W61 effect of the use of rennet substitute on composition and yield of Minas Padrão cheese. J. Camisa[1], S. T. Di Cicco[1], K. Sivieri[2], P. C. B. Vianna*[1], and C. M. V. B. De Rensis[1], *[1]UNOPAR, Londrina, PR, Brazil, [2]UNESP, Araraquara, SP, Brazil.*

The objective of this research was to determine the effect of the use of rennet substitute on composition and yield of Minas Padrão cheese. Pasteurized and standardized milk (3.0% fat) was divided into 2 parts and prepared for each treatment varying the rennet: batch 1(BOV), commercial calf rennet (Chymosin and pepsin) and batch 2 (QPF), commercial rennet substitute Chy-max (Chymosin) and converted to cheese following traditional cheese making procedure. Milk, whey and cheese compositions were determined according official methods. Fat and protein recoveries and yield were determined. Differences on the rennet had no significant influence ($P > 0.05$) on chemical composition of the cheeses. Cheeses made with QPF and BOV showed no significant difference on fat and protein recoveries but QPF showed tendency for higher fat and protein recoveries. The use of Chy-max showed no significant influence on cheese actual yield. The adjusted yield also showed no significant difference with the use of Chy-max, although it had a tendency of increase yield with the rennet substitute.

Key words: calf rennet, chymosin, fat and protein recoveries

W62 Effects of gelation temperature and cutting time on the rheology and quality of curd made from buffalo milk: A comparison with cows' milk. I. Hussain*, J. Yan, A. E. Bell, and A. S. Grandison, *Department of Food and Nutritional Sciences, University of Reading, Reading, Berkshire, UK.*

The rheology and overall quality of curds made from buffalo and cows' milks were measured at gelation temperatures of 28, 34 and 39°C, and cutting times of 45, 60, 75 and 90 min after chymosin addition. The maximum curd firmness (G′) was obtained at a gelation temperature of 34°C in both types of bovine milk. The viscoelasticity (Tan δ) of both curds were increased with the increasing gelation temperature. The rennet coagulation time was reduced with increase of gelation temperature in both types of milk. Frequency sweep (0.1–10 Hz) was used 90 min after of chymosin addition, and both milk samples showed characteristics of weak viscoelastic gel systems. When both milk samples were subjected to shear stress to break the curd system at constant shear rate, 95 min after chymosin addition, the maximum yield stress was obtained at the gelation temperatures of 34°C and 28°C in buffalo and cows' curd respectively. The curd yield and moisture content were decreased with the increase in gelation temperature, while whey fat losses increased. The different cutting times slightly affected the yield and overall quality of curds made from both milk types. Two different curd drainage methods were used to compare the final overall curd quality.

Key words: rheology, gelation temperature, cutting time

W63 Cheese making properties of milk protein concentrate powder as affected by storage at high temperature. N. Rémillard and M. Britten*, *Food Research and Development Centre, Agriculture and Agri-Food Canada, St-Hyacinthe, (QC), Canada.*

Milk protein concentrate is extensively used to fortify cheese milk and increase cheese plant productivity. Long-term storage is known to alter the physicochemical properties of spray dried protein ingredients and might reduce their ability to produce high quality cheeses. To accelerate the storage effect, spray dried milk protein concentrate was stored at 50°C for up to 28 d. After various storage periods, the powder was dispersed in water and characterized for solubility, average particle size, rheology (flow curves) and kinetics of rennet gel formation. Model cheeses were also produced from milk standardized to 3.0% casein and 4.4% milk fat. The casein fraction originating from milk protein concentrate was fixed to 25%. Cheese composition, yield, protein and fat retention coefficients were determined. The solubility of milk protein concentrate decreased during storage at 50°C. Solubility loss averaged 1.8% per day. Casein micelles showed evidence of aggregation with average particle diameter increasing from 200 to 800 nm after 28 days. With increasing storage time, lower flow index and higher consistency were measured on milk protein dispersions. Rennet clotting time was increased and gelation rate was reduced after 7 days storage. These changes are explained by the adsorption of whey protein to casein micelles during storage. Long-term storage of milk protein concentrate slightly increased protein retention in cheese but also increased fat losses in whey, resulting in reduced cheese yield. This study suggests that during the storage of milk protein concentrate powders, mixed aggregates can form between casein micelles and whey proteins, which act as passive fillers and interfere with cheese matrix formation.

