Graduate Student Competition: ADSA Dairy Foods Poster Competition

M142 The influence of process time and heat treatment on bleaching efficacy of liquid whey and retentate. X. Li* and M. A. Drake, *North Carolina State University, Raleigh.*

The residual annatto colorant in fluid whey is removed by bleaching to provide a desired neutral color in dried whey ingredients. Studies have established that bleaching negatively influences whey ingredient flavor. Optimization of bleaching parameters is necessary to minimize flavor effects on finished ingredients. Studies are needed to determine if the cheesemake procedure or processing factors influence bleaching efficacy. The objective of this study was to evaluate if starter culture, whey pasteurization, fluid whey storage, or spray drying affected the bleaching efficacy of liquid whey and retentate. Cheddar cheese whey with annatto (15mL/454kg with 3% norbixin content) was manufactured using a mesophilic lactic starter culture or by addition of lactic acid and rennet (rennet-set). Pasteurized fat-separated whey was ultrafiltered to 9% solids (w/w) and spray dried to 34% whey protein concentrate (WPC34). Aliquots of liquid whey were bleached at 60°C for 1 h (hydrogen peroxide, 250 ppm) immediately (no fat separation or pasteurization), before pasteurization and after fat separation, after pasteurization and fat separation, after storage at 3°C for 24 h, and after freezing at −20°C for 1 week. Aliquots of retentate were bleached analogously immediately and after storage at 3 or −20°C. Freshly spray dried WPC34 was rehydrated to 9% (w/v) solids and bleached. Bleaching efficacy was measured by extraction and quantification of norbixin. Proximate analyses and color analyses (Hunter Lab) were also conducted. Each experiment was replicated 3 times. Starter culture (fermentation), fat separation or pasteurization, or spray drying did not impact bleaching efficacy ($P < 0.05$). Cold or frozen storage decreased bleaching efficacy of fluid whey compared with immediate bleaching ($P < 0.05$). These results confirm that processing steps, particularly hold times, can influence bleaching efficacy.

Key words: whey, retentate, bleaching

M143 Impact of bleaching on flavor of 34% whey protein concentrate and benzoic acid concentration in dried whey proteins. M. A. Listiyani*, R. E. Campbell, R. E. Miracle, L. O. Dean, and M. A. Drake, *North Carolina State University, Raleigh.*

Previous studies have shown that bleaching negatively impacts flavor of 80% whey protein concentrate (WPC80) but bleaching effects on lower protein products have not been established. Benzoyl peroxide (BP), a whey bleaching agent, degrades to benzoic acid (BA) and may elevate BA concentrations in dried whey products. There is no legal limit in the US for BP use in whey, but international concerns exist. The objectives of this study were to determine the impact of hydrogen peroxide (HP) or BP bleaching on the flavor of WPC34 and to evaluate residual BA in commercial and experimental WPC bleached with and without BP. Cheddar whey was manufactured in duplicate. Pasteurized fat-separated whey was subjected to hot bleaching with either HP at 500 mg/kg, BP at 50 or 100 mg/kg, or no bleach. Whey was ultrafiltered and spray dried into WPC34. Color (L*a*b*) measurements and norbixin extractions were conducted to compare bleaching efficacy. Descriptive sensory and instrumental volatile analyses were used to evaluate bleaching effects on flavor. Benzoic acid was extracted from experimental and commercial WPC34 and commercial WPC80 and quantified by high performance liquid chromatography. The b* value and norbixin concentration of BP bleached WPC34 were lower than HP bleached and control WPC34 ($P < 0.05$). HP bleached WPC34 displayed higher cardboard flavor and had higher volatile lipid oxidation products than BP bleached or control WPC34 ($P < 0.05$). BP bleached WPC34 had higher BA concentrations than unbleached and HP bleached WPC34 ($P < 0.05$) and BA concentrations were also higher in BP bleached WPC80 compared with unbleached and HP bleached WPC80, with smaller differences than those observed in WPC34. Benzoic acid extraction from permeate showed that WPC80 permeate contained more BA than WPC34 permeate ($P < 0.05$). These results suggest that BP is more effective in color removal of whey and results in fewer flavor side effects compared with HP and that BA is removed by ultrafiltration and diafiltration.

