and from various genome-sequencing efforts. These sequences covered the casein gene cluster region or parts of it in 15 mammalian species: human, chimpanzee, macaque, marmoset, galago, mouse, rat, rabbit, shrew, bat, dog, cow, armadillo, elephant and opossum.

This and earlier studies indicated that the casein genes are located in a mammalian specific genomic domain. This domain contains besides the casein genes a number of non-casein genes that share evolutionary ancestry, spatial expression patterns (mammary and salivary gland), and functional properties (secreted (phospho)-proteins, involvement in mineral homeostasis, and immune modulation). The presence and structure of orthologous genes in the mammalian species studied was determined. Predicted transcripts were cloned from a number of species. Phylogenetic analyses showed that the divergence of the casein genes is not only due to a high rate of nucleotide substitutions but also to the differential use of exons. Genomic rearrangements were identified that result in deletions of genomic segments containing casein genes, e.g. lack of alpha-s2-like genes in shrew. Overall there is remarkable conservation in this region with regard to the genes present, gene structure, and gene order and orientation despite high divergence at the nucleotide level.

These studies also identified a number of non-coding conserved regions that might play a role in gene regulation. These included the upstream beta-casein enhancer, previously identified in human and cow and now shown to be present in most species studied albeit at different positions with respect to the beta-casein promoter. Computational analyses identified patterns of conservation in these regions and the proximal promoters that represent transcription-factor binding sites known to be involved in casein gene expression.

Acknowledgements: Funding USDA-CRIS 6250-51000-048

Key Words: Milk Protein, Casein, Genomics

38 Distinguish between native and thermally denatured β-lactoglobulin using a monoclonal antibody as a probe. S. J. T. Mao*, W. L. Chen, M. C. Yang, and W. T. Liu, *National Chiao Tung University*, *Hsinchu, Taiwan*.

Previously, we have established a monoclonal antibody (mAb) line to study the thermal denaturation of β-lactoglobulin (LG) and have identified an epitope responsible for its biological functions (Chen et al., J Dairy Sci. 2004 87:2720-2729 and Song et al., J Biol Chem. 2004 Nov 9; [Epub ahead of print]). In the present report, we prepared a mAb that specific only to native LG, the immunoreactivity was totally abolished when LG was cross-linked to casein, lactalbumin, or other milk proteins upon the heating. Characterization of this native mAb shows that residue Cys-121 of LG was possibly involved for the antibody binding using carboxymethylated LG. Since heating is a necessary procedure in bovine milk processing, the loss of native LG is almost unavoidable. We than used this native mAb to develop a quantitative immunoassay to determine the residual LG in the commercially available milks. The result shows that the loss of native LG was from minor to sever levels. Because LG plays provocative roles in fatty acid, retinol, and vitamin D binding as well as in cell proliferation, determination of native LG in milk products becomes a subject of essence.

Acknowledgements: This work was supported by a grant 90-2313-B-009-001, 91-2313-B-009-001, 92-2313-B-009-002 and 93-2313-B-009-002 from the National Science Council (NSC) Taiwan, ROC.

Key Words: β-Lactoglobulin, Monoclonal Antibody, Thermal Denatureation

Dairy Foods: Extended Shelf Life of Fluid Milk

39 Influence of raw milk quality on fluid milk shelf life. D. M. Barbano*[1], Y. Ma[1], and M. V. Santos[2], [1]*Cornell University*, *Ithaca, NY*, [2]*Universidade de São Paulo*, *Pirassununga, SP, Brazil*.

Pasteurized fluid milk shelf life is influenced raw milk quality. The microbial and somatic cell count (SCC) of milk will determine the load of heat resistant microbial enzymes in milk. Generally, high levels of psychrotrophic bacteria in raw milk will contribute significant quantities of heat stable proteases and lipases that will break down protein and fat after pasteurization. Sanitation, refrigeration, and the addition of CO2 to milk are used to control of both total and psychrotrophic bacteria count. It is not uncommon for total bacteria counts of raw milk to be < 10,000 cfu/mL. In the past, fluid milk processors have not focused much attention on milk SCC. Increased SCC is correlated with increased amounts of heat stable protease (plasmin) and lipase (lipoprotein lipase) in milk that originates from the cow. When starting with raw milk that has low bacteria count, and in the absence of microbial growth in pasteurized milk, enzymes associated with high SCC will cause protein and fat degradation during refrigerated storage and produce off-flavors. As the ability to kill, remove, or control microbial growth in pasteurized refrigerated milk continues to improve, the original milk SCC will be the factor limiting the time of refrigerated storage before development of an off-flavor in milk. Most healthy cows in a dairy herd have a milk SCC < 50,000. Bulk tank SCC > 200,000 are usually due to the contribution of high SCC milk from a small number of cows in the herd. Technology to identify these cows and keep their milk out of the bulk tank could substantially increase the value of the remaining milk for use in fluid milk processing. To achieve a 60 to 90 day shelf life of refrigerated fluid milk, fluid processors and dairy farmers need to work together to structure economic incentives that allow farmers to produce milk with the somatic cell count needed for extended refrigerated shelf-life.

