from US04 was closer to zero, standard deviation of the differences was smaller, and correlations were higher. The advantage in correlation from IB01 increased with the amount of new U.S. data in the 2004 evaluation. Both U.S. and IB evaluations were stable on average, increasing in mean only slightly. Regressions were essentially unity in both systems. Correlations were less than expected by about 0.01 overall and lower by 0.04 for subsets with substantial added data. Inclusion of foreign data in addition to U.S. data improved the prediction of later U.S. SCS evaluations.

Key Words: Genetic Evaluation, Somatic Cell Score, Interbull

43 Genetic component of heat stress. S. Oseni, I. Misztal*, S. Tsuruta, and R. Rekaya, *The University of Georgia, Athens*.

A norm reaction model was used to estimate the genetic parameters of days open (DO) and pregnancy rate (PR) under heat stress. Data included DO records for GA, TN and NC. Pregnancy rate was computed as PR=min{1, 1/[(DO-50)/21-1]}. PR, unlike DO, assigns greater weight to smaller DO records. Fixed effects model included herd-year-month of calving, age of the cow, and a regression on 305-d milk yield. The norm-reaction model additionally included the effect of animal with random regression on a heat index, which was normalized solutions to months of calving from the fixed model; residual variance was assumed to be a function of the heat index. The shape of the heat index for DO (PR) was close to sinusoidal (triangular) function with the highest value in April (May) and the lowest value in October (October). For DO and PR, genetic and residual variances and heritabilities were highest for spring calvings and lowest for fall calvings. For DO (PR), the variance associated with the highest level of heat index was 33% (33%) of the genetic variance of the regular effect. Genetic correlation between regular and heat stress effects for DO (PR) was 0.67 (-0.65). As a validation process, DO was computed with the model above, without the heat stress index and the months of calving grouped into four seasons treated as multiple traits. In general, the genetic and residual variances of the multiple trait model followed those of the norm-reaction model for DO. Genetic correlations of spring with summer, and fall with winter were 0.97 and 0.98, respectively. Genetic correlations between spring/summer and fall/winter were around 0.8. The norm reaction model for DO allows inexpensive but limited genetic evaluation of fertility under heat stress. Results of such an evaluation may strongly depend on the editing criteria and on the details of the model.

Key Words: Days Open, Pregnancy Rate, Heat Index

44 Use of peeling and reverse peeling to estimate the power to map a recessive disease gene. L. R. Totir*, R. L. Fernando, and J. M. Reecy, *Iowa State University, Ames*.

Animal pedigrees containing individuals that exhibit the phenotype of a recessive disease (e.g. dwarfism) can be used to map the causative recessive disease gene by performing a genome scan. When planning a linkage study, however, it is important to know beforehand the number of animals that must be genotyped and the marker density needed to have sufficient power to locate the disease gene. Conditional on the observed disease phenotypes, reverse peeling can be used to sample genotypes at the disease locus and at two flanking marker loci. Given the sampled genotypes and the observed disease phenotypes, peeling can be used to compute the logarithm of the likelihood ratio (LOD score). By replicating this process, the power to detect the disease locus can be estimated by calculating the frequency of samples where the LOD score is larger than 3. This strategy was applied to an Angus cattle pedigree of 39 animals including six affected individuals. For this pedigree we studied the behavior of the power to map a disease gene as a function of the number of animals genotyped, and the size of the marker interval. It was determined that, for this pedigree, the power to map a disease gene was larger than 90 percent for marker intervals equal to or smaller than 15 cM. This strategy can be used to design genome scans to map disease genes with adequate power.

Key Words: Power, Peeling, Recessive Disease Gene

Dairy Foods: Chemistry

45 Utilization of front face flourescence spectroscopy for rapid analysis of process cheese functionality. S. K. Garimella Purna*, L. A. Prow, and L. E. Metzger, *University of Minnesota, St. Paul*.

