

sible for putative dog PepT1 (dPepT1) activity reported earlier by us (FASEB J. 2001, 15: A829), we generated a full-length cDNA predicted to encode a 708 amino acid-protein from MDCK cells using 5'- and 3'-RACE and RT-PCR methodologies. Dog PepT1 shares 81, 83, and 83% amino acid identity with human, sheep, and pig PepT1, respectively. To characterize the functional activity of dPepT1, non-polarized Opossum Kidney (OK) cells were transiently transfected with pcDNA3.1-dPepT1 or pEGFP-N1-dPepT1 (GFP-PepT1) plasmids and glycylsarcosine (GlySar, 1 mM) uptake measured 48 h after transfection. With both dPepT1 and GFP-dPepT1, H⁺-dependent [³H]GlySar uptake (pmol•mg⁻¹ protein•30 min⁻¹) by transfected OK cells was optimal at pH 5.5 (3.1 times greater (P < .0001) vs pH 7.5) and saturable (K_m = 0.57 ± 0.25 mM). IC₅₀ studies demonstrated that dPepT1 possesses a range of substrate affinities (TrpLeu: 38 μM, carnosine: 1200 μM, cefadroxil: 600 μM). GlySar uptake was similar with dPepT1 and dPepT1-GFP. Western blot analysis demonstrated immunoreactivity of anti-pig PepT1 antibody for dPepT1 (92 kDa) in OK cell homogenates. To develop a cell culture model to study membrane-specific substrate- or hormone-dependent regulation of dPepT1, polarized OK cells were transfected with dPepT1 and GlySar uptake (pmol•well⁻¹•90 sec⁻¹) measured. Apical GlySar uptake was 8 times greater (P < .01) than basolateral. This report uniquely describes the molecular and functional characterization of dog PepT1, and demonstrates that a useful cell model to study membrane trafficking and membrane-specific regulation of PepT1 has been established.

Key Words: Canine, Peptide Transport, GFP-PepT1

W38 Feeding of chicken or soy protein-based diet differentially affects in vivo PepT1 uptake capacity in dogs. B. Zanghi¹, G. Sipe¹, G. Davenport², and J. Matthews¹, ¹University of Kentucky, Lexington, ²The IAMS Company, Lewisburg, OH.

Intestinal Peptide Transporter 1 (PepT1) expression can be upregulated by increasing amounts of dietary casein and certain dipeptides. Previously, we demonstrated that orally bolused [³H]cefadroxil (CEF, 40 μCi, 40 nmol) was a good substrate to detect changes in PepT1 uptake capacity in adult, female, mongrel dogs (JAS, 2004, 82(1): A375). The objective of these experiments were to evaluate the effect of feeding isonitrogenous diets that contained chicken (C) or soy (S) protein sources on PepT1 functional capacity and total tract digestibility. CEF was bolused 4 (Exp. 1) or 14 h (Exp. 2) after feeding and ³H appearance, metabolism, and disappearance in blood, urine, and feces was measured. Exp 1 compared the effect of 18-d feeding of C, S, and S supplemented with carnosine or glycylsarcosine diets on these CEF parameters using a 4 x 4 Latin Square design (n = 4; BW = 21.3 ± 2.5 kg), whereas Exp 2 evaluated 39-d feeding of C versus S diets with a crossover design (n = 3). For Exp 1 and 2, the C diet had a greater (P < 0.05) apparent total tract DM, OM, CP (92 vs 86%), DE, and NDF digestibility versus any S diet. In Exp 1, plasma content (pmol) of CEF from 3.5 or 5.5 h through 12 h after dosing (renal retention capacity) was 19 or 24% greater (P < 0.06) with the C diet than the S diet. In Exp 2, plasma content of CEF was 200 or 89% greater from 0 through 1.5 h or 2.5 h, respectively, after dosing (intestinal uptake capacity) with the S diet than C diet. No treatment effects were observed for CEF metabolism or ³H disappearance from plasma or urine in either experiment. Within a dietary treatment and across experiments, intestinal and renal CEF absorption capacity increases in the post-prandial state of dogs fed a C diet, whereas CEF absorption capacity is about the same in the postprandial and fasting state of dogs fed a S diet. These data indicate that C and S diets differentially affect in vivo PepT1 functional capacity.

Key Words: Canine, Intestine, Cefadroxil

Dairy Foods: Dairy Microbiology and Dairy Processing

W39 Quality characteristics and consumer acceptance of yogurt fortified with date fiber. I. Hashim*, A. Khaul, and H. Afifi, UAE University, Al Ain, United Arab Emirates.

