

Dairy Foods

M47 Use of caseinomacropeptide index as indicator of adulteration of milk powder in Brazil. M. O. Leite, M. C. P. P. Oliveira,* L. M. Fonseca, M. M. O. P. Cerqueira, M. R. Souza, C. F. A. M. Penna, and T. Rosa, *Department of Food Technology and Inspection, Veterinary School, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Minas Gerais, Brazil.*

Brazil is one of the largest milk producer in the world, with 16.5% of the world milk powder production. Due to raw milk high prices, adulteration by cheese whey addition is a persistent practice, which has been increasingly targeted worldwide due to the potential of affecting the economical sustainability of the dairy industry, markedly in developing countries. Chromatographic determination of caseinomacropeptide (CMP) in milk is still recognized as the most suitable method to detect this adulteration. The CMP is a soluble polypeptide formed after splitting of kappa-casein by clotting enzymes during cheese making, and it will be partitioned in the whey. This work objective was to classify milk powder according to CMP levels, and evaluate legal requirements compliance. During 2009–2010, 125 samples of milk powder, from several dairies across the country were analyzed by high performance liquid chromatography (HPLC Shimadzu LC-10), and CMP levels were evaluated according to Brazilian legal requirements. The samples presented CMP levels ranging from 0 to 1,150 mg CMP/L (amount equivalent to reconstituted milk). Average concentration of CMP was 34.1 mg CMP/L, with a median of 18.3 mg CMP/L. CMP levels up to 30 mg/L were found in 73.3% of the samples, and milk with this CMP concentration is classified as high quality milk. CMP levels ranging from 30 to 75 mg/L were found in 21.8% of the samples, being suitable for milk derivatives production. However, 4.8% of the samples were found with CMP levels above 75 mg/L, being classified as poor quality milk and suspected of adulteration by cheese whey addition, not being suitable for human consumption. It is concluded that is necessary a more strict control and inspection, because 4.8% of the samples were not compliant with the legal requirements for milk destined to human consumption, due to adulteration and abnormal composition.

Key Words: caseinomacropeptide, HPLC, milk powder

M48 Effects of vacuum-deaeration on reconstituted milk flavor made from whole milk powder. H. J. Kang,* Y. K. Shin, and S. C. Baick, *Institute of Dairy Food Research, Seoul Dairy Cooperative, Ansansi, Kyunggi, South Korea.*

This study was conducted to evaluate the influence of vacuum-deaeration during the manufacturing process on flavors of reconstituted milk made from whole milk powder. As the first sample groups for pre-vacuum treatment before heating, whole milk powder solution (12%, wt/wt) was deaerated with a vacuum pump at 40°C for 10, 20 and 30 min, and then heated. On the other hands, as the second sample groups for post-vacuum treatment after heating, reconstituted milk was heated at 95°C for 10 min, and then deaerated at 40, 50 and 60°C for 10 and 20 min. Volatile sulfur compounds were analyzed with SPME and GC/PFPD, whereas ketones and aldehydes were analyzed with SPME and GC/MSD. Statistical evaluations including ANOVA and Turkey honest significant difference ($P < 0.05$) were conducted using SAS 9.0. When reconstituted milk was deaerated before heating, dimethyl sulfide and carbon disulfide were significantly reduced as compared with untreated

reconstituted milk ($P < 0.05$). Dimethyl disulfide was significantly reduced in reconstituted milk deaerated at 40°C for 10 and 20 min ($P < 0.05$). Hexanal and 2-heptanone were significantly reduced in reconstituted milk deaerated at 40°C for 10 min ($P < 0.05$). In post-vacuum treatment test, hydrogen sulfide, methanethiol, and carbon disulfide in the reconstituted milk deaerated at 50°C for 20 min after heat treatment were significantly lower than untreated reconstituted milk ($P < 0.05$), whereas volatile sulfur compounds except for dimethyl disulfide in reconstituted milk deaerated at 60°C for 10 min were significantly decreased ($P < 0.05$). Hexanal and 2-heptanone of reconstituted milk deaerated at 50°C for 10 and 20 min after heat treatment were significantly decreased as compared with untreated reconstituted milk. It was concluded that vacuum-deaeration before or after heat treatment during the manufacturing process could reduce the volatile compounds developing off-flavors of reconstituted milk made with whole milk powder.