Key words: milk protein powder, storage, cheese

W64 Influence of different cheese matrix structures on lipid digestion in a simulated gastro-intestinal environment. S. Lamothe[1], M.-M. Corbeil[1], S. Turgeon[2], and M. Britten*[1], *[1]Food Research and Development Centre, Agriculture and Agri-Food Canada, St-Hyacinthe, (QC), Canada, [2]Dairy Research Centre STELA, Faculty of Agriculture and Food Science, Université Laval, Quebec, (QC), Canada.*

In normal individuals, lipid digestion and absorption are highly efficient processes but in diseases such as short gut, cystic fibrosis and pancreatic deficiencies, the bioavailability of lipids is greatly reduced. Hence, it could be relevant to increase bioavailability of ingested lipids. On the other hand, it could be advantageous to reduce lipid bioavailability for populations with high blood lipid levels and at a high risk of cardiovascular disease and obesity. The objective of this study was to compare the kinetics of fatty acids release and matrix degradation of different cheeses in a gastro-intestinal environment. The relation between physical characteristics of the cheeses (microstructure, texture) and matrix degradation during simulated digestion was also studied. Compositional analysis, rheological measurements and microstructure by SEM were measured on mild cheddar, aged cheddar, light cheddar and mozzarella cheese. Cheese (4.5 g) was cut into small cubes and submitted to simulated digestion. Matrix degradation index, free oil, free fatty acids and microstructure by optical microscopy were analyzed on chime after 5, 30, 60, 120, 150, 180 and 240 min digestion. Fatty acids release kinetics varied markedly according to the type of cheese. Mozzarella showed higher rate and extent of fatty acids release compared with other cheeses. This was paralleled by a greater rate of matrix degradation and amount of free oil. This result could be attributed to the higher moisture content of mozzarella cheese combined with the lower mineral content that weakened the protein network, as shown by a decrease of the firmness, elasticity and cohesiveness. Rate and concentration of fatty acids released from mild

cheddar was markedly lower compared with other cheeses. Limited degradation of the matrix was observed during the digestion. Higher mineral and lower moisture content of mild cheddar resulted in a more cohesive and firm matrix that made it more resistant to degradation. These results suggest that kinetic of fatty acids release is modulated by cheese matrix structure and rheological characteristics.

Key words: cheese, lipids, digestion

W65 Effects of high pressure processing on the chemical, functional and rheological properties of fresh Queso Fresco. D. L. Van Hekken*, M. H. Tunick, R. Kwoczak, and P. M. Tomasul, *USDA, ARS, Wyndmoor, PA, USA.*

Although Queso Fresco (QF), a popular high moisture Hispanic-style cheese sold in the US, is made from pasteurized milk it is subject to post pasteurization bacterial contamination. High pressure processing (HPP) of cheese is being considered because of its lethality to bacteria and potential to extend shelf life. However, little research has been performed to determine the effects of HPP on the functional and rheological properties of QF. Fresh QF, made from pasteurized homogenized milk without starter cultures, was cut into 45x45x150mm^3 blocks, double packaged in vacuum bags, and received the following HPP treatments: 200, 400, or 600 MPa for either 0, 5, 10, or 20 min; samples were stored at 4°C but were warmed to an internal temperature of either 22 or 40°C just before HPP treatment. Between d 6 and 10, samples were assayed for compositional, functional (meltability, initial color, and change in color after heating) and rheological (texture profile, torsion, and small oscillatory shear analyses) properties. The moisture content of the cheese was stable when QF was processed at 22°C but whey was forced out of the cheese matrix and accumulated in the packaging when processed at 40°C. HPP of QF at 22 or 40°C did not affect the non-melt property, the initial bright white color, or the changes in color after heating of QF. Compared with HPP at 22°C, conducting HPP at 40°C resulted in QF having higher values for hardness, chewiness, cohesiveness, shear stress and shear strain. Cheese samples had variable responses to HPP as pressure and length of treatment increased; springiness and cohesiveness were lowest for 600 MPa treatments, shear rigidity at the point of fracture was highest at 600 MPa, and HPP treatment had little effect on viscoelastic properties. High pressure processing altered the rheological properties of QF and, when conducted at 40°C, resulted in excessive wheying-off. As new safety intervention processes are explored, it is essential that the quality traits of the cheese be maintained.

