of Queensland, Australia*, [2]*United States Department of Agriculture, Wyndmoor, PA*.

The objective of this study was to examine the use of cross-flow microfiltration as a step prior to high-temperature short-time (HTST) pasteurization to remove *Bacillus anthracis* (BA) spores that may have been added intentionally to raw milk. In experiments, 2500 mL of retail skim milk were inoculated with an average of 6.0 $\log_{10}$ spores/mL of the attenuated Sterne strain of BA. The milk was then microfiltered in a Membralox TI-70 bench scale pilot unit at 50°C using ceramic membranes with pore sizes of 0.5, 0.8, and 1.4 µm, respectively, to determine permeate flux, spore removal, and transmission of lactose, calcium, and milk proteins, at cross-flow velocities of 2, 4, and 6 m/s. The trials were conducted with or without backpulsing, a feature that prevents membrane fouling and concentration polarization effects. Samples of the permeate were collected over a period of 4.5 hrs and were direct plated onto BHI agar plates to enumerate surviving spores. Results indicated that the .5 µm membrane is unsuitable for microfiltration of milk because low permeate flux and severe pore plugging and fouling were observed after only 5 min of operation. The 0.8 µm membrane, at each cross-flow velocity studied, removed approximately 6.2 $\log_{10}$ spores of BA/mL milk that were recovered in the retentate, whereas, for the 1.4 µm membrane, the maximum number of spores, approximately 3.0 $\log_{10}$ spores of BA/mL, were removed at a cross-flow velocity of 6 m/s. Transmission of lactose, calcium and milk proteins through both membranes was 100%. Permeate flux decay was only about 4% at cross-flow velocity of 6 m/s regardless of use of the backpulse feature. As confirmed in this study, microfiltration of milk prior to HTST pasteurization can remove > 99.9999% of BA spores and thus, improve the safety and biosecurity of the milk supply.

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Key Words: Bacillus Anthracis, Microfiltration, Milk

154 Somatic cell counts and composition of bulk tank raw milk produced in Minas Gerais, Brazil. C. Fonseca, L. Fonseca*, W. Santos, and R. Rodrigues, *Laboratory of Milk Quality Analysis-DTIPOA, School of Veterinary Medicine, UFMG/FUNDEP, Belo Horizonte-MG-Brazil*.

Brazil is adjusting its legal requirements to reach international standards for milk quality. The objective of this work was to evaluate the composition and somatic cell count (SCC) of the bulk tank milk produced in Brazil, and to compare the current findings with the new requirements to be implemented on July 2005. From December 2003 to January-2005, 53,011 milk samples from thirteen dairy industries were analyzed. The dairies were located in the Minas Gerais State, whose production share amounts to 30% of the milk in Brazil. The raw milk samples, preserved with bronopol, were collected by the dairies, and sent to the Laboratory for Milk Quality Analysis (DTIPOA/School of Veterinary Medicine/UFMG) not more than 72 hours after collection, in insulated boxes, with reusable ice. The analyses of SCC were done by flow cytometry, and the compositional were by infrared measurement, using a calibrated Combisystem 2300 (Bentley®). The milk quality data were correlated to climatic and economic data. Average values for bulk raw milk composition were, in g/100g (average±SD): fat (3.63±0.44); protein (3.19±0.20); lactose (4.51±0.14), and total solids (12.32±0.58). The geometric and arithmetic means for SCC were, respectively, 346,000/ml and 474,000/ml. However, there was a tendency of SCC lowering, which ranged from a geometric mean of 501,000/ml on December 2003 to 229,000/ml on December 2004. There was an increase in SCC of the milk during raining season ($p \leq 0.01$). Fat and protein content reached highest values in the dry season, respectively, 3.88 g/100g, and 3.30 g/100g, although total milk production was lower during this season. For SCC, 7.3% of the samples were in disagreement with the new legal parameters (geometric mean of 1,000,000 SCC/ml on July 2005, which will gradually decrease to a standard of 400,000 SCC/ml on 2011). However, increasing awareness of the Brazilian dairy producer, improvement of milking practices, better herd health surveillance, and payment of milk based on quality, it is believed that the majority of the milk producers will soon comply with the above requirements.

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Key Words: Milk Quality, Composition, Somatic Cell Count

155 Effect of formulation and manufacturing parameters on process cheese food functionality-II. Di-Sodium Phosphate. S. K. Garimella Purna*, A. Pollard, and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota, St. Paul*.

The objective of this study was to utilize a rapid visco analyzer (RVA) to study the effect of natural cheese age, di-sodium phosphate (DSP) concentration and mixing speed on process cheese food (PCF) functionality. In this study three replicates of natural cheese were manufactured and at 2, 4, 6, 12 and 18 weeks of ripening a portion of each cheese was subjected to six different PCF manufacturing treatments. These treatments were factorial combinations of DSP at three levels (i.e. 1.5, 2.0, and 2.5%) and two mixing speeds (450 rpm and 1050 rpm). Functional properties of PCF evaluated included manufacturing properties (apparent viscosity after manufacture (VAM)); un-melted textural properties (firmness); melted cheese flow properties (hot apparent viscosity (HAV)); and cheese thickening during cooling (time at 5000cP (T5)). All four parameters (VAM, firmness, HAV and T5) were significantly ($p < 0.05$) affected by natural cheese age, mixing speed and concentration of DSP. The VAM, HAV and firmness decreased as cheese age increased, while T5 values increased as cheese age increased. Similarly firmness was increased at high mixing speed. The age and mixing speed interaction was significant ($p < 0.05$) for VAM and firmness, and as the age of the cheese increased the effect of mixing speed decreased. The age and concentration of DSP interaction was significant ($p < 0.05$) for VAM, HAV and T5, whereas the concentration of DSP and mixing speed interaction was significant ($p < 0.05$) for firmness. The effect of mixing speed as well as concentration of DSP on VAM, HAV, and firmness was larger during early ripening and significant differences between treatments were observed at two weeks, however no significant differences between treatments were observed at 18 weeks. The results demonstrate that natural cheese age, mixing speed during manufacture and the concentrations of DSP have a significant impact on process cheese functionality.

Key Words: Process Cheese, Functionality