Key Words: reconstituted milk, off-flavor, volatile compound

M49 Evaluating the efficacy of a typical CIP protocol for cleaning membrane biofilms under in vitro conditions. D. Singh* and S. Anand, *Dairy Science Department, Midwest Dairy Foods Research Center, South Dakota State University, Brookings.*

This study was carried out to evaluate the effectiveness of different chemicals of an industrial CIP protocol against in vitro biofilms formed on whey RO membranes. Bacterial cells isolated from biofilm consortia of 2- to 14-mo-old membranes included species of *Bacillus*, *Escherichia*, *Klebsiella*, *Enterococcus*, *Streptococcus*, *Staphylococcus*, *Micrococcus*, *Aeromonas*, *Corynebacterium*, and *Pseudomonas*. The CIP protocol tested against 24-h-old single and mixed species biofilms of above microflora included 6 treatment steps based on alkali, surfactant, acid, enzyme, a second surfactant, and a sanitizer application. Experiments were conducted with individual steps of cleaning, as well as, the sequential CIP protocol under static and dynamic conditions, and the data was statistically analyzed. The results revealed a variation in resistance of single species biofilms against the 6 individual steps of cleaning. Biofilms of *Bacillus* isolates were found to be most resistant, and even the most effective step of the cleaning protocol; acid treatment reduced their counts by only 2.09 and 2.16 logs under static and dynamic conditions, respectively. Biofilms of other isolates followed a similar trend. The sequential CIP protocol using all the 6 steps resulted in a greater reduction as compared with individual steps, but presence of survivors even after sanitizer treatment under static and dynamic conditions concluded the inefficacy of CIP chemicals against *Bacillus* biofilms. Mixed species biofilms developed using 10 mo. consortium of *Bacillus*, *Staphylococcus*, and *Streptococcus* was found to be more resistant than the single species biofilms. Even the acid cleaning step resulted in lower reduction of 1.52 log counts under the dynamic conditions. Overall, the sequential CIP protocol against mixed species biofilms resulted in cumulative reductions of 4.48 and 3.56 log under static and dynamic conditions, respectively. It can be concluded that tested CIP protocol had a limited effectiveness to clean membrane biofilms formed on the whey RO membranes.

Key Words: biofilm, CIP, sequential

M50 Effect of transglutaminase treatment on the functionality of MPC and MCC: Process cheese product slice formulations. P. Salunke,* C. Marella, and L. E. Metzger, *Dairy Science Department, Midwest Dairy Foods Research Center, South Dakota State University, Brookings.*

Milk protein concentrate (MPC) is used as an ingredient in process cheese product (PCP) formulations. However, its use can result in texture defects such as soft body and restricted melting characteristics. Use of micellar casein concentrate (MCC), which has a higher level of casein and less whey protein improves the texture of PCP. Further improvement in PCP products may be possible with the use of transglutaminase (TGase), an enzyme that has the ability to crosslink proteins. The objective of this study was to determine the effect of TGase treatment of MPC and MCC retentates on the functionality of MPC and MCC when they are used in a PCP slice formulation. Three lots of MCC and MPC retentate were produced using 3 different lots of pasteurized skim milk. Each replicate of retentate was divided into 3 equal portions. One portion of the retentate was treated with TGase at 0.3 U/g of protein, one portion was treated with TGase at 3.0 U/g of protein and one had no TGase addition. All the retentates were incubated for 25 min at 50°C, heat treated at 72°C for 10 min, cooled to 10°C and then spray dried. Each MCC and MPC was then used in a PCP slice formulation that was standardized to 20.0% fat, 1.26% salt, 48.0% moisture, 17.5% protein, and 2.0% sodium citrate. In each formulation, the MPC or MCC contributed 15.7% protein to the formulation. Each formulation was manufactured in a Rapid Visco Analyzer (RVA) where it was mixed at 1000 rpm for 2 min at 95°C. Subsequently, the cheese was mixed at 160 rpm for a minute. Functional properties of PCP were analyzed using a penetration test, Dynamic stress rheology (DSR) for transition temperature (TT) and Schreiber melt test. As the TGase addition increased, there was significant ($P \leq 0.05$) increase in TT and a significant ($P \leq 0.05$) decrease in Schreiber melt area. The PCP made from MCC had higher TT and Schreiber melt area values than that made from MPC as an ingredient (TGase or no TGase). It was concluded that TGase treatment modifies the melt characteristics of MCC and MPC in PCP application.