Milk and dairy products do not contain fiber while the by-product produced during date syrup production is a good source of dietary fiber. The objective of this study was to investigate the effects of date fiber (DF) fortification on yogurt quality and sensory properties. Quality characteristics, sensory properties and consumer acceptance of yogurt fortified with DF were evaluated. Yogurt samples were prepared from whole milk using a commercial yogurt formula (2.5% milk solid nonfat, 0.6% stabilizer and commercial yogurt culture). Control yogurt and yogurts containing 1.5, 3, and 4.5% DF as well as 1.5% wheat bran (WF) were prepared. Acidity (1.04) and pH (4.47) of yogurt were influenced by DF fortification (1.08 and 4.61-4.65). Yogurts fortified with DF had firmer texture (hardness 55-57) and darker color [lower L* (75.4-84.8) and higher a* (2.7-4.9)] than control (L = 95.5 and a* = -.8) or WF (L=89.3 and a* = 0.8) yogurts. Hedonic ratings by 32 consumers indicated that yogurt appearance (8.3) and color (8.5) were significantly affected by the addition of DF (6.2-6.5). Yogurt containing up to 3% DF had similar hedonic ratings for sourness, sweetness, firmness and overall acceptance as the control yogurt. Increasing DF to 4.5% decreased sensory ratings and acceptability of yogurt significantly.

Fortifying yogurt with 3% DF produced acceptable yogurt with beneficial health effects.

Acknowledgements: This study was funded by the Research Council at United Arab Emirates University.

Key Words: Yogurt, Date Fiber, Quality and Consumer Acceptance

W40 Effect of milk heat treatment on the growth and viability of *Bifidobacterium animalis* Bb12 during fermentation and storage of yogurt. L. Fachin and W. Viotto*, State University of Campinas - UNICAMP, Faculty of Food Engineering, Department of Food Technology, Campinas, SP, Brazil.

Production of yogurt with *Bifidobacterium* spp. has been attracting much attention in the last years due to health benefits of these microorganisms. However, it is claimed that a minimum level of these bacteria (usually 10⁶ cfu/g of the product) should remain viable at the moment of consumption. Many studies have pointed to the low viable counts of these microorganisms during shelflife. Lactulose is a known prebiotic that is produced by severe heat treatments of the milk. The objective of this work was to evaluate the effect of the heat treatment of 142°C/15 s comparing to the control one, 90°C for 5 minutes, on the growth of *Bifidobacterium animalis* BB 12 during yogurt fermentation and its viability during storage, monitoring textural changes, syneresis and yogurt post-acidification. Heat treatment of 142°C/15 s had no effect on the growth of *Bifidobacterium animalis* Bb12 during yogurt fermentation and on its viability during storage. Yogurt post-acidification also did not change but heat treatment impaired texture, decreasing hardness, gumminess and adhesiveness of the product. Whey separation, however, was slightly improved compared to the control.

Key Words: Heat Treatment, Probiotic, Yogurt

W41 Effect of *Propionibacterium freudenreichii* PS-1 on the growth and viability of *Bifidobacterium animalis* Bb12 during fermentation and storage of yogurt. L. Fachin and W. Viotto*, State University of Campinas - UNICAMP, Faculty of Food Engineering, Department of Food Technology, Campinas, SP, Brazil.

Bifidobacterium spp. is increasingly being incorporated into dairy foods, especially yogurt, due to their health benefits. However, many studies have shown

low viability of these microorganisms during shelflife. Consequently, much attention is being paid to increase growing and survival of these microorganisms in dairy foods. In the last decade, some studies have pointed to the ability of *Propionibacterium* spp. in producing some bifidus growth promoter metabolites. The objective of this work was to study the effect of *Propionibacterium freudenreichii* PS-1 on the growth of *Bifidobacterium animalis* Bb 12 during yogurt fermentation and its viability during storage, monitoring textural changes, syneresis and yogurt post-acidification. *P. freudenreichii* PS-1 decreased fermentation time of yogurt by 1.2 hours while slightly increased *Bifidobacterium* growing during fermentation. Viability of *B. animalis* Bb 12 decreased 0.3 log cycles in yogurt with *P. freudenreichii* PS-1 and 0.8 cycles in control yogurt during 4 weeks of storage at 7°C. Yogurt texture was drastically changed by addition of propionibacteria with a great increase in gumminess and adhesiveness of the product. Yogurt with *P. freudenreichii* PS-1 also showed a lesser tendency to post-acidification than the control one and it also decreased whey separation by half of its value after storage.

Key Words: *Bifidobacterium*, *Propionibacterium*, Yogurt

W42 Development of symbiotic goat's milk yogurt beverage. S. Li*, S. Gokavi, and M. Guo, *University of Vermont, Burlington.*

