tory within 72 hours of collection. The skin fibroblast cells were purified from epithelial contaminations by repeated multiple passaging. All the quality assays like cell viability, mycoplasma, fungal and bacterial contamination detection, cell counts, cell proliferation rates, growth curve, cell senescence, genetic stability (karyological, DNA finger printing and frame shift mutations), replicative aging (telomeric dynamics) were studied in different passages. The cell freezing rates, thawing and different cryoprotectants were also studied. In this paper, details of the indigenously standardized somatic cell banking technology have been described. The present status of cryofrozen germplasm in somatic cell bank at -150°C is given in the table.

Cryopreserved germplasm of different livestock species in somatic cell bank

Species	Breeds	Male cell line	Female cell lines	No of samples
Buffalo	2	19	10	1200
Sheep	4	43	46	3500
Goats	2	24	28	2200
Camel	1	12	–	650

Each sample had 1 million cells per ml

Acknowledgements: Authors thank the World Bank for funding the project under National Agricultural Technology Project, Indian Council of Agricultural Research

Key Words: Somatic Cell Banking, Skin Fibroblast Cell Line, Nuclear Transfer

Dairy Foods: Cheese

M37 Chemical, textural and sensory properties of fresh Turkish Kashar cheese. N. Koca*[1,2], M. Metin[1], and V. B. Alvarez[2], [1]*Ege University*, *Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Kashar cheese is a semi-hard Turkish cheese made by heating and stretching its curd. Kashar is one of the most consumed cheeses in Turkey and is classified as fresh or mature depending on its ripening level. The aims of this study were to characterize the chemical composition, texture and sensory properties of commercial cheeses and to determine how those properties relate to each other. Sixteen full fat cheese samples produced by different manufacturers were obtained from retail stores in Izmir, Turkey. Cheese samples were analyzed for pH, moisture, protein, fat and salt. Textural properties were measured by using an Instron Universal Testing Machine. Sensory properties (appearance, texture, flavor and overall acceptability) were determined by nine trained panelists using a scale of 1 to 5 (1:the worst, 5:the best). All cheese properties varied widely. The moisture, fat, protein and salt value ranges were 38.7-50.9%, 17.0-35.0%, 24.09-29.35% and 1.40-2.58% respectively. Hardness, springiness, cohesiveness, adhesiveness, gumminess and chewiness values were between 16.79-59.12 kg, 0.130-0.323, 0.107-0.249, 0.000-0.072 kgcm, 2.770-8.395 kg and 0.360-2.338 kg respectively. Mean appearance scores ranged from 1.78 to 4.67, texture from 2.78 to 4.22, flavor from 2.44 to 3.78 and overall acceptability from 2.44 to 4.11. As expected, the hardness values had significant correlation with moisture contents ($P<0.01$), because high moisture content weakens the cheese matrix by dissolution of proteins. The cheeses having moisture contents between 54.00-58.5% and hardness values between 23.00-33.45 kg had higher overall acceptability and texture scores. The same trend was observed for cohesiveness and springiness. Texture, flavour as well as apperance significantly affected overall acceptability ($P<0.01$). Properties characterization of fresh Kashar cheese and good understanding of their relationship are very important for manufacturers to make good quality and wholesome cheese products

Key Words: Fresh Kashar, Composition, Texture

M38 Yield enhancement of cottage cheese curd manufacture through milk protein fortification. Methods for quality evaluation. C. Kohen*[1,2], R. Hallab[1], A. Grandison[1], M. Lewis[1], and D. Marriott[2], [1]*The University or Reading*, *Reading, Berkshire, UK*, [2]*Creative Food Systems Limited*, *Marlow, Buckingamshire, UK*.

Cottage cheese curd was prepared using milk fortified with a milk protein powder preparation (92.6 % protein - produced from skimmed milk by co-precipitation and spray drying), and compared to non-fortified controls. Fortification led to significant increases in yield; for example, yield increased by over 10 % when the addition level was 0.4 %.

Methods were developed to assess the quality of curd, based on analysis of firmness, microstructure, total solids content, curd size distribution, and sensory evaluation.

Firmness was assessed on dressed and undressed curd with a TA-XT2i Texture Analyser (Stable Micro Systems Ltd, Godalming, UK). Curd microstructure was observed using scanning electron microscopy. Size distribution of curd particles was estimated using a sieving technique. Sensory evaluation was used to assess differences between the curd samples (with added dressing), with significant differences evaluated through triangle tests.