Key words: cheese, high pressure processing, Queso Fresco

W66 ACE-inhibitory activity of commercial Wisconsin Cheddar cheeses during ripening. Y. Lu*, S. Govindasamy-Lucey, and J. Lucey, *University of Wisconsin - Madison.*

ACE-inhibitory (ACEI) peptides have been found in cheeses that have been reported to have anti-hypertensive properties. More types and concentrations of ACEI peptides may be produced with ripening. The objective of this study was to quantify the ACEI activity of Cheddar cheeses during ripening and determine the types of ACEI peptides formed in these cheeses of different ages. Water soluble extracts (WSE) were prepared from commercial Wisconsin Cheddar cheeses at ages of 3–6 d, 2, 6 and 9 mo, 1 and 2 years manufactured from the same plants. Centrifugation and ultra-filtration were used to remove fat and to fractionate the WSE into 3 molecular weight (MW) fractions: <3000 Da, 1000–3000 Da and <1000 Da, respectively. The fractions were subjected to HPLC-Tandem mass spectrometry (MS) and HPLC-electrospray ionization (ESI)-time-of-flight (TOF) MS to identify the ACEI peptides. The fractions with MW <3000 Da were used to conduct ACE-inhibitory activity tests. With age, higher ACEI activity was observed in the WSE of cheese and more types of ACEI peptides were also found. Some of the ACEI peptides, such as, IPP, VPP, EKDERF, VRYL and YPFPGPIPN were synthesized and quantified using HPLC-MS. The concentration of these ACEI peptides increased up to a certain ripening time. The maximum contents of IPP, VPP and EKDERF were 2.8, 7.4 and 5.3 mg/100g cheese, respectively and these levels were found in a 1-year Cheddar cheese. The maximum content of VRYL was found in a 2-year Cheddar cheese with amounts as high as 7.5 mg/100g cheese while the maximum content of YPFPGPIPN was 6.8 mg/100g cheese, which was found in a 6-mo Cheddar cheese. Aged Cheddar cheese is a good source of ACEI peptides and we predicted (based on previous clinical studies with these purified ACEI peptides) that a measurable anti-hypertensive effect in individual consumers would be expected if around ~100 g/day of this 1-year Cheddar cheese was consumed.

Key words: ACE-inhibitory activity, ACE-inhibitory peptides, mass spectrometry

W67 Influence of cooking temperature on the behavior of enterococci and the production of diacetyl in Coalho cheese. P. L. Mamede, J. M. Perri, A. Y. Kuaye, and W. H. Viotto*, *UNICAMP, Campinas, São Paulo, Brazil.*