Key Words: transglutaminase, MCC or MPC, process cheese product slice functionality

M51 Radio frequency dielectric heating treatment of NDM affects whey protein nitrogen index and solubility. M. Michael¹, C. Chen¹, R. Phebus¹, K. Schmidt*¹, H. Thippareddi², and J. Subbiah², ¹*Kansas State University, Manhattan*, ²*University of Nebraska, Lincoln.*

Radio frequency dielectric heating (RFDH) provides uniform, rapid heating throughout a medium, including dry powders. Nonfat dry milk (NDM), one of the major dried milk products made in the US, can be consumed directly or used as an ingredient in foods. However, NDM can be contaminated post pasteurization or spray drying with opportunistic pathogens. While RFDH may provide additional food safety effects, it has also been reported to improve functional applications of other dried powders. Thus, the objective of the study was to determine if RFDH affects the whey protein nitrogen index (WPNI) and solubility of NDM. High heat (HH) and low heat (LH) NDM was treated using RFDH at 75, 80, 85, and 90°C and held for a range of time from 0 to 125 min. Treated powders were assessed for WPNI and solubility following standardized methods and compared with a non-treated sample. Three replications were done, ANOVAs were done to determine significant effects ($P \leq 0.05$) and significant means were differentiated by the Dunnett's test.

LH-NDM treated at 75°C had similar WPNI and solubilities compared with a non-treated sample, regardless of time. However, at all other temperature/time combinations significant decreases in WPNI and solubility occurred ($P \leq 0.05$). For WPNI, decreases ranged from 10.5 to 18%, whereas for solubility decreases ranged from 3.4 to 5%. Overall, the WPNI of treated HH-NDM was not affected; however, the solubility was ($P \leq 0.05$). Solubility decreases ranged from 1.2 to 3% compared with a non-treated sample and significant decreases were observed in all but one sample. Although, some significant changes were observed in the RFDH-treated NDM, it is concluded that this technology merits further evaluation both as a post-process lethality treatment as well as its effects on other functional properties.

Key Words: nonfat dry milk, radio frequency dielectric heating, whey protein nitrogen index

M52 Effect of transglutaminase treatment on the functionality of MPC and MCC. III. Imitation mozzarella cheese formulations. P. Salunke,* C. Marella, and L. E. Metzger, *Dairy Science Department, Midwest Dairy Foods Research Center, South Dakota State University, Brookings.*

A critical parameter in dairy based imitation mozzarella cheese (IMC) is the amount of intact casein provided by dairy ingredients in the formulation. Intact casein provides IMC with a firm unmelted texture and a stringy, elastic melted texture. From a functionality perspective, rennet casein is the preferred ingredient to provide intact casein in a formulation and is superior to milk protein concentrate (MPC) and micellar casein concentrate (MCC). The use of a cross-linking enzyme such as transglutaminase (TGase) has the potential to modify the physical properties of MPC or MCC and may improve its functionality in IMCs. The objective of this study was to determine the effect of TGase treatment of MPC and MCC retentates on the functionality of MPC and MCC when they are used in IMCs. Three lots of MCC and MPC retentate were produced using 3 different lots of pasteurized skim milk. Each replicate of retentate was divided into 3 equal portions. One portion of the retentate was treated with TGase at 0.3 units/g of protein, one portion was treated with TGase at 3.0 units/g of protein and one had no TGase addition. All the retentates were incubated for 25 min at 50°C, heat treated at 72°C for 10 min, cooled to 10°C and then spray dried. Each MCC and MPC was then used in IMC formulation that was standardized to 21.0% fat, 1.0% salt, 48.0% moisture, and 20.0% protein. In each formulation, the MPC or MCC utilized contributed all the protein. Each formulation was manufactured in a Rapid Visco Analyzer (RVA) where it was mixed at 1000 rpm for 2 min at 95°C. Subsequently the cheese was mixed at 160 rpm for a minute. The IMC formulation using either MCC or MPC treated with the highest TGase did not form an emulsion. The RVA end of manufacturing viscosity and transition temperature (TT) was significantly ($P \leq 0.05$) higher and Schreiber melt test area was significantly ($P \leq 0.05$) lower for IMC containing TGase. The IMC made from MCC (with or without TGase) had higher TT values and Schreiber melt test area as compared with that made from MPC. The study demonstrates that TGase treatment modifies the melt characteristics of MCC and MPC in IMC application.