The curd obtained with fortified milk (0.4% protein addition) retained more water than the control (Total solids values 20.9 ± 0.25 % for control and 19.2 ± 1.3 % for fortified) and was softer than the control (Firmness as maximum force 20.6 ± 3.5 g for control and 14.2 ± 3.5 g for fortified). In addition, electron micrographs of fortified curd displayed many more pores than control curd.

The difference in firmness was not detectable after the addition of dressing (Firmness: control 10.7 ± 2.8 g, fortified 11.2 ± 2.6 g). Also, there were no significant differences detected by sensory evaluation between the samples with added dressing. The dressing had a masking effect on minor differences in the curd quality. Hence, fortification with protein during curd manufacture produced a product with equivalent quality with reduced manufacturing costs/kg of finished product through the increased yield.

Key Words: Cottage Cheese, Fortification, Texture

M39 A one-dimensional dynamic model of curd syneresis based on viscoelastic properties of curd. M. Castillo*, S. Torrealba, and F. Payne, *University of Kentucky*, *Lexington*.

Syneresis is a major process in cheese making. The extent of syneresis during cheese making controls the moisture, mineral and lactose content of curd which affects cheese ripening and subsequently the final cheese sensory attributes. Better curd moisture control would decrease the production of under-grade cheese. Estimated annual losses to the U.S. cheese industry in 2001 due to downgrades for cheese defects were $29 million for cheddar cheese. Alternatively, the appearance of whey on the surface of a gel, or wheying-off, is a common defect during storage of fresh cheeses and fermented dairy products. Very little is known about syneresis. Limited knowledge is available about the mechanisms by which the microstructure and rheological properties of gels influence gel porosity, permeability, endogenous syneresis pressure and whey drain-

age. Despite the importance of the syneresis process, it constitutes one of the least understood phases of cheese making, which causes a lack of suitable models for predicting syneresis kinetics and extent. Casein gels consist of a three-dimensional, porous and elastic matrix of casein micelles saturated with an interstitial and viscous fluid called whey. Rearrangement of casein micelles during syneresis is responsible for the shrinkage of the casein matrix and subsequent expulsion of whey. A one-dimensional gel syneresis dynamic model was developed to determine the stresses and strains induced during the dynamic process of syneresis by combining the mechanics of porous media with the theory of viscoelasticity. Induced strains in the curd body are estimated based on viscoelastic deformations from the different pressures acting on the curd during syneresis. A preliminary validation of the model was made based on values obtained from literature review. The results obtained strongly encourage validating the model using one-dimensional syneresis experiments conducted under different coagulation and syneresis conditions.

Acknowledgements: This research was supported by the USDA/NRI grant USDA-NRI-2005-35503-15390

Key Words: Syneresis, Dynamic Model, Viscoelastic

M40 Study of the aqueous phase of Prato cheese. V. S. Monteiro and M. L. Gigante*, *State University of Campinas*, *Campinas, SP, Brazil*.

The objective of this study was to evaluate the physical-chemical balance between the protein matrix and the aqueous phase of Prato cheese in the early stages of the ripening process. The cheeses were manufactured by the traditional method and had its centesimal composition analyzed. To evaluate the effect of ripening time on the aqueous phase of the cheese, samples were randomly taken every day up to the fifth day of ageing and evaluated for the amount of aqueous phase separated by centrifugation. The aqueous phase was evaluated for the levels of total solids, total nitrogen, nitrogen fractions and electrophoretic profile. The experiment design was a completely randomized design with one primary factor and one blocking factor. A total of 3 complete experiments were performed and the results analyzed by analysis of variance (ANOVA) and Pearson's correlation test. The cheeses manufactured exhibited 44.5±0.3% moisture, 29.0±0.6% fat, 22.5±0.9% total protein, 3.1±0.8% ash and 1.10±0.02% salt. The amount of aqueous phase decreased significantly with ripening time, varying from approximately 27% to 5% of the moisture of the cheese during the first 5 days of ageing, representing a 81% reduction in the amount of aqueous phase separated from the cheese, thereby evidencing a rapid increase of the water holding capacity of the protein matrix. In addition, a significant negative association was found between the amount of water in the aqueous phase and the content of total solids, total protein and protein soluble at pH 4.6. The electrophoretic profile showed an increase in the casein fractions (α_{s1}-I-casein and γ-casein) and intact proteins (β-casein and α_{s1}-casein) in the aqueous phase of the cheese after 5 days ripening. The results suggest that the changes in the chemical-physical balance between the protein matrix and the aqueous phase that occur during the first days of ripening may contribute to improving the functionality of Prato cheese as a result of the effect of the aqueous phase on the degree of hydration of the protein matrix.

