manufacturers as it allows a quick, easy and cheap test to determine the functionality of the NFDM samples used for yogurt manufacture.

Key Words: NFDM, Yogurt, RVA

51 Characteristics of κ-casein stabilized emulsions treated with rennet. R. Richter, G. Anita*, G. Perez-Hernandez, and B. Davis, *Texas A&M University, College Station*.

The objective of this research was to determine if gels could be formed from κ-casein stabilized emulsions by treatment with rennet. Emulsions were prepared with κ-casein separated from acid casein (Cayot et al. 1992) and butteroil. The compositions of the emulsions were 0.3% κ-casein and 3, 10 or 20% fat. The pre-emulsion mixtures were heated to 65°C before homogenization at 20 or 100 MPa and cooled to room temperature. $CaCl_2$ was added to emulsions to obtain a concentration of 20 mM. A 0.1% solution of rennet (200 μl) was added to 30 ml emulsion samples. Rheological properties were measured before and after the addition of rennet. The effect of fat concentration and homogenization pressure on the rheological properties of the emulsions was determined. Emulsion behaved as Newtonian fluids before the addition of rennet with mean viscosities of 1.21, 1.45 and 2.12 cP for emulsions containing 3%, 10% and 20% fat respectively. The addition of rennet caused yield stress in all of the emulsions and the viscosity increased to 3.59, 18.18 and 51.17 cP for emulsions that contained 3%, 10% and 20% fat respectively. The mean viscosity of the emulsions increased from 20 cP when emulsions were homogenized at 20 MPa to 26 cP when emulsions were homogenized at 100 MPa. Under the studied conditions, κ-casein gels could not be formed. However, yield stress was observed on the κ-casein emulsions treated with rennet. The changes on the rheological properties depended upon the composition of the emulsions and the pressure applied during homogenization.

Key Words: k-casein, Rennet, Rheological properties

Forages and Pastures: Management of Tall Fescue Forage

52 Performance of beef heifers grazing stockpiled endophyte-infected, endophyte-free or non-toxic endophyte-infected fescue. E. J. Oliphant*, M. H. Poore, J. T. Green, and M. E. Hockett, *North Carolina State University, Raleigh*.

A 70-d study was conducted from Dec 20 to Feb 28 in order to evaluate heifer performance on Jesup endophyte-infected (E+), endophyte-free (E-) and non-toxic endophyte-infected (EN) tall fescue. Botanical composition and nutrient content of each treatment (tmt) was also evaluated. Forty-eight Angus cross heifers (initial wt 269 kg, initial body condition score 5.1) were placed in groups of 4 and randomly assigned to 12 paddocks (avg 1.25 ha). Paddocks were fertilized with 95 kg of N per ha on Sept 24, and forage was stockpiled until the initiation of the trial. Heifers were given a daily allotment of forage with a target residual height of 5 cm. Mineral containing monensin (1780 mg/kg) was available ad lib. The initial grazable mass was higher (P<0.06) for E+ (1443 kg/ha) than for E- (1100 kg/ha) or EN (1233 kg/ha). Daily gains did not differ by tmt (0.33, 0.42 and 0.45 kg/d for E+, E- and EN, respectively). Forage grab samples were taken at 14-d intervals starting Dec 2, and subsamples were separated into green fescue, brown fescue and species other than fescue (primarily crabgrass). There were no differences in nutrient content among tmt within green or brown fescue tissue: (E+ green: 43.3% NDF, 19.8% ADF, 11.75% CP; brown: 67.1% NDF, 34.3% ADF, 7.75% CP), (E- green: 42.5% NDF, 19.3% ADF, 11.62% CP; brown: 66.8% NDF, 33.9% ADF, 7.76% CP), (EN green: 43.6% NDF, 19.9% ADF, 11.25% CP; brown: 68.1% NDF, 34.6% ADF, 7.35% CP). From Dec to Feb, percent green fescue decreased in all tmt (P<0.01) with no significant difference among tmt. Percent fescue in the sward DM was higher (P<0.01) in E+ (87.8%) and EN (87.5%) than in E- (81.1%). Nutrient content of the sward declined (P<0.01) over the winter, but average nutrient composition was similar across tmt: E+ (52.0 % NDF, 25.5 % ADF, 10.96 % CP), E- (52.2 % NDF, 26.1 % ADF, 11.16 % CP) and EN (52.1 % NDF, 25.4 % ADF, 10.53 % CP). These results indicate that endophyte status of stockpiled fescue may have little influence on animal gain or forage quality during the winter grazing season.