Key words: whey, bleaching, flavor

M144 The influence of bleaching agent, solids concentration and temperature on bleaching efficacy and volatile components of fluid whey. A. J. Fox* and M. A. Drake, *North Carolina State University, Raleigh.*

Whey protein is desirable as a neutral flavored, uncolored powder. Fluid whey is often bleached to remove residual annatto and previous research has demonstrated that this process causes off-flavors in dried whey proteins. The objective of this research was to determine the impact of temperature, solids, and bleaching agent on bleaching efficacy and volatile components in fluid whey. A standard Cheddar cheese make-procedure was used to manufacture liquid whey at 6.7% solids. The whey was concentrated to 12% solids (w/v) and 80% protein (w/w) by ultrafiltration and diafiltration. Liquid whey or concentrated whey (retentate) were bleached using benzoyl peroxide (BP) at 100 mg/kg (w/w) or hydrogen peroxide (HP) at 250 mg/kg (w/w) at 5°C for 16 h or at 50°C for 1 h. An unbleached control was subjected to a similar temperature profile. The experiment was replicated 3 times. Annatto destruction (bleaching efficacy) among treatments was compared by solvent extraction and quantitation of norbixin of each treatment compared with an unbleached control. Volatile compounds were extracted and separated using solid phase microextraction gas chromatography mass spectrometry (SPME GC-MS). Bleaching efficacy of BP was higher than HP ($P < 0.05$) for fluid whey at both 5°C and 50°C. HP bleaching was significantly increased in retentate compared with liquid whey ($P < 0.05$). In retentate, there was no significant difference between bleaching with HP and BP at 50°C or 5°C ($P > 0.05$). Retentate bleached with HP at either temperature had significantly higher relative abundances of pentanal, hexanal, heptanal, and octanal than BP bleached retentate ($P < 0.05$). These results suggest that optimal bleaching of liquid whey is achieved using BP at 50°C and that optimal bleaching of retentate is achieved at 50°C with HP or BP. These results also suggest that bleaching with BP is less detrimental to flavor than bleaching with HP.

Key words: whey, bleaching, annatto

M145 Activation of lactoperoxidase for the bleaching of fluid whey. R. E. Campbell*[1], E. J. Kang[1], E. Bastian[2], and M. A. Drake[1], *[1]North Carolina State University, Raleigh, [2]Glanbia Nutritionals Inc., Twin Falls, ID.*

Lactoperoxidase (LP) is a heat stable peroxidase in raw milk that can generate oxidized substrates with antimicrobial activity. Activation of LP with low levels of hydrogen peroxide (HP) (5 – 10 ppm) is required

and this system has been used to preserve raw milk quality. Commercial bleaching of fluid whey with HP alone requires high concentrations (250 – 500 ppm HP) and recent studies have demonstrated that off flavors are generated during bleaching that carry-through to spray dried whey proteins. Bleaching of fluid whey with naturally present LP may be a viable alternative to traditional whey bleaching. The objective of this study was to monitor LP stability in fluid milk and whey, to determine the optimum level of HP for LP whey bleaching and to compare bleaching efficacy of fluid whey with LP to that of HP. Fluid Cheddar whey was manufactured in triplicate from pasteurized whole milk. LP activity was monitored in raw and pasteurized milk and in whey before and after pasteurization by UV-VIS spectrophotometry. The optimum concentration of HP (0 to 100 ppm) for LP activation was determined by monitoring loss of color in fluid whey via reflectance measurement. The optimum HP concentration for LP activity was 20 ppm. In subsequent experiments, fat separated whey was bleached at 35 or 50C with LP (with 20 ppm HP) or by the addition of 250 ppm HP. A control with no bleaching was also evaluated. Bleaching efficacy was determined by measuring norbixin destruction compared with the unbleached control and volatiles were measured by gas chromatography mass spectrometry (GCMS). LP was active in raw and pasteurized milk and whey, although concentrations decreased with pasteurization. Temperature did not affect bleaching efficacy ($P > 0.05$) while treatment (LP or HP) impacted bleaching efficacy ($P < 0.05$). Bleaching of fluid whey with LP (and 20 ppm HP) resulted in higher bleaching efficacy (color loss) than bleaching with HP alone at 250 ppm ($P < 0.05$). Fluid whey bleached with 250 ppm had higher concentrations of volatile lipid oxidation products compared with LP bleached or control whey. These results suggest that LP bleaching may be a viable and desirable alternative to HP bleaching for fluid whey.