Key Words: Prato Cheese, Aqueous Phase, Proteolysis

M41 Proteolysis of Piacentinu Ennese cheese made with different farm technologies. V. Fallico*, C. Pediliggieri, S. Carpino, and G. Licitra, *CoRFiLaC*, *Ragusa, Sicily, Italy*.

Piacentinu Ennese is a pressed ovine cheese of Sicily. It is traditionally made from raw milk, farmhouse rennet and no starters. Recently some producers are using pasteurized milk with commercial rennet and starters. The aim of this survey was to study the impact of different farm technologies on proteolysis of Piacentinu Ennese cheese. Seven batches of cheeses were collected from different farms and five cheeses were produced from each batch to be aged 2, 4, 6, 8 and 10 mo respectively. Protein and S/M contents, along with levels of N soluble in pH 4.6-acetate buffer (pH4.6SN) and in 12% TCA (TCASN), all significantly ($P<0.05$) increased with cheese age. Farm technology had no significant impact on the overall means of cheese chemical composition, mainly due to large variance within treatment, except for the indices of proteolysis. Levels of pH4.6SN and TCASN, expressed as percentages of TN, were significantly higher in industrial than in traditional cheeses. Urea-PAGE profiles of the cheeses showed that farm technology influenced the activities of proteases on caseins. A greater retention of rennet in industrial cheeses produced higher levels of α_s-CN hydrolysis compared to traditional cheeses, whereas plasmin was unaffected by milk treatment. HPLC peptide profiles showed a largest production of soluble compounds in industrial cheeses but also a large variability within treatment among cheeses. PCA of chemical and HPLC data discriminated cheese samples by age and farm technology due to differences in moisture and proteolysis levels, respectively. Proteolysis in Piacentinu Ennese cheese was largely affected by aging time and farm technology. The large variability in peptide profiles was related to different manufacturing conditions at farm level that need to be better defined in order to uniform Piacentinu Ennese cheese quality.

Key Words: Farm Technology, Cheese Proteolysis

M42 Effect of somatic cell count on milk composition and the yield of Prato cheese. G. Mazal[1], M. V. Santos[2], and M. L. Gigante*[1], [1]*State University of Campinas*, *Campinas, SP, Brazil*, [2]*University of São Paulo*, *Pirassununga, SP, Brasil*.

Brazilian Prato cheese is manufactured through rennet coagulation, cooking done by removing part of the whey, replacing it with warm water. The objective of this work was to evaluate the effect of somatic cell count (SCC) in milk on its composition and on the yield of Prato cheese. Initially, two groups of animals were selected to obtain milk with low (< 200,000 cell/ml) and with high (> 600,000 cell/ml) SCC. The milk was submitted to three treatments to obtain Prato cheese: (1) from milk with low SCC and clotting time of 35 minutes; (2) from milk with high SCC and clotting time of 35 minutes; and (3) from milk with high SCC and adjusted clotting time. The milk and whey were evaluated according to pH and total solids, fat, total nitrogen, soluble nitrogen at pH 4.6 and at 12% TCA, ash, lactose, and calcium. The cheeses were evaluated according to the same factors, (except lactose), and also to salt content. The fat, protein and lactose recovery and cheese yield were calculated. A randomized block design was used, with a single factor: SCC (two levels) in the case of milk composition; and treatment (three levels) in the case of fat, protein and lactose recovery and cheese yield. The milk with high SCC showed a significantly smaller concentration of true protein, and a higher concentration of non-protein nitrogen, indicating higher proteolytic activity. The cheeses obtained from the milk with high SCC showed significantly higher soluble nitrogen contents at pH 4.6 and at 12% TCA than the cheeses obtained from milk with low SCC. The protein recovery was significantly higher for the cheeses with low SCC. A significantly higher lactose recovery was observed for the cheeses with high SCC, as well as a tendency for higher moisture. Although with these levels of somatic cells a significant difference in cheese yield was not observed, the cheeses that were obtained from the milk with high SCC showed higher proteolytic activity, which can compromise the ripening development.

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Key Words: Somatic Cell, Protein and Fat Recovery, Prato Cheese

M43 Standardization of the time and temperature conditions to evaluate the meltability of Cream cheese. R. R. Monteiro, A. S. Salles, and M. L. Gigante*, *State University of Campinas*, *Campinas, SP, Brazil*.