Key Words: Endophyte, Fescue, Beef Heifers

53 Calving rate and production responses of long-term exposure to endophyte-infected tall fescue. J. M. Burke*, D. K. Brauer, and M. L. Looper, *USDA, ARS, Booneville, AR*.

The objective was to examine the effect of continuous exposure to endophyte-infected (EI) tall fescue on pregnancy, calving rates, and calf growth in cow-calf pairs. In April 1999 and 2000, Angus and Angus x Hereford cows were randomly assigned to graze 16 ha endophyte-free (EF; n = 20/yr) or 24 ha EI (n = 30/yr). From spring 2000 until fall 2003 cows were continuously exposed to each forage. Heifers were bred in April and cows were bred in May for a 90 and 60 day breeding period, respectively. Cows were removed or culled from treatments if they did not conceive or lost a pregnancy or calf. Cows grazing EI fescue were supplemented daily with 0.5 kg/cow of corn/SBM for 90 d in winter so that body condition scores were similar between EF and EI cows by April. At weaning (early October) pregnancy rate, determined by transrectal ultrasound, and calving rate were similar between pasture groups and length of time on pasture. Calving interval tended to be reduced in cows grazing EI fescue the first year (374.0 ± 4.8 < 386.2 ± 4.4 d; forage × exposure; $P < 0.06$). Percent of cows culled or that died between forage treatments was similar. Despite supplemental feeding of EI cows over winter, body weight (forage × exposure × days postpartum, $P < 0.03$) and condition scores (1 = emaciated, 9 = obese; forage × exposure × days postpartum, $P < 0.001$) were greater in cows grazing EF fescue. Body weight and condition were greater in cows exposed for 3 to 5 years in both forage groups compared to those exposed to forage for 1 or 2 years. Birth weights of calves born to cows exposed to 2 years were reduced compared with 1 or 3 to 5 years of EI fescue exposure (forage × exposure, $P < 0.008$). However, by weaning, the 205 day adjusted weaning weight was similar among exposure groups and greater in EF compared with EI calves (224.3 ± 3.8 > 199.7 ± 2.4 kg; $P < 0.001$). In summary, number of years of exposure to EI tall fescue did not greatly impact cow-calf performance.

Key Words: Beef, Production, Tall fescue

54 In situ digestibility of tall fescue fertilized with different swine manure treatments and harvested on four dates. J. L. Reynolds[1], R. K. Ogden[1], K. P. Coffey*[1], W. K. Coblentz[1], C. V. Maxwell[1], and K. VanDevender[2], [1]*University of Arkansas, Fayetteville,* [2]*Cooperative Extension Service, Little Rock, AR*.