Key Words: transglutaminase, MPC or MCC, imitation mozzarella cheese functionality

M53 Effect of transglutaminase treatment on the functionality of MPC and MCC: Process cheese product loaf formulations. P. Salunke,* C. Marella, and L. E. Metzger, *Dairy Science Department, Midwest Dairy Foods Research Center, South Dakota State University, Brookings.*

Milk protein concentrate (MPC) is used as an ingredient in process cheese product (PCP) formulations. However, its use can result in texture defects such as soft body and restricted melting characteristics. Use of micellar casein concentrate (MCC) which has a higher level of casein and less whey protein improves the texture of PCP. Further improvement in PCP products may be possible with the use of transglutaminase (TGase), an enzyme that has the ability to crosslink proteins. The objective of this study was to determine the effect of TGase treatment of MPC and MCC retentates on the functionality of MPC and MCC when they are used in a PCP loaf formulation. Three lots of MCC and MPC retentate were produced using 3 different lots of pasteurized skim milk. Each replicate of retentate was divided into 3 equal portions. One portion of the retentate was treated with TGase at 0.3 U/g of protein, one portion was treated with TGase at 3.0 U/g of protein and one had no TGase addition. All the retentates were incubated for 25 min at 50°C, heat treated at 72°C for 10 min, cooled to 10°C and then spray dried. Each MCC and MPC was then used in a PCP loaf formulation that was standardized to 18.0% fat, 1.0% salt, 49.0% moisture, 15.0% protein, and 2.5% disodium phosphate. In each formulation the MPC or MCC contributed 12% protein to the formulation. Each formulation was manufactured in a Rapid Visco Analyzer (RVA) where it was mixed at 1000 rpm for 2 min at 95°C. Subsequently the cheese was mixed at 160 rpm for a minute. Functional properties of PCP were analyzed using a penetration test, RVA remelt test and Schreiber melt test. The PCP manufactured from the higher level of TGase had significantly ($P \leq 0.05$) higher RVA apparent viscosity after manufacture, RVA melt viscosity, penetration hardness and had significantly ($P \leq 0.05$) lower Schreiber melt area. The PCP made from MCC and MPC showed no difference in RVA viscosity; however the Schreiber melt area was significantly ($P \leq 0.05$) higher in PCP made from MCC. The study demonstrated that TGase treatment modifies the melt characteristics of the PCP made from either MCC or MPC.

Key Words: transglutaminase, MCC or MPC, process cheese product loaf functionality

M54 Influence of fat replacement by inulin on rheological properties and kinetics of milk coagulation and syneresis of milk gels. O. Arango, H. M. Taterka,* A. J. Trujillo, B. Guamis, and M. Castillo, *Centre Especial de Recerca Planta de Tecnologia dels Aliments (CERPTA), Departament de Ciència Animal i dels Aliments, Facultat de Veterinària, Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

The objective of this study was to evaluate the effect of inulin as a fat replacer on the rheological properties, coagulation kinetics and syneresis of milk gels. A randomized factorial design, replicated 3 times, with 3 inulin concentrations (0, 3, and 6%), 2 levels of fat (<0.2 and 1.5%) and 3 coagulation temperatures (27, 32, and 37°C) was used. The coagulation process was monitored using NIR spectrometry, small amplitude oscillatory rheometry and visual coagulation indexes. The syneresis was evaluated by volumetric methods. Inulin addition significantly ($P < 0.05$) increased the rates of aggregation and curd firming reactions in the casein gels. The observed effect, which was more evident on the aggregation reaction, depended on the concentration of inulin and the coagulation temperature. Addition of 6% inulin reduced the clotting time by ~26% and the time at which the gel reached a storage modulus equal to 30 Pa by ~36%. The optical parameter $R'max$ defined as the maximum value of

dR/dt , was used to calculate an approximation of the temperature coefficients (Q_{10}) for milk coagulation. The apparent Q_{10} values obtained in milk having 0.2% fat were 3.1, 2.8 and 2.4 for samples with 0, 3 and 6% inulin, respectively. These results suggest that inulin addition attenuates the effect of temperature on the coagulation rate. Increasing fat concentration induced a consistent increase in all the optical, rheological, and visual parameters studied, although the observed trend was not statistically significant. The addition of inulin at a level of 6% produced a significant ($P < 0.05$) reduction in syneresis and significantly ($P < 0.05$) increased the curd yield by ~30%. It was concluded that the addition of inulin affects the kinetics of milk coagulation and the cutting time and therefore the use of inline sensors such as NIR may be necessary for an optimal process control.