Goat's milk and its products are gaining popularity in the USA and other developed countries and they are considered as specialty foods. The objectives of the study were to develop symbiotic beverages; and to evaluate the viability of probiotics during storage. Four prototypes were developed: Plain (A), Vanilla (pH 4.1) (B), Strawberry (pH 3.8) (C) and Vanilla (pH 3.8) (D). Yogurt base was made using the starter culture Yofast-20 (mixture of *S. thermophilus*, *L. delbrueckii* ssp. *bulgaricus*, *L. acidophilus*, *Bifidobacterium* spp. and *L. casei*) from Chr. Hansen. To the yogurt base sugar, inulin, pectin, water, strawberry flavor, strawberry concentrate, beet extract, citric acid and probiotic supplement (ABC -1 containing *L. acidophilus*, *Bifidobacterium*, spp. and *L. casei*) were added as per the prototypes and then homogenised. The beverages were stored under refrigerated conditions and analysed for changes in pH, titratable acidity (TA) and viscosity. The probiotics were also enumerated every week to determine their viability during storage. Total solids of the beverages ranged from 17.2-17.8, protein 2.5-2.6, fat 2.9, ash 0.6-0.7 and carbohydrates 11.1-11.9%. The beverages had calcium ranging from 148.0-165.3, phosphorus 145.7-167.7, potassium 246.7-351.3 and sodium 64.0-78.9 mg/kg, respectively. The values of pH, TA and viscosity were 4.10±0.03, 4.09±0.06, 3.83±0.06 and 3.83±0.06, 0.71±0.03, 0.71±0.02, 0.84±0.02 and 0.84±0.02%, 31.5±2.67, 31.1±4.43, 39.9±6.81 and 31.1±3.04 mPas for A, B, C and D, respectively. The initial population of *L. acidophilus*, *Bifidobacterium* spp. and *L. casei* were 3.17±2.2x10⁷, 2.5±1.7x10⁷, 3.7±1.8x10⁷ and 1.8±1.1x10⁷; 9.0±9.2x10⁷, 8.58±2.2x10⁸, 8.94±1.32x10⁸ and 5.39±3.4x10⁸; 2±1x10⁶, 2±1x10⁶, 4±3x10⁶ and 2±1x10⁶ cfu/ml for A, B, C and D, respectively. *Lactobacillus acidophilus* was viable only for two weeks, however, *Bifidobacterium* spp. and *L. casei* remained viable for 3 weeks and their viability will be studied for about 8-10 weeks. The results indicate that goat's milk may be a good vehicle for developing symbiotic beverages.

Acknowledgements: Authors would like to thank Oak Knoll dairy for providing goat's milk for the studies.

Key Words: Goat's Milk, Symbiotic, Beverage

W43 Fat free plain yogurt manufactured with inulins of various chain lengths and *Lactobacillus acidophilus* or *Lactobacillus casei*. K. Aryana*, S. Begum, and P. McGrew, *Louisiana State University Agricultural Center, Baton Rouge.*

Health benefits of inulin are several, namely; it is a dietary fiber, improves activity of beneficial bacteria and increases calcium absorption. Dairy products such as fat free plain yogurt do not have fiber. Objective was to determine the impact of short, medium and long chain inulins on the physico-chemical, sensory and microbiological characteristics of fat free plain yogurt manufactured with *Lactobacillus acidophilus* or *Lactobacillus casei*.

Lactobacillus acidophilus or *Lactobacillus casei* was incorporated in the yogurt mix immediately after inoculation with *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. Short, medium and long chain lengths inulins were incorporated at the rate of 1.5% w/w yogurt mix. Total solids in the control was kept constant with non fat dry milk. Viscosity, pH, syneresis, instrumental color (L*, a*, b*), sensory flavor, body texture, appearance and color of the yogurts were studied at days 1, 11 and 22 after product manufacture. Readings were recorded in triplicate per replication. Two replications were conducted. Data were analyzed by ANOVA using the Proc GLM of SAS. Significant differences were determined at $\alpha=0.05$.

In the yogurts made with *Lactobacillus casei* inulins of different chain lengths did not impact product viscosity, appearance, and b* values. Yogurts with inulins had significantly ($p<0.05$) higher *L. casei* counts compared to control.

Freshly made (day 1) yogurts with either *L. casei* or *L. acidophilus* had significantly ($p<0.05$) higher flavor scores, lower body and texture scores, lower L* (lightness) values compared to yogurts stored for days 11 and 22.

In the yogurts made with *Lactobacillus acidophilus* inulins of different chain lengths did not impact product viscosity, syneresis, pH, a* and b* values. Yogurts with long and short chain length inulins had body and texture scores comparable to the control. The interaction effect of chain length and storage time was significant ($p<0.05$) for *L. acidophilus* counts.

Chain length of inulins did not impact most of the characteristics of probiotic yogurts.

Key Words: Symbiotic, Fermented, Milk

W44 Fat free lemon and strawberry flavored yogurts fortified with folic acid. C. Boeneke* and K. Aryana, *Louisiana State University Agricultural Center, Baton Rouge.*

Folic acid fortification is used in the prevention of neural tube defects such as spina bifida and anencephaly, heart defects, facial clefts, urinary tract abnormalities, and limb deficiencies. Although yogurt is not a good source of folic acid, fortification could aid in prevention of above mentioned defects. The objective of this study was to examine the effect of different concentrations and stages of addition of folic acid on the physico-chemical and sensory characteristics of flavored yogurts over a storage period. Fat free yogurts were manufactured using 0, 25%, 50%, 75% and 100% of the recommended daily allowance of 400 micrograms of folic acid. Treatments included addition of folic acid at these levels before and after pasteurization and incorporation of lemon and strawberry flavoring. Data were analyzed using the General Linear Model procedure with a completely randomized block design by the Statistical Analysis System. Significant differences were determined at $P<0.05$ using Duncans Multiple Range Difference Test. Lemon and strawberry pH values were lower than plain yogurt. Level of folic acid did not impact flavor scores. Mean flavor scores for lemon and strawberry yogurts were higher than plain yogurts. Body and texture values of lemon and strawberry yogurts appeared to decrease over the five week storage period. Addition of flavor to folic acid fortified yogurts helped improve flavor scores.