Forage digestibility varies across a growing season due to factors such as fertility and harvest date. Our objective was to evaluate the in situ DM digestibility of tall fescue (*Lolium arundinacea*, Schreb.) fertilized with different swine manure treatments and harvested on different dates. "GA-Jessup" tall fescue infected with a non-ergot alkaloid producing endophyte (Max-Q®) was either not fertilized (CONT), or fertilized (126 kg N/ha) with normal swine manure (NORM); swine manure from pigs fed phytase (PHY), or PHY treated with aluminum chloride (PHY+AL). Accumulated forage was harvested by clipping with hand shears (2.5 cm stubble height) on April 3, April 28, May 16, and June 23, 2003. Ruminally cannulated steers (n=5; 548 kg BW) were used to evaluate these forages in situ. Degradation rate of DM was greater (P<0.05) from NORM and PHY than from CONT and decreased (P<0.05) with advancing harvest dates through the May 16 harvest. A fertility treatment by harvest date interaction was detected (P<0.05) for most variables. The slowly degradable (B) fraction, potential extent of degradation, and effective ruminal degradability were higher (P<0.05) on April 3 and 28 than on May 16 and June 23 from all fertility treatments. The soluble (A) fraction, fraction B, potential extent, and effective degradability were greater (P<0.05) from fertilized than CONT fescue harvested April 3, but the improvement was not consistent across harvest dates. By May 16 and June 23 harvests, fraction B and potential extent were greater (P<0.05) from CONT than from fertilized fescue. Effective ruminal degradation was not consistently impacted by fertility treatment after April 3. Therefore, inclusion of phytase in swine diets along with subsequent treatment of the manure with aluminum chloride did not

have consistent impacts on forage degradation compared with normal swine manure. Furthermore, fertilization with swine manure increased effective degradation of fescue initially, but the impact was not consistent at later harvest dates.

Key Words: Swine Waste, Phytase, Tall Fescue

55 Selenium concentration of fescue and bahiagrasses after applying a selenium fertilizer. G. Valle, L. R. McDowell*, D. L. Wright, and N. S. Wilkinson, *University of Florida, Gainesville*.

Two experiments were conducted, one with bahiagrass (August to November) in North Central Florida (Gainesville) and the other with fescue (January to July) in Northwest Florida (Quincy), to evaluate the selenium levels of the grasses after applying a slow release selenium fertilizer (Selcote Ultra). The hypothesis is that selenium fertilizer would elevate forage selenium to acceptable levels for ruminant requirements. In the bahiagrass study, forage samples were collected from 3 x 5 m plots replicated 4 times which had been sprayed with Selcote Ultra at randomized treatment rates of 0, 5, 10, 15 and 20 g ha^{-1} selenium. Samples were collected every two weeks for a total of six collections. In the fescue study, the procedure was the same except that forage samples were collected at 2, 4, 6, 10, 16 and 22 wk after applying the fertilizer, and the rates were 0, 5, 10, 24 and 120 g ha^{-1} selenium. For bahiagrass, only the 10, 15 and 20 g ha^{-1} selenium treatments reached acceptable levels in the forage (>0.1 ppm) for beef cattle. The 10 g ha^{-1} selenium treatment reached adequate levels (0.25 ppm) only at 4 wk after application. The 15 g ha^{-1} selenium treatment presented adequate levels of selenium at 2, 4 and 6 wk after application (0.19, 0.17 and 0.17 ppm, respectively). The 20 g ha^{-1} selenium treatment had adequate forage selenium at 4 and 6 wk after application (0.19 and 0.23 ppm respectively). All treatments were deficient at 8 and 12 wk. In the fescue study, all treatments presented adequate concentrations (0.1 ppm) of selenium in the forage, except for the control. At two weeks after application, the 24 g ha^{-1} and the 120 g ha^{-1} selenium treatments had toxic selenium levels in forage. However, these values declined to below toxicity (4-5 ppm) at all other collection dates. In conclusion applying Selcote was more effective for fescue than bahiagrass, with fescue forage selenium still more than adequate 22 wk after application.

Key Words: Selenium, Fertilizer, Forage

56 Rumen parameters of cattle grazing tall fescue pastures differing in endophyte status. A. M. Corrigan*, J. C. Waller, A. M. Saxton, L. C. Miller, and C. J. Richards, *The University of Tennessee, Knoxville*.