The purpose of this study was to evaluate the feasibility of front face fluorescence spectroscopy (FFFS) to predict the functional properties of process cheese spreads. A total of 27 different commercial samples from three different manufacturers were used in this study. Each sample was analyzed using tube melt test and dynamic stress Rheometry (DSR). The tube melt data is a measure of cheese flow in mm, whereas the DSR data was used to calculate the melt temperature (temperature at tanδ = 1). Additionally fluorescence spectra of tryptophan (excitation: 290nm; emission: 305-400 nm) were collected on each sample at 20°C using a front face accessory. Six replicates were taken from each sample and six scans were performed on each replicate. After collection the curves were normalized and the mean curve was baseline corrected. Multivariate statistical analysis was used to correlate the fluorescence data with the functionality data. In the initial analysis two samples with large spectral and concentration residuals were eliminated from the calibration set. The calibration models were developed using partial least square regression (PLS). The analysis included preprocessing using mean centering and verification using cross validation. A correlation coefficient of 0.90 and 0.82 between the fluorescence spectra and the functionality data was obtained for the DSR and tube melt respectively. The regions from 309-315 nm and 355-395 nm of the tryptophan spectra had highest correlation to DSR; while the tube melt data had the highest correlation between 334-348 nm. Examination of the tryptophan spectra indicated that an increase in the melt temperature measured by the DSR resulted in a blue shift in the spectra. These spectral shifts have been related to the protein conformational changes due to change in the environment of tryptophan residues present in the protein. These results indicate that the melt properties of process cheese spreads are related to molecular structure that can be measured using FFFS.

Key Words: Fluorescence, Process Cheese, Functionality

46 Modified milk vs. producer milk samples for calibrating infrared (IR) milk analyzers: which gives the best validation performance? K. E. Kaylegian*[1] and D. M. Barbano[1,2], [1]*Dept. of Food Science, Cornell University, Ithaca, NY,* [2]*Northeast Dairy Foods Research Center, Ithaca, NY*.

Nine IR milk analyzers were calibrated with modified milk samples and nine different IR analyzers were calibrated with producer milk samples. No single lab had more than two instruments. The population of instruments represented three different manufacturers, several different models, and FTIR and filter based instruments. The validation study was replicated three times with different calibration and validation samples. Labs that calibrated analyzers with producer samples used their normal calibration samples and procedures. Modified milk samples (n = 14) were made from pasteurized gravity separated cream, skim milk UF retentate and permeate, lactose, and water. Validation samples (n = 12) were raw individual producer milks. Both the modified milk calibration set and the producer milk validation set were preserved with dichromate and analyzed by all labs using chemical reference methods (ether extraction, Kjeldahl, and oven drying) to produce all lab mean reference values. Validation of individual instruments was assessed by the mean difference (MD) and standard deviation of the difference (SDD) between the IR predicted values and all lab mean reference chemistry values. Comparison of the two calibration sample types was done using Euclidian distance plots. The range of MD for fat, true protein, and total solids tests on the validation set across labs was reduced by 30% or more for analyzers calibrated with modified milks vs those calibrated with producer milks. In general, the SDD was lower for analyzers calibrated with modified milks vs those calibrated with producer milks.

Key Words: Infrared Milk Analysis, Calibration, Validation

47 Rapid impedance method to detect adulterated milk. D. L. Marshall* and G. M. Duran, *Food Science and Technology Dept, Mississippi State University, Mississippi State.*

