perature and put directly on a pizza for baking.

Key Words: CO_2, mozzarella, yield

428 A non-pasta filata Mozzarella cheese making method using CO_2: Cheese functionality. L. Li[1], M. Newbold[2], and D. M. Barbano*[2], [1]*South China University of Technology, Guangzhou, China*, [2]*Cornell University, Ithaca, NY*.

A new method of Mozzarella cheese making was developed using CO_2 as a processing aide to control calcium-protein equilibria and deliver a full-fat Mozzarella with acceptable functionality for pizza baking without using any added starch or phosphates to retain moisture and fat during baking. Two versions of the new process produced cheeses containing about 52 and 58% moisture, while they both had a fat on a dry basis of > 45% and a protein on dry basis of about 43 to 44%. Cheeses produced by the new process are in a particulate form directly from the cheese making and do not require stretching, brining, or shredding. The objective was to determine the free oil release, expressible serum, meltability, apparent viscosity, and pizza baking characteristics of cheese produced by this new process. Free-oil release of full-fat Mozzarella during pizza baking can often be excessive. Cheeses produced by the new process released 4 to 7% of their oil, while commercial low-moisture Mozzarellas released 25% of their fat. Cheeses from the new process had lower (almost zero) expressible serum release after 4 days of refrigerated storage while the commercial low-moisture Mozzarellas released more than 20% of their moisture after 4 days of refrigerated storage. The cheeses from the new process held their moisture much better when baked on a pizza. Cheese produced by the new process had a tube meltability that was nearly twice that of the commercial cheese of the same age and this difference was clearly visible when the cheeses were baked on pizza. The melted cheese consistency, measured as apparent viscosity by helical viscometry, was much softer and more stretchable than the commercial products. Addition of CO_2 to milk prior to rennet coagulation changed the calcium-protein equilibria in the cheese and increased partitioning of caseins into the water phase of the cheese. Higher casein solubility in the water phase of the cheese increased water and fat holding capacity and this provided excellent baking properties of the high moisture cheese without any added non-dairy ingredients.

Key Words: Mozzarella, CO_2, functionality

429 Caseins as molecular chaperones: Functional analysis and structural considerations. Y. H. Yong* and E. A. Foegeding, *Department of Food, Bioprocessing and Nutrition Sciences, North Carolina State University, Raleigh*.

Denaturation and aggregation of proteins are reactions that are relevant to functional applications of proteins in foods. Depending on concentration, aggregation can result in turbidity, precipitation or gelation. One of the approaches to improve the thermal stability of globular proteins is through addition of other compounds to alter the aggregation process. Numerous studies have shown the ability of molecular chaperones to assist proper folding/unfolding and assembly/disassembly of proteins, especially during stressed conditions. In 1999, a mixture of α_{s1} - and α_{s2} -casein was reported for the first time to possess molecular chaperone-like properties to prevent a variety of proteins and enzymes from different types of stress-induced aggregation. In the intervening 10 years, around a dozen journal papers have reported the molecular chaperone properties of caseins, including α-, β-, κ-caseins, whole casein and sodium caseinate. We have summarized and compared the results of these studies to see if they could be explained by a common mechanism. Also, as caseins were reported to be acting in a manner similar to the small heat shock proteins (sHSP) family, we evaluated the similarities and differences of caseins and α-crystallin (first sHSP as a molecular chaperone) from the viewpoints of their structural information (primary to quaternary) and their functional assistance on select substrate proteins. Caseins were compared to another natively unfolded protein, namely α-synuclein, that also has been reported to act like a molecular chaperone. Through all these details, we provide an insight of the role of caseins as a distinct group of molecular chaperones.

Key Words: caseins, molecular chaperones

430 Development and functionalities of milk protein-based paper glue. X. Chen[2,1], Y. L. Gao[2,1], L. H. Zhou[1], and M. R. Guo*[1], [1]*University of Vermont, Burlington*, [2]*Inner Mongolia Agriculture University, Huhhot, Inner Mongolia, China*.