Objectives of this experiment were to compare weight and composition of rumen contents and substrate *in situ* degradation in steers grazing tall fescue (*Festuca arundinacea* Schreb.) pastures. Pasture treatments consisted of continuous grazing of Kentucky-31 endophyte (*Neotyphodium ceonophialum*) infected (E+), Jesup endophyte-free (E-) or Jesup infected with a non-ergot alkaloid producing endophyte (MaxQ). The d was separated into two 12-h grazing periods. Day grazing (DG) was from 0700 to 1900 and night grazing (NG) was from 1900-0700. Two ruminally cannulated steers were randomly assigned to each pasture in early May 2003. After a 7 d acclimation period, steers were subjected to four rumen evacuations NG at 0700 and four DG at 1900. Contents were weighed and sub-sampled. Evacuated rumens were washed and steers were returned to appropriate pastures for 45 min to obtain masticate samples. Between the four evacuation days, alfalfa hay, corn grain, corn gluten feed, and soybean hulls *in situ* degradation was determined for the NG and DG periods by placing a 5 g sample of each substrate, within a 10 x 20 cm Dacron bag, into each steer consuming the three forage treatments. After a 12-h incubation, Dacron bags were mechanically washed and dried. Rumen content, masticate, *in situ* substrate, and *in situ* incubated residue samples were analyzed for DM, NDF, ADF, and CP. Rumen DM contents for steers grazing E- and MaxQ were greater ($P < 0.05$) than steers grazing E+ and DG contents were heavier ($P < 0.01$) than NG. *In situ* DM, NDF, and CP degradation of corn grain was greater ($P < 0.05$) in steers grazing E- and MaxQ than in steers grazing E+. *In situ* alfalfa hay and corn gluten feed DM, NDF, and ADF degradation appeared greater ($P < 0.15$) in steers grazing E- and MaxQ than in steers grazing E+. Soybean hull degradation was not affected by pasture. Generally, nutrient degradation of substrates was not affected by incubation time (NG vs DG).

Key Words: Tall Fescue, Degradability, Endophyte

57 Use of novel endophyte-infected tall fescue for cow-calf production in Arkansas. J. M. Burke*, D. K. Brauer, and M. L. Looper, *USDA, ARS, Booneville, AR*.

The objective was to examine pregnancy, calving rates, and calf growth in cow-calf pairs on endophyte-free (EF), novel endophyte-infected (NE), and endophyte-infected (EI) tall fescue. Angus cows grazed EF, NE (n = 20/16 ha), or EI (n = 30/24ha) starting November 2001 through July 2003. To prevent overgrazing, NE cattle were removed from July to November 2002 and in May 2003. Hay was provided as needed during winter. Pastures were fertilized at a similar rate among fescue varieties with N, P and K in early March and October both years. Cows were bred beginning in May for 60 d. Cows were removed if not pregnant at weaning or lost a pregnancy or calf after calving and replaced with a comparable pregnant cow or cow-calf pair that had previously grazed bermudagrass (for EF and NE groups) or EI (for EI group) fescue. Forage yields were determined monthly in exclusions (n = 3/pasture) in 2003. Yield of EI was greater than EF or NE from April to June and EF and EI forage yield was greater than NE in August (forage × month, $P < 0.02$). Cows grazing EF fescue gave birth to heavier calves than those grazing EI ($P < 0.04$) and NE calf weights were similar to EF and EI weights (EF, 38.3 ± 0.7; NE, 36.7 ± 0.7; EI, 36.3 ± 0.6 kg; $P < 0.10$). Between May and July 2002, EF and NE calves were heavier than EI calves (forage × time, $P < 0.001$); however, calf weights were similar in May 2003 among forage groups ($P = 0.15$). At weaning (early October 2002) pregnancy rate, determined by transrectal ultrasound, was greater in NE than EI cows ($P < 0.03$) and similar between EF and EI cows (EF, 70.9 ± 9.7; NE, 96.2 ± 9.8; EI, 67.8 ± 8.6%; $P < 0.07$). By spring, calving rates were similar among forage groups (EF, 70.0 ± 10.7; NE, 80.2 ± 10.9; EI, 63.2 ± 9.5%; $P = 0.35$). In summary, calf gains from cows grazing NE fescue were greater than EI calves. However, the use of NE fescue as a summer forage at a similar stocking rate as EI (1 cow/0.8 ha) is limited in Arkansas because of overgrazing potential.