Key Words: Folic Acid, Fortified

W45 Physical and sensory attributes of stirred yogurts: impact of the physical properties of initial gel and breakdown process. W. J. Lee* and J. A. Lucey, *University of Wisconsin, Madison.*

In stirred yogurts, the structure of the initial (intact) gel network and stirring method used for the disruption process, are crucial factors determining the sensory and textural properties. Objectives of this research were to study the relationships between physical and sensory properties of the initial yogurt gels and stirred yogurts made from these gels. Yogurt gels were prepared from milk heated at 75 or 85°C for 30 min and incubated at 32, 38, or 44°C. Stirred yogurts were made by shearing these gels at 5 s⁻¹ for 1 min. Low amplitude oscillatory rheology and shear rate sweeps were performed to determine the dynamic moduli and apparent viscosity (AV), respectively. Quantitative descriptive analysis was

used to determine the sensory attributes of stirred yogurts. Increasing milk heating temperature and decreasing incubation temperature resulted in gels with higher storage modulus, AV values at structural breakdown point, and yield stress and with lower maximum in loss tangent and permeability values. In the very low shear rate region (i.e. 0.01 to 0.1 s⁻¹), the AV initially increased with increasing shear rate due to the resistance posed by the intact network; this behavior could not be modeled with commonly used models for stirred yogurt. In stirred yogurts, the use of higher heating and lower incubation temperatures resulted in increased AV, oral viscosity, and the sensory mouth coating attribute as well as a decreased particle size. A positive relation was observed between storage modulus of initial gels and oral viscosity ($r = 0.77$) while permeability was negatively correlated with oral viscosity ($r = -0.84$) and AV at low (10 s⁻¹) shear rate ($r = -0.73$) of stirred yogurt. Maximum in loss tangent during the initial gelation phase was negatively correlated with oral viscosity ($r = -0.85$), mouth coating attribute ($r = -0.88$), and AV at low (10 s⁻¹) shear rate ($r = -0.78$). In conclusion, the physical properties of initial yogurt gels had a significant influence on the physical and sensory properties of stirred yogurts.

Key Words: Yogurt, Rheology

W46 Sensory description of plain yogurt made from milk of different origins. M. Almena*, K. McEvoy, B. Yon, and A. Howard, *University of Vermont, Burlington.*

The goal of this study was to evaluate the sensory characteristics and consumer acceptability of different varieties of plain yogurt made from cow, sheep, goat, water buffalo (WB) and soy milk, respectively. A trained sensory panel evaluated the samples in terms of appearance, texture and flavor characteristics using descriptive analysis. Commercial samples from each yogurt were evaluated by a convenience sample of 109 consumers enlisted at a supermarket that specializes in natural and gourmet foods. Consumers were asked to select the most and least favorite sample, and to rate the texture and flavor of the 5 samples using a 9-pt hedonic scale. The questionnaire also included demographic and eating habits information. Data were statistically analyzed by ANOVA and Chi-square tests using SPSS. Cow milk yogurt was characterized as having a smooth appearance, creamy texture with high acetaldehyde notes and low acidity. The WB yogurt had a distinctive white-porcelain color, very thick and firm texture, with low sweetness and acidic flavor, in contrast to the soy yogurt which had brown color, chalky texture and high sweetness. Sheep milk yogurt had granular appearance, curdy texture and strong sour flavor. Goat milk yogurt also had strong flavor but smooth and creamy texture. Strong significant differences ($P \leq .001$) were identified between the texture scores among consumer data. Goat yogurt had the highest texture score and WB yogurt had the lowest. No significant differences between genders were found in terms of flavor or preferences. However, consumer eating habits, especially the type of yogurt regularly consumed (plain or flavored), strongly determined the acceptability of the product. Individuals who regularly consumed plain yogurt significantly preferred the WB and goat milk yogurts ($P \leq .01$), and identified the soy yogurt as least favorite. However, consumers who eat flavored yogurt preferred the soy milk product, probably due to the higher sweetness level (soy yogurt included sugar, though labeled as "plain").