The meltability properties of cheese are controlled by the chemical composition at the moment of heating. This includes parameters such as protein, fat, moisture, pH, calcium protein hydrolysis and principally the extent of hydration of the casein matrix. Different conditions had been used to evaluated the cheeses meltability, with temperatures varying from 100 to 280°C and exposition time from 4 to 60 minutes. Exploratory experiments carried out to evaluate the melt-

ability of cream cheese indicated the lack of an adequate time/temperature condition to evaluate the meltability of a cheese obtained by acid coagulation. Thus, the objective of this study was to standardize the adequate time/temperature condition to evaluate the meltability of cream cheese. Hot pack cultured cream cheese was manufactured and analyzed for chemical composition. The meltability was evaluated using the method of Schreiber after storage at 4°C for 20 days. The Box-Wilson method was used for a 2^2 experimental design, with three central and four axial points, giving a total number of 11 experiments, varying the temperature (110, 126, 190, 254 and 280°C) and the exposition time (4, 10, 25, 40 and 46 minutes). The testes were carried out in quadruplicate. The meltability was expressed as a percentage of the increase in diameter of the cheese after being submitted to the test. The average composition of the cream cheese was 44.6±0.2% total solids, 6.81± 0.05% proteins, 34.2±0.3% fat, 1.7±0.1% ashes and pH 4.8. The most adequate time/temperature binomial for maximum meltability of cream cheese without burning was established as 170°C/15 minutes. The definition of the best condition to evaluate the meltability makes possible future studies on the influence, for example, of variations in the fat, moisture, and pH, on the melting characteristics of the Cream cheese.

Acknowledgements: FAPESP-SP/Brasil

Key Words: Cream Cheese, Melting

M44 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Cryo-scanning electron microscopy observations. A. Hassan* and S. Awad, *South Dakota State University*, *Brookings*.

The microstructure of reduced and full fat cheeses made with exopolysaccharide (EPS)-producing and nonproducing cultures was observed using cryo- scanning electron microscopy. Fully hydrated cheese samples were rapidly frozen in liquid nitrogen slush (-207 C) and observed in their frozen hydrated state without the need for fat extraction. Different EPS-producing cultures were used in making reduced fat Cheddar cheese. Full fat cheese was made with a commercial EPS-nonproducing starter culture. The cryo-scanning electron microscopy micrographs showed that fat globules in the fully hydrated cheese were surrounded by cavities. Serum channels and pores in the protein network were clearly observed. Fresh full fat cheese contained wide and long fat-serum channels which were formed as a result of fat coalescence. Such channels were not observed in the reduced fat types. Fresh reduced fat cheese made with EPS-nonproducing cultures contained fewer and larger pores than did reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1) which had higher moisture levels. A three dimensional network of EPS was observed in large pores in cheese made with the ropy strain JFR1. Big changes in the size and distribution of pores within the structure of the protein network were observed in reduced fat cheese, except that made with JFR1, as it aged. This indicated that redistribution of the moisture was occurring during ripening. Changes in porosity were less pronounced in both the full fat cheese and the reduced fat type made with the ropy culture JFR1. The changes in moisture distribution seemed to play a major role in the development of the textural and functional properties of cheese during ripening.

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Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Cryo-Scanning Electron Microscopy

M45 Sensory description of fresh Mozzarella cheese. M. Almena*, E. Valentine, P. Kindstedt, and A. Howard, *University of Vermont*, *Burlington*.

Fresh Mozzarella cheese is characterized by a soft and elastic body, pleasant lactic flavor and smooth and juicy appearance. However, specific sensory characteristics may vary depending on initial milk properties, manufacturing and distribution conditions and the *terroir* effect. This study evaluated sensory characteristics of 3 different types of fresh Mozzarella cheese: water buffalo (WB) milk Mozzarella produced in Italy, and 2 cheeses made in the US from cow and WB milk, respectively. The goal was to identify key sensory characteristics that influence acceptability of fresh Mozzarella to American consumers. Commercial samples of each of the 3 Mozzarella types were evaluated by two different groups of subjects: 1) consumers enlisted at a supermarket that specializes in natural and gourmet foods (98 consumer subjects); 2) chefs and specialty cheese retailers (27 professional subjects). Consumers were asked to rate the acceptability of the product using an increasing intensity 9-pt scale. In addition to rating acceptability, the professionals also rated texture and flavor. Both questionnaires included an open section in which subjects were asked to describe the product in terms of sensory characteristics, as well as to provide demographic information. Data were statistically analyzed by paired t-tests, ANOVA and Chi-square tests using SPSS. No significant differences were found in the acceptability ratings of the 3 Mozzarella types. However, preferences within consumer subjects were significantly affected by gender ($P \leq .05$) and professionals preference by age (<40 or ≥ 40). Consumers and professionals identified several sensory attributes that impacted acceptability, including: saltiness (either too salty or too bland), flavor (either too strong or lacking), and texture (either too stringy and dry, too coarse and grainy, or too soft and watery). However, high variability in the acceptability and description of pleasant characteristics of the final product was identified among both consumers and professionals.