Key Words: inulin, milk gels, NIR sensor

M55 Effects of season and locality on amino acid composition of raw milk in dairy cows. J. X. Zhang^{1,2}, J. Q. Wang^{*1}, Y. X. Yang¹, D. P. Bu¹, P. Sun¹, L. Y. Zhou¹, Q. J. Luo², and J. H. Yang¹, *¹Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, ²Xinjiang Agricultural University, Urumqi, China.*

Raw milk is a good source of antioxidants, vitamins (including B¹²), essential amino acids, and natural protein and fat. Favorite balance of amino acids profile in dairy foods would promote absorption in digestive tract. Amino acids composition in milk is influenced by many factors, such as feed composition and lactation stage. The objective of this study was to investigate the effects of season and locality on raw milk amino acid. Milk samples were collected from 6 cities (Beijing, Chuzhou, Harbin, Hohhot, Urumqi, and Xi'an) in spring (February, March, and April) and summer (July, August, and September), respectively. Amino acids were extracted by hydrolyzed with 7.8 mol/L HCl for 24 h, and concentrations of amino acids were determined by Hitachi L-8900 high speed amino acid analyzer. The experimental data were analyzed by SAS 8.0 with GLM procedure and expressed as absolute concentration (mg/mL). The results showed that significant variation ($P < 0.01$) of Cys, Val, Tyr, Phe were determined between spring (1.83, 206.07, 113.33, 140.98) and summer (13.08, 193.83, 101.38, 148.19). Significant difference ($P < 0.01$) of all amino acids existed among these 6 regions. Raw milk from Hohhot had highest Asp (251.37), Glu (691.21), Gly (67.59), Ala (111.38), Ile (177.40), Leu (315.03), Lys (276.34), and Pro (329.54), while Urumqi samples contained highest Ser (133.11) and Tyr (118.07). It was concluded that amino acids in raw milk were influenced by locality significantly, and some of them were also affected by season.

Key Words: season, locality, amino acid

M56 Qualitative analysis of fatty acids variation in milk of different farms in China. J. H. Yang, J. Q. Wang,* Y. X. Yang, D. P. Bu, P. Sun, L. Y. Zhou, T. J. Yuan, and J. X. Zhang, *Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

There are several factors affecting fatty acids (FA) in milk. The variation of milk FA could be defined by a reliable qualitative and quantitative analysis. Principal component analysis (PCA) convert a set of related variables into several new uncorrelated variables called principal components (PCs), using an orthogonal transformation. The number of PCs is less than or equal to the number of original variables. And first few PCs explain the majority of data variation. The objective of this study was to investigate the variation in FA composition of milk from different farms in China using PCA. During April and May, samples were collected from primiparous or multiparous cows (30–90 d in milk) screened from 3 different dairy farms, which were situated in Anhui (n

= 29), Heilongjiang (n = 21) and Xinjiang (n = 27) provinces. Samples were stored at less than -20°C and unfrozen at room temperature. Milk fat was extracted through centrifugation. The FA methyl esters (FAME) were prepared by base-catalyzed trans-esterification and measured using gas chromatography (GC). Data analysis was completed by PCA with cross validation in Unscrambler 9.8 (CAMO, Bangalore, India). The first 4 PCs explained variation of total fatty acids 99.1%. PC1 exhibited heavy loading on C14 (-0.29), C16 (-0.50), C18 (0.46) and c9C18:1 (0.64). PC2 and PC3 had opposite loading values on FA except C18 and c9C18:1. PC4 held a high loading on c9c12C18:2 (0.66) particularly. And the 3D scatter scores of the first, third, and fourth PCs could discern the 3 farms' FA clearly. The scores and loading plots showed: milk from Anhui had higher C18 and c9C18:1, Xinjiang samples contained more c9c12C18:2, and Heilongjiang milk appeared to have more C16. It was concluded that variation of milk FA profile in these farms is attributed to the difference of some specific individual FA.

Key Words: principal component analysis, milk FA, different farms

M57 Qualitative identification of cow, buffalo, and yak milks using near infrared spectroscopy (NIRS). J. H. Yang, J. Q. Wang,* Y. X. Yang, D. P. Bu, P. Sun, L. Y. Zhou, T. J. Yuan, and J. X. Zhang, *Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.*