Commercial paper glue products on the market may contain toxic compounds harmful to the people and the environment. Prototype of environmentally safe paper glues containing polymerized whey protein (PWP) and sodium caseinate were developed and optimized under a full factorial experiment design with factors of protein content, denature temperature, time and other ingredients. The prototypes were analyzed for physicochemical properties including pH value, ash contents, total solids and viscosity, and functional properties including bonding strength, water resistance, temperature and moisture resistance. When compared with the commercial product, the prototypes had higher pH value (6.6/4.7), higher ash content (0.3%/0.1%), lower total solids (15.8%/31.2%) and higher viscosity (5975/2472 mPa), respectively. Bonding strength is considered as the main index because it is the most important property for glues. The bonding strength of the prototypes was up to 161.4 N while commercial sample was 154.6 N. According to the ASTM standards, the water resistance and temperature-and-moisture resistance of the prototypes were better than those of commercial samples. The statistic analyses indicated that the denaturation time had significant effects ($P<0.05$) on bonding strength, while both WPI/PVA ratio and denaturation temperature had very significant effects ($P<0.01$).

Key Words: milk protein, paper glue, bonding strength

Dairy Foods: Dairy Foods/Cheese

431 ADSA Pioneer: A century of predictive cheese yield formulas. D. B. Emmons*, *Food Research Laboratory, Research Branch, Agriculture and Agri-Food Canada,, Guelph, ON, Canada*.

Predictive cheese yield formulas have evolved over more than 100 years from one based only on casein and fat. A major change in 1910 included moisture and a constant for salt and whey solids. Refinements have included salt and whey solids as separate factors, exclusion of whey solids from moisture associated with cheese protein, and use of paracasein instead of casein. Various parts or all of formulas are used in monitoring or controlling experiments and cheese making. The General formula is based on the sum of cheese components: fat, protein, moisture, salt, whey solids free of fat and protein, as well as milk salts associated

with paracasein (Ca, Mg, inorganic phosphate, citrate). The formula was tested using composition of milk, whey, and cheese from 22 vats of Cheddar cheese. Unexpectedly, mean predicted yield was 99.17% (Nx6.31) as a percentage of actual yield; using Nx6.38 it was 99.61%; both standard deviations were 0.18%. That percentage is useful for comparisons among vats. The mean sum of components in cheese was 99.51% (sd = 0.12; Nx6.31) or 99.77% (sd = 0.12; Nx6.38). The predicted yield percentage correlated positively with the sum of components in cheese (Nx6.31); r = 0.992 (P<0.01). This led to the idea of adjusting for each vat the five measured components in the formula by the observed sum of components, as a fraction. The mean of the predicted yields as percentages of actual yields was 99.99% (sd = 0.031%). Another method of equating predicted and actual yields calculated a yield adjustment factor as the ratio of the mean actual yield to the mean predicted yield. As expected, multiplication of predicted yields by this factor of 1.0083 gave a mean of predicted yields of 100.00% as a percentage of actual yields (sd = 0.18%, same as before adjustment). One concludes that systematic or variable errors somewhere in the measurement system of analysis, sampling or weighing is a problem in the use of predictive cheese yield formulas. Also, participation in interlab comparison programs is useful for laboratories analyzing cheese.

Key Words: cheese, yield, formula

432 Cheesemaking properties of camel chymosin. K. B. Qvist*, M. Harboe, H. van den Brink, M. L. Broe, and M. W. Børsting, *Chr. Hansen, Hørsholm, Denmark*.

In cheesemaking, rennet enzymes play decisive roles by initiating milk coagulation, and by hydrolyzing milk protein during cheese maturation. Bovine chymosin (BC) has traditionally been considered the most suitable rennet for most cheeses. Recently chymosin from *Camelus dromedarius* (CC) has been obtained through heterologous expression in *Aspergillus niger* and is now commercially available as CHY-MAX M® from Chr. Hansen. The objective of this work was to determine its main cheesemaking properties, and compare with those of BC. Milk clotting activity was determined in International Milk Clotting Units (IMCU), gelation was monitored using a Formagraph, and general proteolytic activity was determined using dimethylated casein as substrate. Mozzarella, Cheddar and Gouda cheeses were made and chemically analyzed using standard protocols. Texture profile analysis and sensory profiling were used to determine texture and sensory properties of cheese. Proteolysis in cheese during ripening was monitored by determination of soluble and TCA soluble N. Size exclusion and reversed phase HPLC were used to characterize peptides in whey. Milk clotting activity (C) per mole of CC was 70% higher than that of BC, while general proteolytic activity (P) was 75% lower, resulting in a 7-fold higher C/P-ratio. Surprisingly, this means that CC is much more specific for cleaving the Phe_{105}-Met_{106} bond of bovine κ-casein than is BC. Gel firmness developed faster during renneting when using CC, meaning that dosage in IMCU could be reduced by 25% while maintaining time to cutting. Gel formation was less affected by pH and $[Ca^{++}]$ with CC, thus reducing effects of natural milk variation. Whey produced with CC contained lower levels of N, and less casein derived peptides. A cheese yield increase of 0.1-0.2% was observed with CC, compared to BC. During storage, development of soluble and TCA soluble N was slower with CC than with BC. Tendency for development of bitterness was reduced, as was softening of Mozzarella during storage. Taken together these observations suggest that camel chymosin may become the preferred rennet for many applications.