Key Words: Beef, Novel endophyte, Tall fescue

58 Using orchardgrass and endophyte-free fescue versus endophyte-infected fescue overseeded on bermudagrass for cow herds: four-year summary of cattle performance. W. K. Coblentz*, K. P. Coffey, D. A. Scarbrough, T. F. Smith, D. S. Hubbell, III, K. F. Harrison, B. C. McGinley, J. E. Turner, and J. B. Humphry, *University of Arkansas, Fayetteville*.

A four-year trial was initiated in January 2000 with 65 spring-calving cows (549 ± 23.0 kg) to evaluate cow-calf performance on pastures with endophyte-infected tall fescue (IF; *Festuca arundinacea* Schreb.), endophyte-free (FF) tall fescue, or orchardgrass (OG; *Dactylis glomerata* L.) overseeded into dormant common bermudagrass [*Cynodon dactylon* (L.) Pers.]. Two management systems were evaluated to help FF and OG forages persist; these included rotations to new paddocks twice weekly or twice monthly. Pastures with IF were managed with twice monthly rotations. Generally, effects of year and forage management system x year did not affect ($P > 0.05$) calf performance. Actual weaning weight ($P = 0.083$), adjusted 205-d weaning weight ($P = 0.032$), total gain from birth to weaning ($P = 0.081$), and average daily gain from birth to weaning ($P = 0.028$) were greater or tended to be greater for calves raised on non-toxic forages (FF and OG) than for those raised on IF pastures; for actual weaning weights, this represented a 21-kg advantage for non-toxic pastures (OG and FF). Cows grazing OG and FF pastures exhibited higher ($P < 0.035$) bodyweights and body condition scores (BCS) at calving, breeding, and weaning than cows grazing IF pastures; however, BCS for cows grazing IF pastures remained acceptable (range = 6.1 to 6.7). Milk production in May for cows grazing nontoxic forages was greater than observed for cows grazing IF pastures (6.52 vs. 5.42 kg/d; $P = 0.011$), but this differential was not observed in July ($P = 0.587$). Serum prolactin levels also were greater for cows grazing non-toxic forages (181 vs. 90 ng/mL; $P = 0.005$) than for those grazing IF pastures. Conception rates did not differ ($P > 0.456$) among forage treatments (overall mean = 85.8%). Cow-calf performance was improved marginally by including non-toxic, perennial cool season grasses in bermudagrass pastures, but establishment costs

and additional management requirements may limit the acceptability of this approach.

Key Words: Tall Fescue, Orchardgrass, Cow-Calf Performance

59 Using orchardgrass and endophyte-free fescue versus endophyte-infected fescue overseeded on bermudagrass for cow herds: four-year summary of forage characteristics. W. K. Coblentz*, K. P. Coffey, D. A. Scarbrough, T. F. Smith, K. F. Harrison, D. S. Hubbell, III, B. C. McGinley, J. E. Turner, and J. B. Humphry, *University of Arkansas, Fayetteville*.