Coalho cheese, a typical Brazilian cheese, is a semi-hard, white-colored cheese made from cow′s milk. Its elastic or rubbery texture and its low melting capacity are the principal attributes of Coalho cheese in the grilled form, but flavor also plays an important role. Bacteria of the genus *Enterococcus* were the predominant micro biota in Coalho cheeses that displayed a buttery flavor and aroma. The behavior of the *Enterococcus* genus during the different stages of cheese making, and the influence of cooking temperatures on the diacetyl/acetoin content of Coalho cheeses during refrigerated storage were evaluated. Three vats of cheese were made at different curd cooking temperatures (40, 45 and 50°C), using pasteurized milk previously standardized to casein: fat ratio = 0.83 ± 0.04. Cheese making was repeated on 3 different days, resulting in 9 experiments. Cheeses were stored at 4°C during 90 d. The milk pasteurization process was not effective to eliminate the enterococci. Both the steps of curd cooking and curd salting selectively favored the growth of this genus, known to tolerate high salt concentrations, resist high temperatures and lowering of the pH. The growth of *Enterococcus* was favored by curd cooking, but was not affected by variations in the cooking temperature. The *Enterococcus* population and the production of diacetyl/acetoin increased significantly with the storage time of the Coalho cheeses. The production of diacetyl/acetoin and the consequent development of a buttery flavor and aroma in Coalho cheese can be associated with the development of *Enterococcus*. The authors are grateful to CNPq (Brazilian Natl. Research Council) for their financial support.

Key words: cheese, *Enterococcus*, diacetyl

W68 Identification of the main esterase involved in lipolysis by *Propionibacterium freudenreichii*. M. C. Abeijón Mukdsi[3,4], H. Falentin[1,2], M.-B. Maillard[1,2], R. B. Medina[3,4], S. Parayre[1,2], S.-M. Deutsch[1,2], S. Lortal*[1,2], and A. Thierry[1,2], [1]*INRA, UMR1253, Rennes, France,* [2]*Agrocampus Ouest, Rennes, France,* [3]*CERELA-CONICET,*

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Free fatty acids are important flavor compounds in cheese, where they bring pungent, rancid, cheese, and fruity notes. They mainly result from the lipolytic activity of cheese microorganisms. *Propionibacterium freudenreichii*, a species used as a ripening culture in Swiss cheese, is the main agent of Swiss cheese lipolysis, with 96% of the free fatty acids released during the ripening resulting from *P. freudenreichii* activity [Dherbécourt et al. 2010 J. Agric. Food Chem. 58:11732-11739]. Our aim was to identify the most probable lipolytic esterase(s) involved in cheese lipolysis by *P. freudenreichii*. Since cheese lipolysis mainly occurs during *P. freudenreichii* growth, we focused our study on surface-exposed or secreted esterases. Out of the 12 putative esterases previously predicted from the genome sequence of *P. freudenreichii* CIRM-BIA1 [Dherbécourt et al. 2008 Microb. Cell Fact. 7], the lipolytic esterase PF#279 was shown to be secreted, and the putative esterase PF#774 was predicted to be anchored in the plasma membrane [Dherbécourt et al. 2010 Appl. Environ. Microbiol. 76:1181-1188]. To evaluate the respective role of these 2 proteins in lipolysis, *P. freudenreichii* CIRM-BIA1 was knocked out and then complemented for the genes encoding these 2 proteins, separately. Each of these genes was also overexpressed in *P. freudenreichii* CIRM-BIA1. All these genetically modified strains were assessed for their lipolytic activity during their growth in a medium containing an emulsion of milk fat. Results showed that the mutants inactivated for PF#279 showed a very low residual lipolytic activity, whereas inactivating or overexpressing PF#774 had no impact on lipolysis level. This study shows that only one lipolytic esterase, PF#279, is involved in milk fat hydrolysis in *P. freudenreichii* CIRM-BIA1 and is a key component in Swiss cheese lipolysis.

Key words: lipolysis, *Propionibacteria*, Swiss cheese

W69 Characteristics of the chemical composition and lipolysis during ripening of Emmental cheese. N. S. Oh*, Y. K. Shin, J. P. Ok, and Y. H. Park, *Institute of Dairy Food Research, Seoul Dairy Co-op., Institute of Dairy Food Research, Seoul Dairy Cooperative, Ansansi, Kyunggi, South Korea.*