Key Words: camel chymosin, specificity, cheese yield

433 Aggregation of casein micelles by combined rennet and acidification studied by rheology and diffusing wave spectroscopy: Effect of heat treatment. C. Cooper*, M. Alexander, and M. Corredig, *University of Guelph, Guelph, ON, Canada*.

Skim milk was heated using a HTST-microthermics unit, and the effect of the heat-induced soluble complexes on the properties of milk gels obtained by combined rennet and acidification was investigated, by analyzing the soluble complexes formed, and following the gelation using rheology, diffusing wave spectroscopy and monitoring the release of caseinomacropeptide. Soluble complexes, as previously observed in batch-heated milk, were only found in the most extensively heated HTST conditions studied (85°C/300 s). As severity of heat treatment decreased, the soluble complexes formed were smaller and contained less β-lactoglobulin and α-lactalbumin and more hydrophobically-associated caseins. The sera of heat-treated milk always contained disulphide-linked minor whey proteins and κ-casein. Different heating temperature-time regimes did not affect the amount of caseinomacropeptide released. All acid gels with rennet showed an increased pH of gelation and gel stiffness compared to acid gels without rennet. With low amounts of rennet, the effect of heat treatment on the gelation behaviour of the casein micelles was quite similar to that of acid-induced gels, with heat treatment causing a significant increase in the gelation pH and gel stiffness. In high rennet-acid gels, the aggregation of the enzymatically-destabilized micelles occurred prior to and/or was more predominant than the formation of an intermediate network of denatured whey proteins, and the effect of heat-induced soluble complexes on gelation properties was reduced. This work is the first to compare the effect of HTST-heating and amount of rennet on the destabilization and interaction of casein micelles during aggregation by combined rennet and acidification. Better understanding of these systems may allow for optimal design of combined gels.

Key Words: heat induced soluble complexes, renneting, acidification

434 Improvement in the texture of low-fat Cheddar cheese by altering the manufacturing protocol. N. Bansal*[1], N. Y. Farkye[1], and M. A. Drake[2], [1]*California Polytechnic State University, San Luis Obispo*, [2]*North Carolina State University, Raleigh*.

In recent years, due to increased consumer awareness for healthy foods, there has been an increased demand for low-fat cheeses. However, most low-fat cheeses have a hard body and a poor and rubbery texture. The objective of this study was to evaluate the effect of blending mature full-fat cheese with freshly-made low-/nonfat curd on the composition, proteolysis and texture of the low-fat Cheddar cheese. Full-fat control cheese (FFC) was manufactured from whole milk by a standard stirred-curd Cheddar method using commercial cheese starter. Low-fat control cheese (LFC) was manufactured from pre-acidified milk containing <0.55% fat by the stirred-curd Cheddar method, except that a higher cooking temperature was used and curds salted at a higher pH. Experimental low-fat cheese (ELFC) was made like the LFC, except that shredded mature full-fat cheese (10% of the expected yield of the low-fat curd) was blended with the fresh low-fat curd/whey mixture after healing. Cheesemaking was replicated three times. Cheeses were ripened at 45° F. Instrumental analysis and a trained sensory panel documented texture properties of the cheeses. There were no significant differences (p>0.05) in the composition of LFC and ELFC. The moisture and protein content of the low-fat cheeses was significantly (p<0.05) higher than the FFC. The level of water-soluble nitrogen and the level of primary proteolysis, as detected by urea-PAGE, increased with the age of cheese and were similar in all cheeses. At 6 months of ripening there were no

significant differences ($p>0.05$) between the hardness, cohesiveness, springiness, gumminess and chewiness of ELFC and FFC as measured by texture profile analyzer; whereas the LFC was significantly harder, more cohesive, more springy, more gummy and more chewy than the FFC and ELFC. By sensory analysis, both low-fat cheeses were distinct in texture attributes from the FFC ($p<0.05$), but ELFC were less firm and less springy and more cohesive with a higher degree of breakdown compared to LFC ($p<0.05$). These results suggest that blending mature full-fat cheese during the manufacture of low-fat cheese has potential to improve its texture.