Key words: bleaching, whey, lactoperoxidase

M146 Bleaching efficacy of ozone gas in liquid whey and its effects on flavor of 80% whey protein concentrate. T. J. Smith* and M. A. Drake, *North Carolina State University, Raleigh.*

Bleaching of whey is a necessary commercial practice but recent studies have demonstrated that hydrogen peroxide and benzoyl peroxide bleaching can cause off flavors. The objective of this study was to determine the viability of ozone as an alternative whey bleaching agent. Flavor effects and bleaching efficacy of ozone gas on whey and retentate were evaluated in benchtop experiments before pilot scale manufacture of 80% whey protein concentrate. Cheddar whey and retentate were produced in triplicate. Bleaching variables tested included bleaching temperature (35 and 60°C), ozone (200mg/h in 600mL whey) exposure time (15, 30, and 45 min), and whey solids (6.7 and 12%). Bleaching efficacy was evaluated by measurement of norbixin relative to an unbleached control. Based on benchtop results, hot bleaching of liquid whey with 1h ozone exposure was selected for WPC80 production. To ensure safety, ozone bleaching was performed at a lower level (1.6g/h in 94.5 L whey) and compared with a control (no bleaching) and hydrogen peroxide (HP) bleaching (250ppm). WPC80 was manufactured in triplicate. Bleaching of retentate with ozone was higher at 35°C compared with 60°C ($P < 0.05$); temperature did not affect liquid whey bleaching with ozone ($P > 0.05$). In benchtop studies, a 63% decrease in norbixin content was observed in fluid whey after 45 min ozone exposure. In pilot scale manufacture, WPC80 from HP bleached whey had a 27% norbixin destruction while that bleached with ozone had a 9% reduction. Ozone-treated WPC80 exhibited animal and flour/pasta flavors and HP bleached WPC80 was characterized by cabbage and fatty flavors. These flavors were not present in the control unbleached WPC80. Higher levels ($P < 0.05$) of nonanal and decanal were present in the ozone WPC80 while higher levels ($P < 0.05$) of pentanal, DMDS, hexanal, heptanal, 2-pentylfuran, and octanal were present in the HP WPC80 compared with the control WPC80. These results suggest that ozone bleaching does not represent a promising alternative to approved bleaching agents in whey protein production although it could possibly remain feasible at or close to saturation levels.

Key words: whey, bleaching, ozone

M147 The impact of sodium reduction on the flavor, texture and flavor chemistry of full fat and low fat Cheddar cheese. M. K. Kim*[1], R. E. Miracle[1], D. J. McMahon[2], and M. A. Drake[1], *[1]North Carolina State University, Raleigh, [2]Utah State University, Logan.*