Key Words: Yogurt Sensory Evaluation, Milk Type

W47 Incorporation and survival of immobilized probiotic bacteria in arroz con leche, a Mexican dairy dessert. H. Hernandez-Sanchez*, E. Alvarez, and M. Labastida, *Instituto Politecnico Nacional, Mexico, DF, Mexico.*

Lactobacillus casei has been shown to be a probiotic bacteria with therapeutic and immunomodulatory properties and able to colonize the intestine when ingested in dairy products. Immobilization has been used in probiotic cultures to increase their survival during their transit through the gastrointestinal system. If the size of the beads of immobilized microorganisms is big, the consumers may not like it. Foods with particles in suspension could be good options to incorporate the immobilized probiotics and this is the case of Arroz con Leche, a popular dairy dessert in Latin America which includes rice, milk, sugar and cinnamon in its preparation. *L. casei* was grown in MRS broth and the cells

harvested by centrifugation and suspended in a sterile solution of sodium alginate which was allowed to drip slowly into a vessel containing CaCl₂ solution to obtain 2 mm beads with a concentration of 5 X 10⁶ cfu/g. Free and immobilized *L. casei* cells were incubated in 0.01 N HCl at 150 rpm and 37°C for 1 h to simulate the transit through the stomach. Survivals of 2 and 40% were measured for the free and immobilized cells respectively. The size of the beads decreased in 30% after the incubation. The sensory evaluation results indicated a good acceptance of the dessert with the incorporated immobilized *L. casei* cells. It can be concluded that a good functional dairy product could be obtained by this method and that immobilization actually improved the survival of the microorganisms.

Acknowledgements: The authors appreciate the financial aid of COFAA and CGPI-IPN.

Key Words: Probiotics, Immobilization, Arroz con Leche

W48 Assessment of potential probiotic properties of *Lactobacilli* strains isolated from traditionally home-made Koumiss in Inner Mongolia of China. H. Zhang*, T. Sun¹, J. Xu¹, L. Wang¹, Y. Yun¹, B. Menghe¹, R. Wu¹, J. Wang¹, and M. R. Guo², ¹Inner Mongolia Agricultural University, Huhhot, Inner Mongolia, China, ²University of Vermont, Burlington.

Fifty strains of *Lactobacilli* isolated from 16 samples of traditionally home made koumiss in Inner Mongolia of China were assessed for their potential probiotic properties. *L. Casei* ZL3-6 and *L. acidophilus* ZL12-1 were screened out for their resistance and tolerance to the *in vitro* gastrointestinal digestion. *L. Casei* ZL3-6 showed higher ability of resistance to bile salt compared with *L. acidophilus* ZL12-1. They can still grow in the media containing 1.6% and 0.3% of bile salt for *L. casei* ZL3-6 and *L. acidophilus* ZL12-1, respectively. Both of *L. casei* ZL3-6 and *L. acidophilus* ZL12-1 can hydrolyze bile salt to liberate free bile acid in the growth media. There is no significant difference in activity between the two strains during the period of incubation at 37°C for 24 h. The two strains showed a strong ability of removing cholesterol from the growth media 49.61% by *L. casei* ZL3-6 and 32.39% by *L. acidophilus* ZL12-1, respectively. The results indicate that the two isolated strains may be the potential candidates for developing probiotics.

Key Words: Koumiss, Probiotic, *Lactobacilli*

W49 High protein buttermilk powder; manufacture and properties. V. V. Mistry* and J. R. Dornellas, *South Dakota State University, Brookings.*

A process was developed to manufacture a sweet buttermilk ingredient powder. The process involved the concentration of sweet buttermilk by ultrafiltration to approximately 5X concentration, followed by double diafiltration to 5X with water. The initial protein content of buttermilk was 2.9% and the final 15.9% (21% total solids). Powders were manufactured from buttermilk that was ultrafiltered as well as from diafiltered buttermilk. The concentrates were spray-dried in a single-stage, gas-fired spray dryer with a rotary atomizer at an inlet air temperature of 200°C and outlet air temperature of 85 to 95°C. The powders from ultrafiltered buttermilk had a protein content of approximately 61.5%, 4.9% moisture and 13.3% lactose. The diafiltered powder had a protein content of approximately 73% and a moisture content of 5.3% and 1% lactose. Powders were packaged and stored under four storage conditions; room temperature and refrigerated storage under vacuum packaging, and room and refrigerated temperature storage under atmospheric conditions. Powders were tested for solubility index, oxidation, and gelation. Storage studies over six months revealed no off-flavor development during storage under refrigerated or room temperatures or under vacuum or atmospheric conditions. Powders produced with diafiltration and having over 72% protein had a typical protein flavor. Solubility index of ultrafiltered powders (4.6 mL) was significantly lower than those of diafiltered powders (22.7 mL). Heat induced gels were prepared from the powders by reconstituting powder to 15% protein in water using and adjusting pH to 6.0. The liquids were then heated to 80°C for one hour and cooled under running tap water for 2 hours. Gels were stored at 7°C overnight before measuring firmness using a penetrometer. Firmness of the ultrafiltered powders was 276.4 mm and that of the diafiltered powders was 345 mm. This process offers

opportunities for the production of high protein powders from sweet buttermilk for food applications.