Key Words: Mozzarella Cheese, Water Buffalo Milk, Sensory Description

M46 Influence of calcium, phosphorus, residual lactose, and salt-to-moisture ratio (S/M) of Cheddar cheese on glycolysis during ripening. P. Upreti*, L. L. McKay, and L. E. Metzger, *MN-SD Dairy Food Research Center, University of Minnesota*, *St. Paul, MN*.

Glycolysis in Cheddar cheese involves conversion of lactose to glucose and galactose or galactose-6-phosphate by starter and non-starter lactic acid bacteria. Under ideal conditions (i.e., where bacteria grow under no stress of pH, a_w, and salt), these sugars are mainly converted to lactic acid. However, during ripening of cheese, survival and growth of bacteria occurs under the stressed condition of low pH, low aw, and high salt content. This forces bacteria to use alternate biochemical pathways resulting in other different organic acids (viz. citric, orotic, acetic, pyruvic, propanoic, butyric). The objective of this study was to determine if the level and type of organic acids produced during ripening was influenced by the buffering properties (due to Ca and P), amount of substrate (lactose) and bacterial activity (due to S/M) in cheese. Eight cheeses with two levels of Ca and P (0.67 and 0.47% vs 0.53 and 0.39%), lactose at pressing (2.4 vs 0.78%) and S/M (6.4 vs 4.8%) were manufactured. The cheeses were analyzed for organic acids (citric, orotic, pyruvic, lactic, acetic, propanoic, butyric) and residual sugars (lactose, galactose) during 48-wk of ripening by using an ion-exchange HPLC method. Results indicate that there was a significant ($p<0.05$) decrease in lactose and increase in lactic acid between salting and day 1 of ripening, however there was no substantial change subsequently. More lactic acid was produced in low S/M treatments as compared to high S/M treatments ($p<0.05$). Minor changes in the levels of butyric and propanoic acids were observed until 4-mo of ripening. However, by 12-mo of ripening, there was a 7-fold increase in the level of these acids; with low S/M cheeses having higher levels of these acids as compared to high S/M cheeses ($p<0.05$). A gradual decrease ($p<0.05$) in orotic acid and a gradual increase ($p<0.05$) in pyruvic acid content of cheeses were observed during 12-mo of ripening. In contrast, acetic acid did not show a particular trend, indicating its role as an intermediate in a biochemical pathway, as opposed to a final product.

Key Words: Organic Acids, Cheese Ripening

M47 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Textural and melting properties. S. Awad*, A. Hassan, and K. Muthukumarappan, *South Dakota State University*, *Brookings*.

Texture development and meltability of reduced fat cheeses made with exopolysaccharide (EPS)-producing cultures was monitored during ripening. Results showed that texture profile analysis (TPA) parameters such as hardness, gumminess, springiness, and chewiness increased as the fat content decreased.

Cheeses made with EPS-producing cultures were the least affected by fat reduction. No significant differences in hardness, springiness and chewiness were found between young reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp. *cremoris* (JFR1; the culture that produced cheese with the highest moisture level) and its full fat counterpart. During ripening, whereas hardness of full fat cheese and reduced fat cheese made with JFR1 increased, a significant decrease in its value was observed in all other cheeses. After 6 months of ripening, reduced fat cheeses made with EPS-producing cultures maintained lower values of all TPA parameters than did those made with no EPS. Fat reduction decreased cheese meltability. However, no significant differences in meltability were found between the young full fat cheese and the reduced fat cheese made with the ropy culture JFR1. Both aged full fat cheese and that made with JFR1 had similar melting patterns. They both became soft and creamy without losing shape when heated while reduced fat cheese made with no EPS ran and separated into greasy solids and liquid. Panelists did not detect significant differences between the full fat cheese and reduced fat cheese made with JFR1 which were less rubbery/firm, curdy and crumbly than all other reduced fat cheeses.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Texture Profile Analysis

M48 Application of exopolysaccharide-producing cultures in making reduced fat Cheddar cheese. Viscoelastic properties. S. Awad*, A. Hassan, and K. Muthukumarappan, *South Dakota State University*, *Brookings*.