Sodium and fat reduction are key issues for food processors. Salt plays a crucial role in the ripening of natural Cheddar cheese in both flavor and texture development. However, modest reductions in sodium may be acceptable and a quantitative study on the impact of various sodium reductions on flavor and texture development of Cheddar cheese has not been conducted. The objective of this study was to evaluate the role of salt reduction on the flavor and texture of full fat and low fat Cheddar cheese. Low fat and full fat Cheddar cheeses that contained 0.7%, 1.2%, 1.7%, 2.2% 2.7% or 3.25% (wet weight) salt were manufactured in triplicate at Utah State University. Cheeses were ripened at 8°C and samples were taken following 3, 6, or 9 mo for sensory and instrumental volatile analyses. A trained sensory panel (n = 10) documented flavor and texture attributes. Volatile compounds were extracted by solid phase microextraction and identified using gas chromatography mass spectrometry. Selected compounds were quantified using external standard curves. Consumer acceptance tests were conducted after 3 and 9 mo aging. Salty taste and to a lesser extent umami taste, increased with increasing sodium concentration ($P < 0.05$). Firmness of cheeses decreased with decreased sodium after 3 mo ripening and other attributes were impacted with further ripening. Aromatic flavor attributes of cheeses were not distinct at 3 mo ($P > 0.05$) but differences ($P < 0.05$) were documented as cheeses aged. Brothy and rosy flavors and bitter taste were associated with sodium reduction after 6 mo ripening in low fat cheeses and after 9 mo in full fat cheeses. Changes in flavor and texture attributes due to sodium reduction were larger for low fat cheeses compared with full fat cheeses. Cheeses with lower salt concentrations had higher relative abundances of volatile phenyl compounds compared with cheeses with 3.25% salt. Consumer acceptance of cheeses decreased when sodium was decreased by more than 50 percent. Sodium reduction alters flavor and texture properties of Cheddar cheeses and these changes are pronounced with ripening.

Key words: Cheddar cheese, sodium reduction, fat reduction

M148 Fortification of milk for Cheddar cheese manufacture using skim milk powder. A. C. Moynihan* and P. L. H. McSweeney, *University College Cork, Cork, Ireland.*

Using powders to fortify cheesemilk could have potential applications in ingredient cheese or to overcome problems caused by milk seasonality. The objective of this study was to make cheese from milk fortified with skim milk powder (SMP) and to determine its effect on cheese yield, composition, texture, meltability, proteolysis and microbiology. Skim milk (40 L) was fortified with 3.75 kg SMP to make a

milk stock with a higher casein content and the casein to fat ratio was standardized to 0.7 using cream. This mixture was added to cheese vats and made up to 50 L with pasteurized milk to give cheese milk with casein levels of 2.61% (CSMP), 2.86% (LSMP), 3.22% (MSMP) and 3.83% (HSMP) and Cheddar cheese was made therefrom. Significant differences ($P < 0.05$) were observed in moisture-adjusted cheese yields (9.76, 10.84, 12.06 and 14.99 kg/100kg milk for CSMP, LSMP, MSMP and HSMP, respectively). No significant difference ($P > 0.05$) was observed between the cheeses in terms of moisture in non-fat substances. pH values tended to be higher as SMP fortification level increased. Texture analysis showed that low level addition of SMP had no significant ($P > 0.05$) effect on the hardness values of the cheese throughout ripening compared with CSMP but higher levels of addition of powder resulted in increased hardness. The meltability of all cheeses increased with ripening time but HSMP and MSMP melted less than CSMP and LSMP cheeses. As cheese ripening progressed levels of proteolysis increased significantly ($P < 0.05$) in all cheeses but higher levels of SMP fortification resulted in slower proteolysis. Numbers of non-starter lactic acid bacteria (NSLAB) were higher in the fortified cheeses; as the level of powder addition increased so did the numbers of NSLAB. Fortifying Cheddar cheese with SMP had significant effects on yield, textural, melt, proteolytic and microbiological properties of the cheese without having major effects on its composition. Lower levels of fortification can give a cheese with similar properties to the control but with increased yield.