Key Words: Shelf Life, Raw Milk, Somatic Cell Count

40 Current status of commercial fluid milk quality. K. Boor*, N. Carey, S. Murphy, and R. Zadoks, *Cornell University*, *Ithaca, NY*.

Packaged fluid milk samples were collected from 23 dairy processing plants across New York State at least twice per year over a period of 10 years and subjected to shelf life analyses that included Standard Plate Count (SPC), coliform count and sensory evaluation. Products were tested initially and after storage at 6.1°C for 7, 10 and 14 days post-packaging. On an annual basis, the percent of samples that met the Pasteurized Milk Ordinance (PMO) standard of SPC < 20,000 CFU/ml after 7, 10 and 14 days ranged from 46% to 66%, 25% to 50% and 12% to 32%, respectively. Over the ten year period, SPC values across test-days: decreased in eight plants, including the four plants that had the lowest SPC scores among all 23 plants; increased in two plants; and did not change significantly in the remaining 13 plants. The percent of samples positive for coliforms in a given year ranged from 5% to 15% on initial testing and up to 34% after subsequent storage. The percent of samples scored as unacceptable from a sensory perspective (score < 6.0) after 7, 10 and 14 days ranged from 0% to 8%, 16% to 35%, and 41% to 67%, respectively. For the majority of plants, product flavor scores improved during this 10 year period. While some plants involved in the study can produce fluid milk products that are consumer acceptable when stored at 6.1°C for > 14 days, others consistently fall short of this goal.

Acknowledgements: This work was supported by the New York State Dairy Promotion Order, dairy farmers dedicated to the production, manufacture and distribution of quality dairy products.

Key Words: Fluid Milk, Quality, Shelf Life

41 Extending refrigerated shelf life of fluid milk using a novel HTST system. M. A. Drake* and G. Cartwright, *North Carolina State University*, *Raleigh*.

Shelf life remains a crucial economic issue for pasteurized fluid milk. The Feldmeier system is a tubular heat exchanger that functions as a piggyback system on a conventional high temperature short time (HTST) plate pasteurizer allowing higher heat treatment of the milk. The system may provide an alternative economical way to increase refrigerated shelf life of fluid milk. Raw milk (1000 kg) was obtained on three occasions, standardized to 1.5 % fat (w/v) and pasteurized at one of five different temperatures (75°C for 20 seconds only (control) or with the additional heat treatments of 103, 114, 125 or 136C for 3 seconds). Milk was packaged in paperboard cartons or bag-in-boxes and stored at 4C. Pasteurized milks were tested following 0, 7, 14, 21, 28, 42, 49, 66, 80 and 101 days. Microbiological quality and enzymatic quality were determined. Descriptive sensory analysis was conducted with a trained panel at each timepoint. Consumer acceptance testing (n=75) was conducted within 24 h and after 7 and 60 days. Conventionally pasteurized milks reached shelf life failure (>10E6CFU/mL and sensory failure) within 38 days while all Feldmeier milks retained microbiological and sensory shelf life through 80 days. Trained panelists detected higher cooked flavors in the Feldmeier system milks compared to control milks, but these flavors and differences decreased with storage time. Consumer acceptability was comparable to conventional HTST milk after 1 week of refrigeration. The Feldmeier system may be an economically feasible method to increase shelf life of refrigerated pasteurized milk.

Key Words: Shelf Life, Fluid Milk, Refrigerated Storage

42 Application of microwave processing to extend shelf life of fluid milk. J. Simunovic*, P. Coronel, and D. Clare, *North Carolina State University*, *Raleigh*.

One of the significant emerging markets for white and flavored fluid milk and milk-based beverages are vending machines, especially in schools districts where availability of milk has been regulated as mandatory. Distribution by existing beverage vending machines requires processing treatments to impart commercial sterility (i.e. shelf stability) due to unfavorable temperature conditions during the distribution, storage, and vending stages. Flavor quality of such milk preserved using conventional thermal processing is inferior to pasteurized milk based beverages and is considered one of the main concerns for marketability of shelf stable fluid milks.