Reduced fat Cheddar cheese is always more firm, rubbery and elastic than the full fat counterpart. The objective of this work was to study the influence of different exopolysaccharide (EPS)-producing lactic cultures on the viscoelastic properties of reduced fat Cheddar cheese. Results showed that the elastic, viscous and complex moduli were higher in reduced fat cheeses made with EPS-nonproducing cultures than those in the full fat cheese. No significant differences in the viscoelastic properties were found between young reduced fat cheese made with a ropy strain of *Lactococcus lactis* ssp *cremoris* (JFR1) and its full fat counterpart. The slopes of the viscoelastic moduli as a function of frequency were significantly lower in the full fat than in reduced fat cheeses. Creep test showed that fresh reduced fat cheese made with JFR1 was less rigid and more deformable than those made with EPS-nonproducing cultures. The creep/recovery properties of young reduced fat cheese made with JFR1 and the full fat type were similar. No significant differences were found in the viscoelastic properties between reduced fat cheese made with no EPS and those made with EPS-producing adjunct cultures of *Streptococcus thermophilus*. After 6 months of ripening, cheeses made with EPS-producing cultures maintained lower elastic and viscous moduli than did those made with no EPS.

Key Words: Reduced Fat Cheddar Cheese, Exopolysaccharides, Viscoelastic Properties

M49 Mexican Mennonite-style cheese: Sensory profile of young cheeses from Chihuahua, Mexico. D. L. Van Hekken*[1], M. A. Drake[2], F. J. Molina Corral[3], V. M. Guerrero Prieto[3], and A. A. Gardea[3], [1]*USDA, ARS, Eastern Regional Research Center*, *Wyndmoor, PA*, [2]*North Carolina State University*, *Raleigh*, [3]*Centro de Investigacion en Alimentacion y Desarrollo*, *Cuauhtemoc, Chih, MX*.

Sensory profiles of fresh semi-hard Mennonite-style cheese produced in the northern Mexican state of Chihuahua were developed to characterize the complex flavor and texture of the traditionally-made Hispanic-style cheese.

Multiple allotments of Mennonite-style cheese (9 raw milk and 6 pasteurized milk cheeses), obtained within 3 days of manufacture from 15 different cheese plants throughout Chihuahua, Mexico, were shipped overnight to ERRC and evaluated between 14 and 18 d after manufacture. Microbial analysis was conducted prior to testing to ensure product safety. Descriptive analyses of cheese flavor and texture were conducted with panelists trained to use a universal or product specific SpectrumTM intensity scale, respectively.

As expected, sensory profiles of cheeses varied among the different manufacturers. Overall, salty and sour tastes and diacetyl flavor were the most prominent attributes. The raw milk cheeses had more intense sour and bitter notes compared to cheeses manufactured from pasteurized milks. Many cheese texture attributes were similar, but raw milk cheeses were perceived as firmer than pasteurized milk cheeses.

As the demand for Hispanic-style cheeses increases, defining and understanding the sensory attributes of traditionally-made Mexican cheeses provides guidance as new ways are explored to improve the production and shelf life of the cheese.

Key Words: Cheese, Hispanic-Style, Sensory

M50 Organic acid profiling of commercially available Hispanic cheeses. N. Gonzalez*[1], K. Hein[2], M. Sancho-Madriz[1], H. Heymann[2], and K. Adhikari[1,3], [1]*California State Polytechnic University*, *Pomona*, [2]*University of California*, *Davis*, [3]*Kansas State University*, *Manhattan*.

Hispanic cheeses are an important part the Hispanic diet. Not much effort has been made to standardize the processes for manufacturing Hispanic cheeses.

The objective of the study was to determine the organic acid profiles of Hispanic cheeses from two manufacturers for comparison purposes. Organic acids affect the sensory properties and shelf-life of fermented dairy products such as cheese. The content of various organic acids in Hispanic cheeses might be an indicator of consistent manufacturing processes among manufacturers.

Organic acid profiling of three varieties of Hispanic cheeses (Asadero, Panela, and Queso Fresco) of two brands (Brand A and Brand B) was performed by using ion-exchange high performance liquid chromatography (HPLC). The organic acids separated and quantified included citric, lactic, and acetic acids. Univariate and multivariate statistics was done using SAS® and Unscrambler® to find differences in the cheese varieties.

The analysis of variance (ANOVA) results indicated that all the cheeses from both producers differed significantly ($P < 0.05$) for all three organic acids. Mean separation by Fisher's least square differences indicated that the citric acid content was similar for the cheeses from both producers except for Asadero from Brand B cheese company. Lactic acid content differed significantly ($P < 0.05$) in all varieties of both brands. No clear trends were detected for acetic acid. Principal Component Analysis (PCA) of the data showed that the Brand B Asadero was an outlier due to low levels of citric and acetic acid as compared to the rest of the cheeses. The PCA map also showed that organic acid contents were not consistent between the same varieties of the two brands tested. When the brands were compared by partial least square regression, citric and acetic acids were negatively correlated, while lactic acid was positively correlated.