Key words: Cheddar cheese, skim milk powder, yield

M149 Rapid measurement of lactose concentration in cheese whey by using handheld blood glucose meter. A. C. Biswas*, J. K. Amamcharla, and L. E. Metzger, *Midwest Dairy Foods Research Center, Dairy Science Department, South Dakota State University, Brookings.*

Whey is a valuable byproduct of cheese production, and is used to manufacture a variety of whey based products. In addition to whey protein, lactose is an important component of whey, and influences the quality and cost of whey-based products. A blood glucose meter method was previously developed for determination of the lactose content of raw milk and process cheese. The objective of the current research was to modify the previously developed blood glucose meter method, and apply it to the analysis of whey. Additionally, a new generation ReliOn Confirm glucose meter was utilized. In the method, 1 g of whey was diluted with 20 g of 0.1 *M* phosphate buffer (pH 7.4). Five ml of diluted whey and 0.1 mL of β-galactosidase enzyme were mixed, and incubated at 40°C to hydrolyze the lactose into glucose and galactose. After 10 min, the sample was analyzed with 4 different lots of test strips to evaluate the variation between the lots. An individual calibration curve was developed for each test strips lot using the model whey solutions that had a constant protein content of 0.8%, and different lactose concentrations ranging from 2 to 6%. These model whey solutions were standardized and prepared by mixing ultra-filtered whey retentate, whey permeate, lactose powder, and water in different ratios to obtained the final concentration (2%, 3%, 4%, 5%, and 6%) of lactose. A universal calibration curve was also developed by pooling the data from all 4 test strips lots. Simultaneously, the calibration standards were analyzed for lactose concentration using an HPLC-based reference method. The slopes and intercepts of individual calibration curves were between 0.945 to 1.009, and −54.96 to −38.73, respectively. The slope and intercept of universal calibration curve was 0.978 and −46.775, respectively. Future study will focus on validation of the universal calibration curve equation for analysis of whey with a range of lactose concentration typically observed during cheese manufacture.

Key words: cheese whey lactose, rapid method, glucose meter

M150 Organic acid identification and quantification in low-fat Cheddar cheese by capillary zone electrophoresis. R. Kumar* and T. C. Schoenfuss, *University of Minnesota, Department of Food Science and Nutrition, St. Paul.*

Low fat cheese can lack important sensory attributes due to the reduction in fat. The biochemical changes during ripening are related to the development of characteristic flavor. When fat replacement ingredients are used in a cheese, these ingredients could be metabolized by culture and non-starter organisms to create flavor compounds. The objective of this study was the identification and quantification of organic acids in low-fat Cheddar compared with full-fat control by capillary zone electrophoresis using a commercial anion analysis kit (Beckman Coulter, Inc., Brea, CA). Eight organic acids (acetic, butyric, citric, formic, lactic, propionic, pyruvic and oxalic) were measured in cheese samples produced with and without whey protein concentrate (Avonlac 180, Glanbia Nutritionals, Monroe, WI) and polysaccharide fat replacers (Novagel RCN 15, FMC Biopolymer, Philadelphia, PA) and Pectin (XSS 100, Danisco USA Inc., New Century, KS). Separations were performed on a P/ACE MDQ capillary electrophoresis with indirect UV detection at 230 nm. Samples were prepared by solubilizing cheese in water, centrifuging and filtering supernatant before analysis. The separations were carried out on a 50 cm, 75μm i.d. bare fused silica capillary. The sample was injected with pressure at 3448 Pa (0.5 p.s.i.) for 10 s at 30kV with reverse polarity and separation was performed at 25°C. An internal injection standard (sodium octanoate) was used for the quantification of the anions. All quantifiable organic acids were present in significantly greater concentrations in low-fat cheese than full fat control. Among low fat cheeses, formic acid was significantly higher in Novagel treatment cheese and acetic acid was higher in cheese with whey protein concentrate. It was demonstrated that the anion analysis kit can be used effectively in identification and quantification of organic acids in cheese.