Key Words: Buttermilk, Protein, Drying

W50 Effects of packaging material, storage temperature, and fat content on the changes of the chemical composition of Ultrapasteurized milk bottled in amber polyethylene Terephthalate (PET) containers. J. Bailard*, W. Harper, M. Pascall, and V. Alvarez, *The Ohio State University, Columbus.*

Shelf life of high temperature short time (HTST) milk is 14-21 days. Ultra-pasteurization (UP) milk is heated to temperatures higher than HTST, increasing shelf life. Packaging and heat affect shelf life. Polyethylene terephthalate (PET) bottles are better barriers to moisture and oxygen compared to polyethylene. Amber colored PET reduces light oxidization, decreasing flavor changes and spoilage. Extending the shelf life of milk increases its competitiveness in the beverage industry. The objective is to determine the effect of storage temperature and fat levels on shelf life of UP milk in amber PET bottles. Skim and whole milk were ultrapasteurized and aseptically packaged in amber PET bottles and stored at 24°C and 7°C. Milk stored at 24°C was sampled every 3 days for 30 days, and milk stored at 7°C was sampled every 6 days for 90 days. Dissolved oxygen, headspace oxygen, and standard plate count were analyzed. Milk samples were analyzed with an electronic nose based on negative chemical ionization with gas chromatography used to verify results. Milk stored at 24°C has a shorter shelf life than refrigerated milk. The headspace of skim and whole milk stored under refrigeration and at 24°C decreased over a 90 day and 30 day period, respectively. The dissolved oxygen for the 24°C decreased over time for whole and skim milk compared to the refrigerated milk which increased over time. SPC showed no growth for 90 day refrigerated milk and for 24°C stored milk. Using electronic nose, volatiles in skim milk and whole milk were able to be separated. Electronic nose data was consistent with shelf life results with volatiles being comparable at different time points, indicating the milk was acceptable until 90 days.

Key Words: Polyethylene Terephthalate (PET), Ultra-Pasteurization, Shelf Life

W51 Effects of evening primrose oil addition on quality of cholesterol-removed butter and lowering blood cholesterol. T. H. Jung, J. J. Kim, S. H. Yu, and H. S. Kwak*, *Sejong University, Seoul, Korea.*

This study was designed to carry out effects of evening primrose oil (EPO, containing 80% gamma-linolenic acid) on quality of cholesterol-removed butter during 8 week storage and lowering blood cholesterol in rats. Three different treatments were control (no β -CD, no EPO), β -CD-treated butter (10% β -CD, no EPO) and EPO-added and β -CD-treated butter (10% β -CD, 2% EPO). The rate of cholesterol removal reached 92.7%. TBA value was higher in EPO-added and cholesterol-removed group than others throughout storage periods. Most of rheological values in EPO-added and cholesterol-removed butter increased with storage period, and were similar to those in control. Especially, scores of hardness and cohesiveness were higher in β -CD-treated butter. In sensory analysis, most of properties except texture and color were affected adversely in EPO addition at every storage period. In animal study, total blood cholesterol was significantly lower in β -CD-treated group, and EPO-added and β -CD-treated group as 201.8 and 190.5 mg/dL, respectively, compared with that in control as 230.0mg/dL after 6 week feeding. The present results indicated that although EPO addition resulted in high TBA value and impaired sensory quality, total blood cholesterol and triglyceride were lowered in rats.

Key Words: Evening Primrose Oil, Blood Cholesterol, β -Cyclodextrin

W52 Sensory evaluation of regular, whey and cultured butters. S. Jinjarak*, A. Olabi, R. Gonzalez, W. Lires, and R. Jimenez-Flores, *California Polytechnic State University, San Luis Obispo.*

The objective of this work was to characterize the sensory qualities of whey, cultured and regular unsalted butters produced at the Dairy Product Technology Center (DPTC; n=3) or obtained from commercial sources (n=6). Descriptive analysis was performed to determine the significant differences between samples

and interactions between variables. A panel of nine judges rated samples on a triplicate basis. Training took nine one-hour sessions and was followed by regular evaluation sessions. The samples were rated on a 15-cm line scale and data obtained was analyzed using SAS® statistical software. Significant differences between the three types of butters were obtained on yellow, acidic odor (p<0.001), cheese odor, cardboard odor, acidic and grassy flavors (p<0.01), porous, hard, shiny, mouth coating and nutty flavor (p<0.05). Cultured butter was significantly shinier than whey butter and had a higher score than regular butter. Whey butter was more yellow than cultured butter, which in turn was more yellow than the regular butter. The whey butter was more porous, and had higher scores on nutty flavor and cardboard odor than regular and cultured butters. Regular butter was significantly harder than cultured butter but not whey butter. Cultured butter had more mouth coating, acidic odor and flavor and grassy flavor than regular and whey butters. The commercial samples were more porous, crumbly, and had more artificial butter odor, rancid odor and flavor and cardboard odor. Results from Principal Component Analysis indicated that DPTC Whey butter and DPTC Regular butter were similar and were characterized by a sweet taste. Whey butter characteristics compared very favorable with commercial cultured butter and was very similar to regular butter.