Our study indicated major dissimilarities between the same cheese varieties of the two brands. This indicates that manufacturing standards should be more uniform among different producers of Hispanic Cheeses.

Acknowledgements: Agriculture Research Initiative for funding the project.

Key Words: Hispanic Cheeses, Organic Acids, HPLC

M51 Effect of processing parameters on the rheological properties of cheese milk at cutting and its impact on cheese yield. R. Mishra*, S. Govindasamy-Lucey, M. Johnson, and J. Lucey, *University of Wisconsin*, *Madison*.

Objective of this study was to understand the effects of altering rennet gelation conditions on fat and nitrogen recoveries in cheese. Effects of varying gelation temperature (GT) (28.8-35.6°C), gelation pH (6.39-6.73) and milk solids nonfat (MSNF) (8.3-11.7%, casein: 2.8-4.0%) on rheological properties of milk and resulting Cheddar cheese yield were studied using a two-level factorial, central composite rotatable design. Cheese was made in 20 L vats where gels could be cut in < 1 min, in contrast to commercial cheese vats where the cutting

cycle can be quite long. Gel cutting point for different cheesemaking conditions was subjectively assessed. In separate experiments, dynamic small amplitude oscillatory rheology was used to study gelation properties, at the previously subjectively selected cutting times. Large deformation properties of milk gels at these cutting times were studied using a single low shear rate. Second order polynomial models successfully predicted the relationship between processing parameters and moisture-adjusted cheese yield (MACY). MACY was strongly ($P < 0.05$, $R^2 = 0.83$) negatively affected by gelation pH and positively by MSNF levels and its quadratic term. In gels with similar gelation pH and GT, an increase in MSNF resulted in an increase in fat and, nitrogen recoveries in cheese. Storage modulus (G'_{cut}) values and yield stress at cutting (s_{ycut}) increased with increasing MSNF. In gels with similar MSNF and GT, a decrease in gelation pH resulted in an increase in fat and nitrogen recoveries and MACY. G'_{cut} tended to decrease and s_{ycut} increased. In gels with similar gelation pH and MSNF, a decrease in GT resulted in an increase in fat and nitrogen recoveries and MACY except at very low (28.8°C) temperatures where very low fat recoveries were observed. G'_{cut} tended to decrease and s_{ycut} tended to increase with decrease in GT. Gel characteristics at cutting and the time required for cutting are important considerations in optimizing fat and nitrogen recoveries.

Key Words: Rheology, Gelation, Yield

M52 Effects of various emulsifying salts on the rheological and texture properties of pasteurized process Cheddar cheese. N. Shirashoji*[1,2], J. J. Jaeggi[2], and J. A. Lucey[2], [1]*Food Research & Development Laboratory, Morinaga Milk Industry Co.*, *Kanagawa, Japan*, [2]*University of Wisconsin*, *Madison*.

The objectives of this study were to understand how various types of emulsifying salts (ES) alter the functionality of pasteurized process Cheddar cheese. Process cheeses were made from 4 mo old Cheddar cheese and the types of ES investigated were: trisodium citrate (TSC), disodium orthophosphate (DSP), tetrasodium pyrophosphate (TSPP) and sodium hexametaphosphate (SHMP) (concentrations of ES ranged from 0.25-2.75%). Cheese mixtures were heated at 80°C for various holding times (0-20 min) using a Blentech twin-screw cooker. A central composite experimental design and response surface methodology were used for data analysis. Hot melted cheese was poured into pouches and stored at 5°C for 7 d. The pH value of all cheeses was maintained at pH ~5.6. The functional properties were assessed using small amplitude oscillatory shear (SAOS), texture profile analysis, degree of flow (DOF) value at 60°C using UW Melt profiler. Several significant prediction models were demonstrated for the key responses (e.g. DOF; R^2>0.68, adhesiveness, R^2>0.70). DOF and hardness increased and loss tangent (meltability index) at 40°C decreased as the concentration of ES increased except for TSPP. For TSPP minimum meltability occurred at ~1.1% ES addition. For SHMP, with increasing holding time and high ES concentration there was an increase in the hardness and the storage modulus value at 70°C (from SAOS). The cheese made with TSPP showed no significant trends in hardness. Negative correlations were observed between hardness and meltability in cheeses made with TSC, DSP, SHMP ($r > -0.92$), but there was no significant correlation in cheese made with TSPP ($p > 0.1$). The maximum value of loss tangent was positively correlated with DOF in cheeses made with DSP, TSPP and SHMP ($r > 0.68$) but not for cheese made with TSC. This study revealed that each type of ES may have different affects on process cheese functionality.