Key words: low fat cheese, organic acids, capillary electrophoresis

M151 Stability of sterilized micellar casein concentrates (MCC) during storage. A. Sauer* and C. I. Moraru, *Cornell University, Ithaca, NY.*

The use of micellar casein concentrates (MCC) obtained by membrane separation is receiving increasing interest from the dairy industry. Currently, there is a lack of knowledge regarding the storage behavior of sterilized MCCs. This work aimed at evaluating the stability, particularly the occurrence of aggregation and sedimentation, in sterilized MCCs during storage at 25°C. MCCs with casein concentrations of 5–10% were subjected separately to continuous-flow UHT treatment and in-container retorting, and subsequently stored for 8 weeks at 25°C. As control, non-heat treated MCC with added preservative (Broad Spectrum Microtabs II) was used. Sedimentation was evaluated by measuring the protein content in the bottom layer of the storage containers. Samples were analyzed weekly for protein content, particle size and pH. The study was performed in triplicate. Particle size in control samples increased up to wk 5 of storage, while particle sizes in retorted samples remained constant throughout storage. Control samples were stable for up to 8 weeks (no significant sedimentation was observed), while retorted samples showed significant sedimenta-

tion, with up to 22% increase of protein content in the bottom layer of the storage container. For the retorted samples, sedimentation was the least pronounced in the 10% MCC samples, and most pronounced in the 5% MCC samples. Very strong sedimentation was observed in all UHT treated samples, with large variability between replicates. To estimate sedimentation over prolonged storage, sedimentation kinetics was established for all samples. The rate of sedimentation for 10% MCCs in replicates 1 and 2 was 0.02% protein/day, in replicate 3 it was 0.06%protein/day. Overall, it was concluded that UHT treated MCC preparations were unstable during storage, and may require additional stabilization to increase their storage stability, while the retorted preparations were relatively stable. The results of this study provide valuable information about the storage stability of sterilized MCC obtained by membrane filtration, which can be used for the manufacture of shelf stable, protein rich beverages.

Key words: micellar casein concentrate, sterilization, storage stability

M152 Use of capillary gel electrophoresis for quantification of individual milk proteins in ultra- and microfiltration retentate. P. Salunke*, C. Marella, and L. E. Metzger, *Midwest Dairy Foods Research Centre, South Dakota State University, Brookings.*

Quantification of milk protein into various fractions has technological and functional significance. For determination of the casein (CN) and whey protein (WP) content of milk and milk products a multistep precipitation technique that includes non-casein nitrogen (NCN), non-protein nitrogen (NPN) and total nitrogen (TN) analysis is typically utilized. This method results in a crude fractionation of milk protein and does not quantify the individual protein fractions. However, capillary gel electrophoresis (CE) is emerging as an effective method for qualitative and quantitative separation of individual milk proteins based on molecular weight (MW). The objective of the present work was to utilizing CE to separate various protein fractions in skim milk, milk protein concentrate (MPC) and micellar casein concentrate (MCC), and compare the results to the traditional NCN, NPN and TN analysis. Three samples each of skim milk, MPC and MCC (9 total samples) were collected and CE was performed in triplicate on each sample using a Beckman P/ACE MDQ capillary electrophoresis system (Beckman-Coulter, Fullerton, CA) equipped with a UV detector set at 214nm. Separation was obtained using a 50µm bare fused silica capillary of 30.2cm. SDS-MW analysis kit (Beckman-Coulter) was used for the separation. The area of each peak was calculated from the electropherogram. The TP, NCN and NPN protein of each sample was also determined. The ratio of peak areas for αS1-CN: αS2-CN: β-CN: κ-CN: γ-CN as determined by CE was similar in the skim milk, MPC and MCC samples. The ratio of WP/true protein was significantly ($P < 0.05$) lower in MCC as compared with skim milk and MPC. Additionally the CN/True protein ratio obtained using CE was similar to the CN/True protein ratio determined with Kjeldahl analysis. The results indicate that CE can be used to determine the CN/True protein ratio of skim milk, MPC, and MCC and can be used to determine the relative concentration of individual milk proteins.