Key Words: Butter, Sensory Analysis, Cultured Butter

W53 Characterization of slow acid-producing *Streptococcus thermophilus* strains. R. J. McCarthy*, O. Anggraeni, W. J. Harper, and P. D. Courtney, *The Ohio State University, Columbus.*

The simultaneous manufacture of quality Swiss cheese and kosher-certified whey is a challenge. Over-acidification of the curd at the lower cook temperatures required for kosher whey can result in low-grade cheese. Slow acid-producing *Streptococcus thermophilus* strains may slow curd acidification at the kosher cook temperature. The objective was to compare growth, acid production, and gene expression of *S. thermophilus* for potential use in a kosher process. Thirteen slow acid producing *S. thermophilus* cultures were obtained from culture manufacturers. One fast acid producing culture was included for comparison. Each strain was inoculated into UHT milk, pre-warmed to 48.3°C or 51.7°C. UHT milk and a standard inoculation rate standardized conditions for all strains. Colony forming units and pH were monitored over time. Strains were genetically typed by pulsed field gel electrophoresis of genomic DNA treated with *Sma*I or *Apa*I. Genetic profiles were compared using statistical software. The ATPase and urease genes were amplified from one *S. thermophilus* strain by PCR and used as probes in Southern hybridizations. Northern blots determined intensity of gene expression in log and stationary phases. Ten of the 13 strains reduced the pH slower than the control, fast acid producing strain. Growth rates or final cell densities correlated with acid production. The final pHs ranged from 4.93 to 5.59. Strains S754 and S847 reduced the pH to only 5.59 and 5.4, respectively, suggesting acid sensitivity in these strains. No clustering of slow acid production or acid sensitivity was observed in the comparison of DNA restriction profiles. Six strains were selected for further genetic analysis. Southern blots confirmed the presence of ATPase and urease genes. Northern blots indicated a difference in gene expression among the six strains and a correlation between expression level and acid production. Results may assist in selection of *S. thermophilus* strains for slow acid production at low cook temperatures, potentially allowing quality cheese and kosher whey production.

Key Words: *Streptococcus*, Swiss Cheese, Kosher Whey

W54 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Composition and proteolysis. S. Awad*, A. Hassan, and F. Halaweish, *South Dakota State University, Brookings.*

In a previous study, EPS-producing cultures produced reduced fat Cheddar cheese with physical properties similar to those of its full fat counterpart. This reduced fat cheese developed bitterness after 3 months of ripening. The objective of this work was to monitor proteolysis during ripening of reduced fat Cheddar cheeses made with different EPS-producing and nonproducing cultures. Results showed that the actual yield, moisture, moisture in the nonfat substance (MNFS) and residual coagulant activity were significantly higher in cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1) than in all other reduced fat cheeses. Proteolysis, as determined by polyacrylamide gel electrophoresis and

the level of water soluble nitrogen, was also higher in cheese made with JFR1 than in all other reduced fat cheeses. However, cheese made with JFR1 contained the least amount of free amino acids among all cheeses. RP-HPLC analysis showed a significant increase of hydrophobic peptides (causing bitterness) during storage of cheese made with JFR1. The results showed that bitterness in reduced fat Cheddar made with EPS-producing cultures resulted from the high moisture level and chymosin activity. This study recommends using debittering cultures in conjugation with EPS-producing strains in making reduced fat Cheddar.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Bitterness

W55 *Propionibacterium freudenreichii* growth is differentially affected by the serum of Swiss cheese slurries prepared with different *Lactobacillus helveticus* strains. P. Limpisathian*, W. J. Harper, and P. D. Courtney, *The Ohio State University, Columbus.*

Swiss cheese makers report that some combinations of *L. helveticus* and *P. freudenreichii* cultures result in poor eye and flavor formation, whereas other combinations perform well. The objective was to develop a rapid method to predict successful strain pairings. Cheese curds were prepared aseptically from UHT milk using *S. thermophilus* alone (control) or *S. thermophilus* plus one of four *L. helveticus* strains. Curds were homogenized into a slurry with 60% moisture and 1% salt in moisture. The slurries were centrifuged, and the resulting serum was filtered. Each sterile slurry serum was added to chemically defined medium (CDM) lacking amino acids. One of five *P. freudenreichii* strains was inoculated into CDM containing each slurry serum, and growth was monitored spectrophotometrically. Maximum growth rate and lag phase were calculated using the Richards model. Peptide profiles of slurry sera were observed using HPLC. *Propionibacterium freudenreichii* growth was not observed in CDM lacking slurry serum. CDM supplemented with slurry sera, including the control serum prepared without *L. helveticus*, supported the growth of four of the five *P. freudenreichii* strains to different extents. *Propionibacterium freudenreichii* P764M1 did not grow with any slurry serum. *Lactobacillus helveticus* L350 slurry serum stimulated growth of four *P. freudenreichii* strains beyond that observed with the control serum. In contrast, *L. helveticus* L346 slurry serum inhibited growth of these four strains in comparison to the control serum. L887 slurry serum slightly stimulated *P. freudenreichii* P873 growth,

but delayed ATCC9614 growth. L856 slurry serum also slightly delayed ATCC9614 growth compared with the control serum. Slurry sera from different *L. helveticus* strains differed in their peptide profiles, which may contribute to the observed differences in *P. freudenreichii* growth. The slurry serum model has potential for screening *P. freudenreichii* and *L. helveticus* pairings for Swiss cheese manufacturing.