A four-year trial was initiated in January 2000 to evaluate forage production, basal cover, and persistence of endophyte-infected tall fescue (IF; *Festuca arundinacea* Schreb.), endophyte-free tall fescue (FF), or orchardgrass (OG; *Dactylis glomerata* L.) overseeded into dormant common bermudagrass [*Cynodon dactylon* (L.) Pers.] for spring-calving cows. The FF and OG pastures were managed with either a twice weekly (HM) or twice monthly (LM) rotation schedule, while the IF pastures were managed with a LM rotation schedule only. Forage-related response variables were evaluated with a split-plot design, where forage system (IF-LM, FF-HM, FF-LM, OG-HM, and OG-LM) was the whole-plot term and sampling/evaluation date was analyzed as a repeated measure. Forage availability (four-year mean = 3809 kg/ha) was not affected ($P = 0.601$) by forage management system, but was affected by sampling date ($P < 0.0001$) and the forage system x sampling date interaction ($P = 0.010$). Total basal cover varied ($P < 0.0001$) with sampling date, ranging from 36.3 to 51.5%, but was not affected by forage system ($P = 0.679$) or the interaction of main effects ($P = 0.354$). The interaction of forage system and evaluation date affected ($P = 0.038$) the percentage of the desired cool-season species in each pasture. Generally, FF and IF remained relatively stable over the entire study, ranging from 49.2 to 72.5% for FF-HM, 54.0 to 73.5% for FF-LM, and 46.9 to 65.8% for IF. However, the percentage of OG declined markedly ($P < 0.1$) since June 2002 in both the HM and LM grazing systems, ending at 36.2 and 14.7%, respectively, on the final (November 2003) evaluation date. After four years, FF has persisted well, but OG stands have thinned markedly, particularly under the LM rotation schedule. Therefore, FF may be a better choice than OG as an alternative to IF for spring-calving cow herds in the Upper South.

Key Words: Tall Fescue, Orchardgrass, Bermudagrass

National ADSA Foods Only (Graduate): ADSA Dairy Foods Graduate Paper Contest

60 Influence of pre-exposure of mycobacterium avium sub sp paratuberculosis to different environments on invasion of bovine epithelial cells in in vitro cell culture system. D. A. Patel*[1], L. Meunier-Goddik[1], and L. Bermudez[2], [1]*Food Science and Technology, Oregon State University, Corvallis,* [2]*Department of Biomedical Sciences, Oregon State University, Corvallis*.

Mycobacterium avium sub sp paratuberculosis (MAP) is a causative agent of Johnes disease (JD) in cattle having significant economic impact. It is known that after crossing the mucosal barrier, MAP can disseminate and infection can spread to various sites including mammary gland. MAP can be exposed to high osmolarity and the intracellular environment of mammary gland epithelial cells. To study the influence of the environment on MAP invasion of bovine epithelial cells; MAP strain ATCC 19698 was used in the study. Immortalized MDBK (Madin Darby Bovine Kidney) cells were used as a model of bovine epithelial mucosa. MAC-T cells (mammary epithelial cells) were used for intracellular passage of MAP. MAP culture was inoculated in to raw milk, water and Middlebrook 7H9 broth (7H9 broth) containing Mycobactin J and OADC (10 % V/V) at 37 °C in the presence of antibiotics. MAP was also used to infect MAC-T cells for 1d and 4d at 37°C. MAC-T were then lysed and bacteria separated from host cell by differential centrifugation at 4 °C. MAP exposed to several environments was then added to polarized MDBK cells for 2hr. The percentage MAP invasion was calculated as percent of MAP inoculum that internalized in to MDBK cells. Statistical significance was determined by students t test and ANOVA. Our results indicated that MAP invasion is not significantly different at 1d among milk, broth and water preexposed samples. However, MAP passage in MAC-T cells significantly increased invasion percent (15 fold at 1d, p-value < 0.001 and 10 fold at 4d, p-value < 0.001) compared to control. Employment of RNA subtraction hybridization will help to define which MAP genes are associated with the invasive phenotype. These results indicate that exposure of intracellular MAP significantly increases its invasion efficiency for bovine epithelial cells. This characteristic may be important in establishing successful infection in susceptible host.