Near infrared spectroscopy (NIRS) has been used in agricultural and food products testing extensively. Compared with many other detection methods, it has better for accuracy, in non-destructive to samples and rapid. The spectrum of dairy milk can predict major components such as protein, fat, and lactose with high precision. The objective of this study was to investigate the variations of milk spectrum between 3 dairy species, which included dairy cows (n = 27), buffaloes (n = 21) and yaks (n = 30). The milk samples were stored at below -70°C . After thawing in 37°C water, samples were shaken lightly for uniformity. Milk raw spectrums were obtained with a DA 7200 diode array Near-IR analyzer (Perten instruments AB, Huddinge, Sweden) in the spectral range 950–1650nm with 100 scans. Operation of the spectrophotometer and collection of spectra were performed using Simplicity software 4.0. Data were processed by multivariate regression software (Unscrambler, version 9.8, CAMO, Bangalore, India). After transformation of MSE/RMSE and elimination of outliers, the PCA analyst with cross validation showed: first 3 principal components (PC) explained the variation of calibration and validation set 98.8 and 98.7%, respectively. PC1 represented the variation of milk spectrum on 1382 nm, PC2 and PC3 described spectrum difference on 1454 and 1404 nm wavelength respectively, although first 3 PCs had same interpretation on 1210 nm. 3D scatter scores image showed PC1, PC2 and PC3 could distinguish between the milk spectra of the 3 species. Milk from buffaloes had its characteristic absorption peaks on 1404 nm wavelengths, while yak samples on 1382 nm, and milk spectrum from cows had a subtle trait on 1518 nm, according to the loading and scores images. It was concluded that the NIRS spectrum was able to distinguish milk from cows, buffaloes, and yaks through multivariable analysis.

Key Words: NIRS, qualitative identification, milk species

M58 Transfer of conjugated linoleic acid from milk to ice cream. G. A. Gagliostro*¹, L. E. Antonacci¹, G. Genero¹, M. R. Williner², and C. A. Bernal², ¹INTA, Balcarce, Buenos Aires, Argentina, ²UNL, Sante Fé, Argentina.

The objective was to test the recovery rate (RR) from milk to ice cream (IC) of cis9 t11C18:2 (RA), t11 C18:1 (VA) and other fatty acids (FA).

The experimental dairy cows were treated as 2 group (5 animal each): One Oralac (OR) supplemented group (0.798 kg/d), and one control (C) without supplementation. OR is a lipid supplement, which has 90% DM, 68.6% fat, and contains palmitic (11.25%), stearic (4.65%), oleic (31.7%), linoleic (44.7%), linolenic (2.45%), EPA (0.6%) and DHA (1%). After 21 d of OR feeding milk samples were analyzed for FA (GLC) and used for IC making. Differences between milk and IC FA were tested by the Student *t*-test for paired observations. OR cows produced (kg/d) more milk (32.1 vs. 26.5) and 4%FCM (25.4 vs. 22.9). Milk fat (g/kg) decreased (33.3 in C vs. 25.1 in OR, $P < 0.009$) and milk protein (35.2 vs. 31.9) and lactose (48.7 vs. 47) were not affected. Milk from OR cows showed higher contents (g/100 g) of VA (7.39 vs. 2.75) and RA (2.96 vs. 1.23) and lower C12:0 (2.23 vs. 3.35), C14:0 (8.39 vs. 9.82), and C16:0 (19.45 vs. 23.45). The atherogenicity index (IA) of milk was reduced from 1.92 (C) to 1.37 (OR). IC making showed no differences in FA composition. The RR of FA ranged from 115% for RA (1.23 in milk vs. 1.42g/100g in IC) to 82% for C18:2n-6 (2.84 in milk vs. 2.33g/100g in IC). When the high RA milk was transformed in IC, the RR of VA and RA was 97%. Composition (g/100 g) of C14:0 (8.39 vs. 7.59) and C18:2n-6 (2.25 vs. 1.95) were lower in IC and C16:0 increased (19.45 vs. 23.44). The IC elaborated with the high RA milk (IC-OR) showed a lower ($P < 0.05$) composition (g/100g) of C12:0 (1.95 vs. 3.38) and C14:0 (7.59 vs. 10.00) with a reduction in the AI (1.48 vs. 2.07) compared with the IC-Control. Values (g/100 g) for VA (7.19 vs. 2.96) and RA (2.71 vs. 1.42) resulted higher in IC- OR. Content (g/100 g) of t9 C18:1 was higher ($P < 0.0002$) in IC-OR (0.58) than in IC-Control (0.17) whereas t10 C18:1 did not differ (1.42 vs. 0.86). Saturated FA were lower ($P < 0.02$) in IC-OR (50.5 g/100 g) than IC-Control (57.4 g/100 g). Unsaturated FA (g/100 g) were higher ($P < 0.04$) in OR-IC (37.5) than IC-Control (32.9). Content of C18:2 and C18:3 were not different. It was concluded that no losses in VA or CLA concentrations were detected when milk was transformed into ice cream.