Non-contact volumetric sterilization using microwave energy is one of the available options for rapid, uniform heating of milk under continuous flow, which could potentially address the noted flavor quality issues of shelf stable milks. Analyses of dielectric properties, recirculated pressurized test runs as well as sterilization and aseptic packaging trials were performed for white and chocolate milk beverages using 915 MHz microwave energy with proprietary cylindrical applicators as energy focusing and delivery structures. Some of the technical issues also addressed were design of high temperature and pressure-rated microwave-transparent conduits and modeling and simulation of dielectric properties and heating behavior of milks in order to formulate appropriate pre-sterilization solutions. Obtained shelf stable beverages were analyzed for microbial stability, flavor profiles and color and compared to same products sterilized using conventional thermal treatment after extended storage under ambient conditions. Flavor quality of microwave-treated products was confirmed as superior to products sterilized using conventional plate heat exchangers.

Key Words: Extended Shelf Life, Fluid Milk, Microwave

43 Use of microfiltration (MF) to improve fluid milk quality. D. M. Barbano* and M. W. Elwell, *Cornell University*, *Ithaca, NY*.

Our objectives were to model bacterial growth in commercially pasteurized skim milk as a function of storage temperature, to determine the efficacy of a MF and pasteurization process in reducing the number of total bacteria, spores, and coliforms in skim milk, and to estimate the shelf life of pasteurized microfiltered skim milk as a function of storage temperature. For objective 1, pasteurized skim milk was stored at 0.1, 2.0, 4.2, and 6.1°C. The bacteria count in these samples was determined semi-weekly. A total bacteria count >20,000 cfu/mL was considered to be the end of shelf life. Shelf life ranged from 16 d at 6.1°C to 66 d at 0.1°C. Decreasing temperature increased lag time and reduced logarithmic growth rate. The effect of temperature on lag time was the biggest contributor to longer shelf life. For objective 2, raw skim milk was microfiltered at 50°C using a Tetra Alcross M7 Pilot Plant equipped with a ceramic Membralox membrane (pore diameter: 1.4 μ) and pasteurized at 72°C for 15 s. Bacteria counts of MF and pasteurized MF skim milk were determined using a most probable number (MPN) method. Across 3 trials, raw milk bacteria count was reduced from 2400, 3600, and 1475 cfu/mL to 0.240, 0.918, and 0.240 cfu/mL, respectively, by MF. Bacterial counts in the pasteurized microfiltered skim milk for the 3 trials were 0.005, 0.008, and 0.005 cfu/mL respectively, for a 5.6 log reduction due to the combination of MF and pasteurization. For objective 3, pasteurized microfiltered skim was stored at 0.1, 2.0, 4.2, and 6.1°C and the bacteria count was determined weekly for 92 d. At 6 time points, decrease in CN/TP (%) was measured as an index of proteolysis. After 92 d, 50% of samples stored at 6.1°C and only 12% of samples stored at 4.2°C had a bacteria count >20,000 cfu/mL. No samples stored at 0.1 or 2.0°C reached a detectable bacteria level. When bacteria count was <1,000 cfu/mL, shelf life was limited by proteolysis to 32 d at 6.1°C, 46 d at 4.2°C, 78 d at 2.0°C, and >92 d at 0.1°C.

Key Words: Microfiltration, Shelf Life, Bacterial Removal

44 Dairy applications for microfiltration. H. Iversen*, *Tetra Pak*, *Vernon Hills, IL*.

In the mid 90s, the microfiltration technology was introduced in the Dairy industry Canada. Creating a brand name PurFilter, the industry was able to convert approximately 15 to 20% of the consumers to microfiltered milk. The product brought an extended shelf life (ESL) milk to the consumer, with a better taste and improved profit for the industry. The log reduction achieved is approximately 4 to 5, allowing a shelf life of 35 days in a market traditionally used to 15 to 20 days with pasteurized milk.

Since then a number of improvements where brought to the technology. The membranes now offer cutting points of 0.8 to 1.4 Âμ, log reduction higher than 6 or 7, and although the commercial sterility has not been reached yet, the milk shelf life can now be extended significantly. The application of this technology in the US market could impact significantly the industry, improving milk sensory bringing better profitability to the industry.

Key Words: Microfiltration, ESL

Graduate Student Competition: National ADSA Dairy Production

45 Processing barley grain for midlactation dairy cows: Steam-rolling versus grinding. A. Nikkhah*[1], H. Sadri[2], M. Alikhani[2], and G. Ghorbani[2], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Isfahan University of technology*, *Isfahan, Iran*.

Economical constraints of replacing conventional grinding with complex steam-processing equipment have faced the dairy industries with a major challenge. The objective of this study was to evaluate the rumen conditions and productivity of dairy cows fed differently processed barley grains. Eight multiparous Holstein cows in their midlactation (85 ± 15 days in milk) were used in a double 4 × 4 Latin square design with four 21-d periods. Processing index (**PI**), or the ratio of the processed barley grain density to the whole barley grain density expressed as %, was used to measure the processing extent of the rolled grains.