Key Words: Mycobacterium avium sub sp paratuberculosis, Invasion Assay, Mammary Epithelial Cells

61 Elucidation of the role of chymosin-mediated proteolysis in texture development during Cheddar cheese ripening. J. A. O'Mahony*[1,2], J. A. Lucey[2], and P. L. H. McSweeney[1], [1]*Department of Food and Nutritional Sciences, University College, Cork, Ireland,* [2]*Department of Food Science, University of Wisconsin, Madison*.

More than 20 years ago, it was hypothesised that proteolysis of α_{s1}-casein by residual chymosin, early in ripening, is responsible for the initial softening observed in Cheddar cheese. To investigate this hypothesis, full-fat, Cheddar cheeses (2 kg) were manufactured with 0.1, 1.0 or 10.0 μmol pepstatin (a potent inhibitor of chymosin) added per litre of curd/whey mixture at the start of cooking to obtain residual chymosin levels of 89, 55 and 16% of the activity in the control cheese, respectively. Texture profile analysis of cheeses was performed by compression (2 cycles) to 25% of original height. Levels of intact α_{s1}- and β-caseins were measured by densitometric analysis of urea-polyacrylamide gel electrophoretograms of pH 4.6-insoluble fractions from the cheeses. During the first 21 d of ripening, the rate of development of pH 4.6-soluble nitrogen (expressed as % of total nitrogen) was 0.29, 0.14, 0.06 and 0.04 %/d for control cheese and cheeses made with 0.1, 1.0 or 10.0 μmol L^{-1} pepstatin, respectively. Concurrently, the level of intact α_{s1}-casein decreased by 49, 25, 7 and 3% in these cheeses. At 21 d of ripening, there was a significant ($P<0.001$) reduction in hardness (maximum force on first compression cycle) in each of the 4 cheeses with initial (1 d) hardness values of 189, 204, 207 and 233 N decreasing to 115, 139, 163 and 187 N, in cheeses made with 0.0 (control), 0.1, 1.0 or 10.0 μmol L^{-1} pepstatin, respectively. It was concluded that, irrespective of the extent of α_{s1}-casein hydrolysis, there was a significant softening of Cheddar cheese texture during the first 21 d of ripening and it appears that the hydrolysis of α_{s1}-casein by chymosin is not a prerequisite for Cheddar cheese softening. We believe that some physicochemical change(s), such as a reduction in the amount of calcium associated with the *para*-casein matrix of the curd may be responsible for this textural change.

Key Words: Proteolysis, Texture, Cheddar Cheese

62 Compositional factors associated with calcium lactate crystal formation in naturally smoked Cheddar cheese. P. Rajbhandari* and P. S. Kindstedt, *University of Vermont, Burlington*.

We have observed a high incidence of surface crystals among retail samples of naturally smoked Cheddar cheese. We have also occasionally observed that some samples displayed crystals whereas others originating from the same vat of cheese did not. This study compared the compositions of naturally smoked Cheddar cheese samples that contained surface crystals (Cry+) with those of samples originating from the same vat that were crystal-free (Cry-). Six pairs of retail samples (Cry+ and Cry-) produced at the same cheese plant on different days were obtained from a commercial source. Each pair was 5-6 mo old upon receipt and was stored for up to 18 mo at 4°C to insure that the Cry- sample remained crystal-free. Then, the crystalline material was scraped off the surfaces of Cry+ samples and analyzed for lactic acid, Ca, P, moisture and CP. Cry+ and Cry- samples were then sectioned into 3 concentric subsamples (0-5mm, 6-10mm and > 10mm depth from the surface) and analyzed for pH, TA, TS, NaCl, total and water-soluble Ca and P, and CP. The data were analyzed by ANOVA according to a repeated measures design with 2 within-subjects variables. The crystalline material contained 52.9% lactate, 8.1% Ca, 0.1% P, 28.5% water and 8.9% CP on average. Both Cry+ and Cry- cheese samples contained significant gradients of decreasing moisture from center to surface. Compared to Cry- samples, Cry+ samples possessed significantly higher moisture,