The objective of this study was to characterize the lactate metabolism and lipolysis in Emmental cheese made of Korean raw milk throughout the ripening periods; 14 d at 10°C, 42 d at 23°C, and 30 d at 4°C. Emmental cheese was made using commercial starter culture with propionic acid bacteria (PAB) and without PAB as control at the pilot plant scale. The changes in contents of 5 organic acids, which were citric acid, lactic acid, formic acid, acetic acid and propionic acid, and individual free fatty acids (FFAs) were measured using HPLC/PDA and GC/FID. As a result of propionic fermentation by PAB, the concentration of acetic and propionic acid was increased up to 1.6 and 5.7 g/kg, respectively and mainly increased dramatically in the stage of hot room (23°C). Lactic, citric and formic acid contents were 2.6, 2.5 and 0.8 g/kg at the end of ripening. As a result of lipolysis, the amount of total free fatty acids (FFAs) was 7.2 g/kg. Compared with control, levels of individual FFAs from butyric (C4:0) to linoleic (C18:2) acids increased significantly ($P < 0.05$) during ripening period. Especially in the 23°C room, 79% of total FFAs was released and most abundant FFAs are palmitic (C16:0) and oleic acid (C18:1). Then, it showed that the lipolysis of Emmental cheese was strongly affected by bacterial lipase from PAB.

Key words: Emmental cheese, organic acids, lipolysis

W70 Oxidative stability of Prato cheese added with lutein. D. Maus, A. A. O. Xavier, M. T. K. Kubo, R. A. Jorge, A. Z. Mercadante, and W. H. Viotto*, *UNICAMP, Campinas, São Paulo, Brazil.*

The carotenoid lutein has been associated to the reduction and prevention of age-related macular degeneration (AMD), the leading cause of irreversible blindness in the elderly people. Since this carotenoid is not synthesized by the human body, its addition to cheese is an option of lutein supplementation in the diet, and it can also act to prevent photo-oxidation of cheese. The storage conditions of cheese in supermarkets may lead to changes in the product due to the presence of riboflavin (RBF), which under light stimulus promotes oxidation of vitamins, lipids and proteins, leading to nutrient losses and sensory changes. The objective of this work was to evaluate the stability of lutein added to the cheese and RBF, in the presence and absence of light, during 56 d of refrigerated storage. The formulation of lutein used was Lutein 20% FS - natural coloring of lutein for food, from DSM Nutritional Products (Basel - Switzerland). Prato cheeses without addition and with addition of 0.04% formulation of lutein on the mass of milk (estimated content of 80 μg/g milk) were evaluated as the behavior of RBF and lutein during storage at 12°C. A split-split-plot design was used for analyses of lutein and riboflavin contents and the results were evaluated by ANOVA. There was degradation of 35.3% of riboflavin in cheese without the addition of lutein exposed to light. For cheeses with added lutein, there was no degradation of riboflavin in both the absence and presence of light. In all cheeses, the levels of lutein remained virtually constant throughout the period of storage, allowing the assumption that all added lutein remained available at the end of storage period. These facts indicate that lutein, when present in cheese, has a protective role by preventing the degradation of riboflavin.

Key words: carotenoids, cheese, photo-oxidation

W71 Comparison of texture and sensory attribute between Gouda cheese and cholesterol-removed Gouda cheese during ripening. H. J. Jung*, E. J. Ko, and H. S. Kwak, *Sejong University, Seoul, South Korea.*

The present study was carried out to examine the texture and sensory evaluation between Gouda cheese and cholesterol-removed Gouda cheese made by crosslinked β-cyclodextrin (β-CD). Both cheeses were ripened at 14°C, 85% RH for 6 mo. The texture and sensory characteristics of the cheeses were measured during ripening (0, 1, 2, 3, 4, 5 and 6 mo). To analyze the texture properties, the 2-bite compression test was performed using by texture analyzer, and to evaluate sensory properties, 9-trained panelists examined the cheeses. In chemical composition analyses, moistures were significantly different between cheese (42.96%) and sample cheese (48.44%) ($P < 0.05$). But fat and protein in the control and the sample were 32.99, 22.51 and 31.45, 20.45%, respectively, and were not significantly different ($P < 0.05$). The amount of cholesterol was 82.41 mg/100 g and the percentage of cholesterol removal was 91%. In the texture analysis, hardness, gumminess and chewiness were significantly increased, but cohesiveness and springiness were not increased in both cheeses during ripening periods ($P < 0.05$). In comparison of the control and sample cheeses, hardness and springiness were not significantly different, but cohesiveness, gumminess and chewiness were different ($P < 0.05$). In sensory properties, appearance (yellowness and dryness), aroma (butyric, fruity, musty and nutty), flavor and taste (butyric, sour, salty, bitter and after taste) and texture (hardness, springiness, crumbliness, sticky, dryness and mouth coating) were significantly increased except buttery,