Key words: capillary electrophoresis, milk protein concentrate, micellar casein concentrate

M153 Incorporation of whey:buttermilk heat-denatured protein aggregates in model set-type yogurt. M. Saffon*[1], V. Richard[1], S. F. Gauthier[1], M. Britten[2], and Y. Pouliot[1], *[1]STELA Dairy Research Center, Institute of Nutraceuticals and Functional Foods (INAF), Université Laval, Québec, QC, Canada, [2]Food Research and Development Center (FRDC), Agriculture and Agri-Food Canada, St-Hyacinthe, QC, Canada.*

Previous work showed that it was possible to generate aggregated protein material by heating buttermilk in the presence of whey. It was hypothesized that addition of these protein aggregates would increase serum retention and improve firmness of yogurts. Whey and buttermilk protein mixtures (25:75) were adjusted to pH 4.6 and heated at 90°C for 25 min. Set-type model yogurts were prepared from milks standardized to 15% (w/v) total solids and 4.2% (w/v) protein using skim milk powder (SMP). Whey:buttemilk aggregates were introduced to substitute 40, 60, 80 or 100% of the proteins from SMP. Enriched milks were heated at 85°C for 20 min. After cooling at 42°C, milks were inoculated with a commercial yogurt starter (*S. thermophilus*, *L. bulgaricus*) and incubated until pH 4.6 was obtained. Syneresis was determined by centrifugation at 222 × *g* during 10 min at 4°C and texture properties were obtained by penetration using a TA-XT2 texture analyzer. All yogurt preparations were performed in triplicate and textural properties of yogurts were compared with those of control yogurt using *t*-tests. Addition of new aggregates significantly decreased ($P < 0.001$) forces of fracture, firmness, adhesiveness and relaxation. Syneresis was also increased. Substituting 60% of the proteins from SMP using aggregates had the least impact on the textural properties of yogurts. Particle size distribution analyses of milks before and after heating milks showed that unheated milks contained 2 populations of particles while heated milks contained only one population of particles. This suggests that whey:buttermilk aggregates may interact with milk protein during heating. Overall, our results show that whey:buttermilk aggregates can be used as protein ingredient in yogurt formulas, however, more work is needed to maximize heat-induced interactions between whey:buttermilk aggregates and milk proteins.

Key words: heat-denatured protein, yogurt, texture properties

M154 Linking environmental and sensory qualities of a Vermont artisan cheese. A. Greenbaum*[1], S. Carpino[2], M. Almena[1], S. Bosworth[1], P. Kindstedt[1], and A. Trubek[1], *[1]University of Vermont, Burlington, [2]CoRFiLaC, Ragusa, Italy.*

In collaboration with the Vermont Agency of Agriculture, Food and Markets, researchers at the University of Vermont have created the Taste of Place Initiative, involving research and outreach with cheesemakers to understand the quality of their product by identifying unique sensory characteristics. This particular research project investigates how the natural environment influences the final sensory characteristics of a particular alpine style farmstead cheese by identifying and characterizing key differences in sensory notes and chemical flavor compounds, and determining whether those differences are attributable to differences in the makeup of the pasture and practices of 2 Vermont artisan cheesemakers and their facilities. During this project SmartNose and gas chromatography-olfactometry analysis, sensory panels, observation, sample collection and cheesemaker interviews were conducted. First, pasture samples were collected from both farms on the same 2 d in early summer and 2 d in the fall. The pasture samples and aged cheese samples from 2 wheels of the cheese made the day of summer pasture collection and fall pasture collection were frozen and stored in a −32°C freezer until they were shipped to the CoRFiLaC lab in Ragusa, Sicily, and later analyzed using SmartNose, gas chromatography-olfactometry to identify similarities in volatile compounds between the pasture and corresponding cheese samples. A half-kilogram of each wheel of cheese sent for SmartNose and GC-O

analysis was also sampled during sensory analysis using Quantitative Descriptive Analysis. Preliminary results revealed overlaps across methodologies as similar descriptors found during QDA were defined during cheesemaker interviews and also correlated with environmental observation. The correlation between pasture and cheese samples has yet to be determined. By defining unique sensory characteristics of this artisan cheese, the results can impact struggling rural areas by keeping historically local products in production, thus creating rural employment and stabilizing rural population.