Key Words: conjugated linoleic acid, milk, ice cream

M59 Assessment of adulteration by urea addition to milk by Fourier transform infrared methodology (FTIR). M. C. P. P. Oliveira,* R. S. Conrado, L. M. Fonseca, M. M. O. P. Cerqueira, and M. O. Leite, *Department of Food Technology and Inspection, School of Veterinary Medicine, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil.*

Urea or milk urea nitrogen (MUN) is a non-protein component of milk. Non-protein nitrogen is composed of 30 to 50% of urea nitrogen, while the remaining is composed of creatinine, uric acid, amino acids, and ammonia, among others. MUN has been used as a tool to assess the herd nutritional status, and the excretion of nitrogen to the environment. Adulteration of milk by urea has been occurring in some developing countries. This fraudulent practice seeks to increase analytical values for solid-not-fat (SNF) or protein content of milk. The objective of this study was to evaluate the CombiScope FTIR, an equipment based on Fourier transform infrared methodology (FTIR) in comparison with ChemSpec 150 Analyzer, a enzymatic method, to quantify adulteration by urea addition to milk, and to investigate its effect on protein levels. Extraneous urea was added to the raw milk, simulating a fraudulent practice, and simultaneously analyzed by CombiScope FTIR, and ChemSpec 150 Analyzer. A total of 60 raw milk samples were split into 3 subsamples each, respectively, without any urea addition, 20 mg, and 40 mg of urea addition for 100 g of milk. FTIR results for MUN in milk samples added with extraneous urea were lower than expected only at levels of 40 mg/100 g ($P < 0.05$). There was no significant difference in the levels of protein readings by FTIR equipment after urea

addition to the milk. It was concluded that FTIR equipment failed to detect extraneous urea added to the milk at levels of 40 mg/100 g, and protein levels measured by FTIR were not affected by added urea, as happens with the standard nitrogen analytical methods.

Key Words: milk, FTIR, urea addition to milk

M60 Freezing point of raw milk by Fourier transform infrared methodology (FTIR). R. S. Conrado, M. C. P. P. Oliveira,* L. M. Fonseca, L. R. Borges, M. M. O. P. Cerqueira, M. O. Leite, R. Rodrigues, M. R. Souza, and C. F. A. M. Penna, *Department of Food Technology and Inspection, School of Veterinary Medicine, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil.*

Milk adulteration with water addition is a worldwide problem, with prominence in developing countries. Several methods have been developed for its detection. Determination of freezing point of raw milk has been known as one of the best methods in detection of milk adulteration. Classical methods for freezing point determination have high precision and accuracy, but low output. The objective of this study was to evaluate the freezing point of milk analyzed by FTIR equipment, in comparison with a standard method (freezing point determination by thermistor cryoscope). About 220 samples of bulk tank milk were randomly chosen from 220 farms located in Minas Gerais State, Brazil, and simultaneously analyzed by a thermistor cryoscope (Laktron, LK 7000; PZL, Londrina-PR, Brazil) and a FTIR equipment (CombiScope FTIR; Advanced/Delta Instruments, Drachten, Netherlands). The chosen farms are representative of each region of the state, which is responsible for 30% (7 million metric tons) of Brazilian milk production. Each sample was added with bronopol as preservative, and final freezing point results were obtained by subtracting the effect of its soluble components. Average results for milk freezing point was -0.518°C with a standard deviation of 0.0013°C . Values of freezing point for samples obtained from herds predominantly crossbred were significantly lower when compared with pure Holstein herds. Average values for thermistor cryoscope, and FTIR were, respectively -0.520°C , and -0.518°C , with no significant difference between the 2 methods ($P > 0.05$), and Pearson correlation coefficient of 0.87. It is concluded that FTIR equipment presented a good reliability and repeatability over the range of freezing point for normal milk and for abnormal milk; that is, above -0.520°C , being an efficient screening method to detect milk adulteration by water addition to milk samples in dairy herd improvement programs and dairy industry payment systems.

Key Words: freezing point, thermistor cryoscope, FTIR cryoscope

M61 Identification of a high γ -aminobutyric acid-producing *Lactobacillus plantarum* from traditional dairy products in Inner Mongolia of China. Y. Guo², Y. Shan¹, C. Man¹, S. Yang², Y. Xue², Y. Liu², X. Dong², J. Wang², M. Guo^{*3}, and Y. Jiang^{1,2}, ¹National Dairy Engineering and Technology Research Center, Northeast Agricultural University, Harbin, Heilongjiang, China, ²Department of Food Science, Northeast Agricultural University, Harbin, Heilongjiang, China, ³Department of Nutrition and Food Sciences, The University of Vermont, Burlington.