Key Words: *Propionibacterium freudenreichii*, *Lactobacillus helveticus*, Swiss Cheese

W56 Processing factors that affect the quality of pilot plant scale Swiss type cheese. C. J. Kuo*, N. Koca, T. Ji, V. B. Alvarez, and W. J. Harper, *The Ohio State University, Columbus.*

Industry reports frequent problems with overset eyes when using the Kosher requirement of cooking to less than 49 deg. C. Work with Swiss cheese made under pilot plant conditions showed that overset eyes occurred in most cheese being cooked at 48 deg. C and not in cheese cooked at 53 deg. C, a standard make procedure. Twenty-six blocks of Swiss type cheese were made at the university pilot plant over 6 processing days as an attempt to find the most important processing factors that affect the cheese quality. Combination of different ratios of starter organisms, method of placing curds into molds, and method of pressing were selected as the variables for the trials. After 21 days in the warm room (22°C), the products were compared based mainly on the quality of eye formation. Changes in starter culture ratio and in curd placing method did not improve the eye quality significantly. At the same curd pH at dipping (6.4), increase weight to more than two folds during pressing made marked improvement on eye quality. Higher pressure (not vacuum) also resulted in higher acetic and propionic acid contents. The data suggested that overset is primarily related to the greater number of nucleation sites due to a difference in curd textural properties. Preliminary treatment with vacuum in between first and second pressing appeared to reduce overset and make for a denser structure. Optimization of the vacuum treatment in respect to time and degree of vacuum requires additional work. The vacuum treatment is not practical commercially, but can provide an understanding of the mechanism of overset eyes common in Kosher cook Swiss cheese.

Key Words: Swiss Type Cheese, Pilot Plant, Processing

Food Safety: Control of Hazards

W57 Effects of in-feed anti-salmonella egg yolk antibodies on shedding and antibiotic resistance of bacteria in swine. S. Rattanabattimong*, A. Mathew, S. Chattin, E. Jarboe, and R. Clift, *University of Tennessee, Knoxville.*

Two experiments were conducted to determine effects of anti-salmonella egg yolk antibodies (ASEYA) on shedding of *Salmonella enterica* Typhimurium and antibiotic resistance of *E. coli*. In Experiment 1, 132 weaned pigs in 2 replicate trials were randomly assigned to 6 dietary treatments including a control without additives or similar diets containing apramycin followed by carbadox, or oxytetracycline, or ASEYA, or dried egg yolk lacking ASEYA, or spray dried plasma protein. Following initiation of treatments, pigs were challenged with a *S. Typhimurium*. Fecal samples were collected prior to treatments, just prior to challenge, and on various days until pigs reached market weight, for isolation of salmonella and *E. coli* to determine shedding and antibiotic resistance patterns. In Experiment 2, 64 market-age pigs in 2 replicate trials were randomly assigned to 4 treatments, including a control diet without additives, or diets containing ASEYA, or dried egg yolk without ASEYA, or IM injections of ceftiofur. Treatments were continued for 2 days, after which pigs were challenged with *S. Typhimurium* then mixed and transported to a holding facility to simulate shipping to market. Fecal samples were obtained prior to initiation of treatments, just prior to challenge and transport, immediately following transport, and at 24 and 48 hours following transport, for recovery of salmonella. In Experiment 1, the percentage of pigs shedding salmonella was decreased ($P < .05$) for antibiotic treatments compared to other diets; however,

resistance was higher ($P < .05$) in *E. coli* from pigs fed antibiotics. In Experiment two, although a treatment effect was observed immediately after transport ($P < .001$), neither ASEYA nor ceftiofur were effective in reducing salmonella shedding. These studies indicate that in-feed addition of anti-salmonella egg yolk antibodies may not be effective in controlling shedding of salmonella in swine.

Key Words: Salmonella, Egg Yolk Antibodies, Swine

W58 Effect of grain processing on performance and fecal shedding of *E. coli* O157 in finishing feedlot heifers. B. E. Depenbusch*, E. R. Loe, M. C. Corrigan, T. G. Nagaraja, and J. S. Drouillard, *Kansas State University, Manhattan.*

Ninety-two crossbred yearling heifers (initial BW = 347 kg) were fed diets containing dry-rolled corn (DRC) or steam flaked corn (SFC) to assess the impact of grain processing on prevalence of *E. coli* O157. Steam flaking typically results in more extensive ruminal digestion, and thus less substrate flow to the hindgut, potentially altering populations of flora in the hindgut. During the prescreening phase, heifers (n=92) were fed a common DRC finishing diet. Heifers were screened for presence of *E. coli* O157 using a fecal grab sample (FECAL) and by swabbing the rectoanal mucosa (RAMS). Animals that tested