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M53 The dynamics of sequential casein hydrolysis: An analytical approach. P. Joseph*[1], D. McMahon[1], J. Broadbent[1], and C. Oberg[2], [1]*Utah State University*, *Logan*, [2]*Weber State University*, *Ogden, UT*.

Proteolysis is a vital event that occurs during cheesemaking and maturation of a variety of ripened cheese. The hydrolyzed products vary from large peptides, comparable in size with intact caseins, intermediate-sized and small peptides, and free amino acids and their degradation products. Many methods used for assessing proteolysis in cheese during ripening have followed the fate of small peptides arising from α_{s1}-casein (f 1-23) and β-casein (f 193-209) due to their role in flavor attributes. From a functional point of view, however, the hydrolysis of α_{s1}-casein (f 24-199) and β-casein (f 1-192) and their products would be important as they could impact the association and linkage of peptides due to their hydrophobic regions, size, and associated phosphoserines. The aim of this study was to develop a method to follow the sequential hydrolysis of intact caseins and α_{s1}-(f 24-199) and β-(f 1-192) caseins using reverse phase-high performance liquid chromatography (RP-HPLC) and capillary electrophoresis (CE). Sampling was done at different time points in the cheesemaking process and during aging until 6 months and extracted with a 150 mM trisodium citrate/0.2% sodium chloride buffer. The large peptides were concentrated using a 3K Dalton membrane and analyzed by RP-HPLC. RP-HPLC was performed with a 0.1% trifluoroacetic acid (solvent A)/0.085% TFA in 80% acetonitrile (solvent B) linear gradient elution on a Beckman System Gold and monitored at 214 and 280 nm. The amount of solvent B was raised from 40 to 60% in 30 min. Intact and α_{s1}-(f 24-199) and β-(f 1-192) caseins observed at draining (cheesemaking) and 1 week (ripening) were found to be reduced at 6 months. Further, 3-4 (medium to large) peptides were observed that significantly changed in peak areas and size over time. These peptides can be used to track molecular changes occuring in the cheese matrix during ripening and could serve as indicators of functional properties.

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Key Words: Caseins, Reverse Phase-High Performance Liquid Chromatography, Capillary Electrophoresis

M54 Effects of insoluble calcium phosphate content on rennet coagulating properties of milk. J. Choi*[1], D. S. Horne[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Charis Food Research, Hannah Research Institute*, *Ayr KA6 5HL, Scotland*.

In considering rennet curds as hard sphere particle gels, internal micelle structure is considered irrelevant. Attractive hydrophobic interactions, calcium phosphate crosslinks and electrostatic repulsion are the main forces that maintain internal stability of casein micelles. Loss of colloidal calcium phosphate (CCP) from within casein micelles modifies these interactions, which should impact the properties of rennet-induced gels. To examine the impact of removing CCP from micelles on gelation properties, two approaches were used. Diluted lactic acid was added to skim milk to decrease pH to 6.0, 5.8, 5.6, and 5.4. EDTA was slowly added (0, 2, 4, and 6 mM) to skim milk whose final pH values were adjusted to pH 6.0. Dynamic low amplitude oscillatory rheology was used to monitor gel development. In low pH samples storage modulus (G′) exhibited a maximum (GM); with a decrease in G′ during longer aging times. Microstructure of rennet-induced gels near GM and three h after this GM was studied using confocal scanning laser microscopy. Gels at GM were subjected to a constant low shearing to fracture of the gel. With a reduction in pH, and consequent decrease in CCP content, GM value and yield stress decreased while the loss tangent value increased (indicating a weaker, more flexible casein network). A similar trend was observed for addition of EDTA. There was a significant positive correlation between CCP and GM ($r > 0.94$) and a negative correlation between CCP and maximum loss tangent ($r > -0.79$). There was a decrease in apparent interconnectivity between strands in gel microstructure during aging, which agreed with the decrease in G after GM. Loss of CCP reduced casein cross-linking and probably increased repulsion between exposed phosphoserine residues, resulting in weaker more flexible gels. There was a highly significant positive correlation ($r > 0.84$) between loss tangent value of these rennet-induced gels and the maximum loss tangent values (i.e. an index of meltability) of direct acid cheeses made from these gels.

Key Words: Colloidal Calcium Phosphate, Rennet Coagulation