nutty in aroma and sweetness in taste in both cheeses during ripening ($P < 0.05$). And appearance, aroma, flavor and taste, and texture were not significantly different between the control and sample cheeses ($P < 0.05$). Therefore, this study may suggest that the quality of cholesterol-removed Gouda cheese is not different from the control cheese.

Key words: Gouda cheese, cholesterol removal, sensory evaluation, texture

W72 Influence of pH on flavor of low fat Cheddar cheese. M. M. Motawee*[1] and D. J. McMahon[2], *[1]National Organization for Drug Control and Research, Cairo, Egypt, [2]Western Dairy Center, Utah State University, Logan.*

Low fat cheddar cheese typically lacks flavor characteristic of full fat cheddar cheese. This study investigated whether flavor or low fat cheese could be improved by modifying cheese pH and lowering storage temperature. Cheese was made from 700 kg of 0.6%-fat milk using lactococcal starter culture and lactobacilli adjunct culture. Milk was renneted at 31°C, cooked to 35°C, drained, curd washed with cold water, dry stirred, salted, and pressed into 9-kg blocks and stored at 3, 6, and 10°C. Make procedure was varied to produce cheese with pH (at 60 d) from 5.08 to 5.55 with similar moisture, salt and fat. Sensory descriptive analysis was performed using the Spectrum scale after 4 mo on cheese aged at 3 and 6°C and compared with retail-purchased full fat cheeses. Scores for cooked, fruity, oxidized, pineapple, rancid, sulfur and whey flavors were negligible (≤0.5) for both low fat and full fat cheeses. There were few differences in flavor scores of low fat cheese attributed to pH or storage at 38 or 42°F. There was a consistent tendency for cheese aged at 3°C to receive slightly lower scores, such as 2.4 vs. 2.9 for sour and 1.4 vs. 1.7 for umami flavor. Sour, umami and salty flavors of low fat cheeses were not influenced by pH and these were all slightly less compared with full fat cheese, i.e., 2.7 vs. 4.4, 1.6 vs. 2.1, and 2.9 vs. 3.8, respectively. Low fat cheeses also scored lower for lactone (0.8 vs. 1.6), nutty (0.8 vs. 1.4) and buttery (0.8 vs. 1.8) flavors. Cheese microflora was studied by plating on Elliker agar for total lactic acid bacteria, and on Rogosa agar for lactobacilli, with the difference between them being attributed to lactococci. Starter culture levels were about 10^7 cfu/g initially and between 10^6 to 10^7 by d 30, and stayed about 10^6 cfu/g through 90 d then dropped off by 120 d to being much less than the nonstarter bacteria (this occurred earlier in cheese stored at 10°C). Lactobacilli levels were about 105 after 5 d of storage, increased to 10^6 by 30 d for all cheeses, and reached 10^7 cfu/g by 90 d in the 10°C cheese. Levels of thermophilic bacteria stayed relatively constant at 10^3 to 10^4 cfu/g throughout storage irrespective of temperature.