Illegal milk adulteration can reduce cheese yield, slow fermentation rates, and reduce milk quality. To detect adulteration, a cryoscope is used to measure milk freezing point. Because changes in solute concentration affect the freezing point, some adulteration practices that add water also include addition of salt, sugar, or dried milk powder to increase solids content to maintain freezing point and fool the cryoscope. At certain solid-to-water adulteration ratios, the cryoscope gives readings that indicate the milk was unadulterated. Impedance technology, which analyzes resistance to flow of electrical currents, is used by the dairy industry to measure product quality and estimate shelflife. The purpose of the present study was to investigate whether impedance can be utilized to detect added salt water in milk. In this study, adulterated milk samples were prepared by adding various amounts of salt solutions to whole milk, resulting in concentrations of 0, 0.01, 0.02, 0.03, 0.04, and 0.05% salt, and 0, 1, 2, 3, 4, and 5% water. Freezing points of the samples were determined using a cryoscope and Impedance I-values were determined using a Bactometer. The Bactometer was unable to detect added water in the absence of salt. With water alone added in increasing amounts, the cryoscope readings showed an R^2 of 0.994, while the Bactometer had an R^2 of 0.2. In contrast, the Bactometer was able to easily detect the addition of salt. R^2 for the Bactometer and cryoscope readings were 0.998 and 0.843, respectively, for varying salt concentrations. The Bactometer was able to rapidly detect (6 minutes) salt-water additions even when the cryoscope could not. The cryoscope was more effective than the Bactometer at testing milk or milk with added water, but the Bactometer was superior at detecting adulteration with salt water. Because many dairy plants use a Bactometer microbiological testing, it could be used as a supplemental test to the cryoscope to determine if milk is adulterated.

Key Words: Impedance, Cryoscope, Milk Adulteration

48 Characterization of flavor and flavor compounds in dried whey protein concentrates and isolates. M. Carunchia Whetstine*, M. Drake, and A. Croissant, *North Carolina State University, Raleigh.*

Dried whey and whey protein are important food ingredients. Functionality of whey products has been studied extensively, but flavor has not been systematically studied. Flavor inconsistency and flavors which may carry through to the finished product can limit whey ingredient applications in dairy and non-dairy foods. The application of analytical sensory and instrumental methods to identify and characterize specific flavors and the chemicals that cause specific flavors enhances our understanding of whey ingredients. The objectives of this research were to identify and characterize sensory flavor and volatile aroma-active compounds that contribute to flavor in whey protein concentrates (WPC) and isolates (WPI). Seven WPC80 and 8 WPI samples, less than three months old, were collected in duplicate from 6 different manufacturers. Samples were rehydrated and evaluated in duplicate by descriptive sensory analysis (n=7). Duplicate samples with internal standards were extracted with diethyl ether, followed by isolation of volatile material by high vacuum distillation. Volatile extracts were analyzed using gas chromatography-olfactometry (GCO) with post peak intensity analysis. Compounds were identified by comparison of retention indices, odor properties and GC-MS data against reference standards. Selected compounds were quantified by standard addition. Sensory analysis of model systems was used to confirm the relationship between selected compounds and specific flavors. Whey proteins were variable in flavor and exhibited cardboard/wet paper, animal/wet dog, soapy, brothy, cucumber, and cooked/milky flavors, along with the basic tastes sweet and bitter, and the feeling factor astringency. Key volatile flavor compounds in WPC80 and WPI were guiacol (burnt/smokey), 2-nonenal (fatty/old books), (E,E)-2,4-nonadienal (fatty/oxidized), (E,Z)-2,6-nonadienal (cucumber), (E,Z)-2,4-decadienal (fatty/oxidized), and dodecanal (waxy/soapy). Baseline data on flavor and flavor sources in whey proteins will aid in the identification of methods to control or minimize flavor variability.

Key Words: Whey Protein Flavor, Gas Chromatography Olfactometry, Sensory Analysis

49 Effect of fat type and fat globule surface coating on the volatile fatty acid profile of yogurt. D. W. Everett*[1], J. Crownshaw[1], A. Ginestet[2], R. Wierda[1], M. Leus[1], and J.-P. Dufour[1], [1]*University of Otago, Dunedin, New Zealand,* [2]*Ecole nationale superieur de biologie appliquée à la nutrition et l'alimentation, Dijon, France.*