γ -Aminobutyric acid (GABA) as a non-protein amino acid, is the major inhibitory neurotransmitter in the sympathetic nervous system and plays a crucial role in cardiovascular function. It is well known that GABA is widely distributed in nature and could be produced by animal brains, plant germs and microorganisms. The objective of this study is to isolate and identify high GABA-producing lactic acid bacteria from traditional dairy products in Inner Mongolia of China. Eighteen strains exhibited different GABA-producing ability in MRS

broth by high performance liquid chromatography analysis. Among them the strain NDC 75017 produced the highest amount of GABA, and its yield reached to 138 mg/L. By phenotypic, physiological and biochemical methods, NDC 75017 was characterized as gram-positive, catalase-negative, facultatively anaerobic, non-spore-forming and non-motile rod, which could produce lactate from lactose and did not ferment L-arabinose and D-turanose. In addition PCR amplifications of 16S rDNA and 16S-23S rDNA intergenic spacer region (IGS) were carried out with primers P1 (AGAGTTTGATCCTGGCTCAG), P6 (GGTTACCTTGTTACGACTT) and P2 (CTGTACACACCGCCG-GTC), P7 (GGACTTAGATGTTTCAGTTC), respectively. Based on 16S rDNA gene sequence, we found that the strain NDC 75017 shared 99.8% similarity with *Lactobacillus plantarum* WCFS1 and *L. plantarum* ST-III. Furthermore, the similarity of 16S-23S rDNA IGS gene sequence between NDC 75017 and above reference strains was 99.5%. Therefore the strain NDC 75017 was identified as *L. plantarum*. Contributed to its high GABA-producing ability, this strain can be used as a potential starter culture to produce GABA-enriched fermented dairy products in future. This work was supported by National Science and Technology Project (2011AA100902), National Natural Science Foundation of China (31171718), Program for Changjiang Scholars and Innovative Research Team in University (IRT-0959-203), and Key Project of Education Department of Heilongjiang Province (12511z005).

Key Words: identification, *Lactobacillus plantarum*, γ -aminobutyric acid

M62 Whey protein isolate affects cysteine content and gel quality of yogurt. S. Bala and K. Schmidt,* *Kansas State University, Manhattan.*

Whey protein isolate (WPI) is an excellent protein source which is used in a variety of processed foods. Some people with diminished γ -cystathinase are prone to develop cataracts due to decreased glutathione in their eye tissues. For this group, dietary cysteine may be beneficial for their health. Yogurt contains a significant quantity of whey proteins, hence if supplemented with WPI, cysteine could be enhanced. The objective of this research was to increase cysteine content in yogurt while maintaining gel quality. All yogurt mixes were formulated to have a total solids of 12.5% - the control mix consisted of nonfat dry milk (NDM) and the experimental formulas contained mixtures of NDM and WPI (2.0, 2.5 and 3.5%). Mixes were heat treated at 90°C for 7 min, cooled to 43°C , inoculated and fermented at 43°C until 4.5- 4.6 pH. Yogurt samples were maintained at 4°C for 24 h and evaluated for total solids, pH, cysteine content and gel quality following published methods. Three replications were performed, and ANOVA and Dunnett's test were done to determine significant differences. All yogurts had similar total solids contents, but the experimental yogurts had significantly greater cysteine contents, which ranged from 2 to $3.8 \times$ when compared with the control ($\sim 141 \text{ mg}/1000\text{mL}$). The pH of the experimental yogurt with WPI (2.0%) was similar to the control (~ 4.52) but the other experimental yogurts had a lower pH compared with the control. The experimental yogurts had significantly greater firmness (ranged from ~ 2.3 to $8.2 \times$) and water-holding capacity (ranged from ~ 2 to $3 \times$) compared with the control ($\sim 51 \text{ g}$ and $21\% \text{ wt}/\text{wt}$, respectively). The yogurt with WPI (2.0%) had a 2-fold increase in cysteine content but the gel firmness was $\sim 116 \text{ g}$. Supplementing yogurt mixes with WPI increased the cysteine content in the yogurt without adversely affecting the yogurt quality, except for gel firmness; however, other strategies may need to be used to address the gel firmness.

Key Words: yogurt, whey protein isolate, cysteine