Key words: Cheddar, low fat, flavor

W73 Free fatty acid compositions of low-fat and full-fat goat milk cheeses stored under refrigeration for three months. W. Nouira[1], Z. Guler[2], and Y. W. Park*[1], *[1]Fort Valley State University, Fort Valley, GA, [2]Mustafa Kemal University, Hatay, Turkey.*

Amount of free fatty acid (FFA) is an indicative of degree of lipolysis in dairy foods. The objective of the study was to determine differences in composition and total FFA contents between low-fat (LF) and full-fat (FF) plain soft goat milk cheeses stored for 3 mo at 4oC. The 2 types of cheeses were manufactured using a bulk tank goat milk collected from the Fort Valley university farm. LF cheese was manufactured after cream removal from the whole milk. FFAs of all LF and FF cheeses were extracted in diisopropyl ether using polypropylene chromatography column, and FFA concentration was determined using a gas chromatography, equipped with a fused silica capillary column. Moisture, fat, protein contents (%) and pH of fresh LF and FF cheeses were: 55.1, 52.3; 1.30, 25.6; 3507, 22.5; 5.40, 5.42, respectively. The concentrations (mg/g cheese) of FFAs in the fresh FF and LF cheeses before the storage for C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, C16:0, C18:0, C18:1, and C18:2 were: 0.020, 0.072; 0.070, 0.035; 0.061, 0.055; 0.181, 0.167; 0.073, 0.047; 0.174, 0.112; 0.579, 0.152; 0.308, 0.202; 0.521, 0.174; and 0.057, 0.026, respectively. The respective FFA to total fatty acids ratios for 0, 1 and 3 mo aged FF and LF cheeses were 8.44, 12.4; 6.31, 16.91; 12.03, 14.19. Total FFA contents of LF cheeses at 0, 1 and 3 mo aging were 48.0, 96.8 and 36.4% of those in FF cheeses. It was concluded LF cheese generated more FFA than FF cheese although total FFA amount was significantly ($P < 0.05$) lower in LF cheese.

Key words: lipolysis, free fatty acid, goat milk cheese

W74 Increasing functionality of low fat mozzarella cheese using polysaccharides. E. N. Oberg*, W. R. McManus, and D. J. McMahon, *Utah State University, Logan.*

We examined the ability of polysaccharides to function as fat mimetics in low fat mozzarella string cheese to improve functionality by acting to form protein fibers during cheese extrusion. Low fat (LF) mozzarella cheese curd made from 273 kg of 0.7%-fat milk was salted at a rate of 10 g/kg then divided into 3.6-kg batches that were hand-stretched in hot (80°C) 5% brine and formed into a homogeneous mass. The hot cheese was hand mixed with a hot (80°C) polysaccharide slurry and placed into a small piston-driven extruder and cheese forced through a 16-mm die to form the string cheese and cut manually into about 15-cm lengths. From preliminary trials using starches (waxy corn, waxy rice, and instant tapioca starch), xanthan and guar gum, and polydextrose we determined that LF string cheese made using xanthan gum most resembled retail string cheese. Cheese was then made using 10% xanthan gum slurry added at 0.25%, 0.5%, 1.0%, 1.5%, and 2.0% levels as well as a control with no added gum. Cheeses were analyzed for fat, salt, pH, and moisture. After 2 wk of 4°C storage, the cheese was analyzed for extent of stringiness by pulling apart the cheese longitudinally, visually observing and photographing size, length and appearance of individual strings of cheese, consumer liking, and hardness using a penetrometer shear test. Using a hedonic scale (1 to 9) for overall liking the LF with 1% added xanthan slurry (score = 6.8) was liked more ($P < 0.05$) than a retail comparison string cheese (score = 6.2) and the LF cheese with no added gum scored lower (5.9). When considered on a JAR scale, 71% of panelists scored the LF cheese with added xanthan as having the right texture, while only 49% did so for the retail cheese. The no added gum LF cheese was considered too firm. By visual comparison, adding the xanthan gum slurry produced greater fiber formation with the longest and best string separation. After 8 wk storage, the LF cheeses had softened extensively with fracture stress for LF cheese decreasing from 11.8 to 20.5 kg at 2 wk to 2.22–3.45 kg at 8 wk. Extent of stringiness also decreased considerably during storage.

Key words: mozzarella, string cheese, low fat