Yogurt (20 g) was manufactured containing either soy oil or anhydrous milk fat (AMF) globules coated with one of four materials: two spray-dried buttermilk powders (BMP), casein, or freeze-dried milk fat globule membrane (MFGM) produced by centrifugation at 15°C. Natural fat globules in yogurt was used as a control. Skim milk was standardized to 5% casein by ultrafiltration. Soy or AMF emulsions were prepared at 75 MPa using a Microfluidizer, and added to the concentrated skim to a fat:casein ratio of 4:3. *Mucor miehei* rennet protease was added to duplicate samples. Yogurt was cultured with *Lactobacillus bulgaricus* and *Streptococcus thermophilus* at 31°C until pH 5.5, stored for 122 days at 12°C, then kept at -80°C before analysis by gas chromatography (GC). Samples were heated at 50°C for 60 minutes and volatile components adsorbed onto carboxen/polydimethylsiloxane solid phase microextraction fibers. Fatty acids were identified by GC- mass spectrometry, and peak areas measured using GC with flame ionization detection.
Standard plate counts of the four milk powders were less than 10^3 cfu/g at 32°C. The rennet protease had no significant effect on GC peak areas. C4 acid concentration was 10-fold higher for AMF compared to soy yogurts. For soy yogurts, MFGM coating gave a 3-fold increase in C4 acid compared to the other coatings, a 2-fold decrease in C5 and C7 acids, and a 2-fold increase in C8 and C10 acids. No trends were evident for C6, C9, or C12 acids. Casein and both BMP coatings gave similar fatty acid profiles. For AMF yogurts, natural fat globules produced a 30 to 100-fold increase in C4 acid compared to the other coatings, a 10-fold increase in C5 acid, and no evident trend for the other fatty acids. Comparing AMF and soy yogurt, AMF produced 5-10 times more C4 acid, 3-6 times less C7 acid, 2-3 times more C8 acid, 2-3 times less C9 acid, and 2 -6 times more C10 acid. The low heat MFGM generated a greater amount of even numbered fatty acids compared to casein or the high heat treatment BMP. The nature of the fat globule coating evidently impacts upon lipolysis in yogurt.

Key Words: Yogurt, Volatile, Lipolysis

50 The influence of non-fat dry milk characteristics on yogurt functionality. A. Pollard* and L. E. Metzger, *Department of Food Science and Nutrition, University of Minnesota, St. Paul.*

Yogurt functionality, especially non or low fat yogurt is almost entirely dependent on the characteristics of the milk solids used in the formulation. Yogurt formulation utilizes a high proportion of non fat dry milk (NFDM) either as base material, or for fortification purposes to achieve appropriate solids concentration. Variation in milk solids characteristics can cause substantial differences in yogurt viscosity and syneresis. The characteristics of NFDM can vary markedly due to many factors including method of production (spray drying conditions), date of production (seasonal changes), and storage conditions. Currently there is no method of determining the functional characteristics of NFDM samples other than solubility tests. Unfortunately, solubility tests do not provide an accurate prediction of the characteristics of the NFDM samples when used for yogurt manufacture. To address the issue of NFDM functionality, a measurement technique using a Rapid Visco Analyser (RVA) was developed. In this method, a NFDM sample is added to water (50%w/w), and mixed at a high shear rate (950RPM) for 5 minutes at 70°C. Subsequently, the sample is heated from 70°C to 92°C over 18 minutes with continuous mixing at 150RPM. During the entire test, the viscosity profile is recorded using the RVA. In a preliminary study, seven low-heat NFDM samples were analyzed using this method. In this test, viscosity profile varied significantly for different samples even though all samples were low heat NFDM. Non fat yogurts at 15 and 20% total solids were then manufactured using the NFDM samples. A significant correlation between RVA viscosity profile and yogurt viscosity was observed at both solids levels (R2 of 0.84 for 15% total solids, 0.92 for 20% total solids) and yogurt syneresis at 15% solids only (R2 of 0.85 for 15% total solids). This indicates that the viscosity of NFDM measured in the RVA can be used to predict functionality of the NFDM when used for yogurt manufacture. This should be of great interest to commercial

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