Key Words: low-fat, cheese, texture

435 Impact of grating and reforming on the texture of low fat/ nonfat cheese. C. Akbulut*[1], S. Govindasamy-Lucey[2], J. A. Lucey[1], J. J. Jaeggi[2], and M. E. Johnson[2], [1]*Department of Food Science, University of Wisconsin, Madison*, [2]*Wisconsin Center of Dairy Research, University of Wisconsin, Madison*.

Producing nonfat and low fat cheese with desirable texture and flavor is one of the most challenging areas for the cheese industry. In this preliminary study, we investigated the textural properties of nonfat and low fat cheese produced by a novel technique where nonfat/ low fat cheese was produced after grating the cheese and using pressure to try to reform the shreds into a curd mass that was less firm than the original cheese. Our objective was to determine the effects of processing parameters (operating temperature and particle size of cheese) during the reforming process on cheese texture. The pilot plant system that we used was composed of a shredder (commercial Urschel Shredder) and an extruder (Vemag). In bench-top scale experiments we used a food processor (Robot coupe R2Dice) for shredding and placed the shredded cheeses into plastic syringes and pressed them with a Carver Press. Cheese bases having pH value ~5.6 were obtained from skim milk by direct acidification using citric acid. They were grated into 5 different particle sizes by a food processor using graters of different sizes (1.5, 2, 3, 6 and 9 mm diameter) and pressed for 1 h after filling into syringes. Textural analyses were performed on the nonfat cheese base and reformed cheese that were stored within the syringes for 1 week at 4°C in order to let the cheese fuse together again. The use of smaller particle sized cheese tended to produce softer reformed cheese, probably through the greater disruption of physical interactions in the cheese. This trend may depend on the type of cheese base as we also tried other cheese bases and there appeared to be little impact of particle size. To investigate the impact of temperature cheese bases were shredded at same shred size, brought to three different temperatures (4, 21 and 35°C) by incubating overnight and then run through the Vemag for reformation. At high temperatures, cheese tended to be softer and smoother. We are currently performing pilot-scale trials on these variables.

Key Words: low fat cheese, nonfat cheese, texture

436 Influence of brine concentration and temperature on composition, microstructure and yield of feta cheese. D. J. McMahon*[1], M. M. Motawee[2], and W. R. McManus[1], [1]*Western Dairy Center, Utah State University, Logan*, [2]*National Organization for Drug Control and Research, Cairo, Egypt*.

The protein matrix of cheese undergoes changes immediately following cheesemaking in response to addition of salt and lowering of temperature. Normally such changes are limited by the amount of water entrapped in the cheese at block formation. However, for cheeses such as feta cheese, brine acts as a reservoir of water. Our objective was to determine the extent to which the protein matrix expands or contracts as a function of salt concentration and temperature, and whether such changes can be reversed. Blocks of feta cheese made with overnight fermentation at 20 and 31°C yielded cheese of pH 4.92 and pH 4.83 ($P<0.05$) with 50.8 and 48.9 g/100g moisture ($P<0.05$), respectively. These cheeses were then cut into 100 g pieces and placed in plastic bags containing 100 g of whey brine solutions of 6.5, 8.0 and 9.5% salt, and then stored at 3, 6, 10, and 22°C for 10 d. After brining, cheese and whey were re-weighed, whey volume measured and cheese salt, moisture and pH determined. A second set of cheeses were similarly placed in brine (n=9) and stored for 10 d at 3°C, followed by 10 d at 22°C, followed by 10 d at 3°C, or the complimentary treatments starting at 22°C. Cheese weight and whey volume (n=3) were measured at 10, 20 and 30 d of brining. Cheese structure was examined using confocal microscopy. Temperature had greatest influence on composition, weight and cheese volume. Salt-in-moisture content approached expected levels based on brine concentration and ratio of brine to cheese, i.e., 4.6, 5.7 and 6.7%. Brining at 3°C increased ($P<0.05$) cheese moisture, especially for cheese with initial pH of 4.92, with moisture up to 58 g/100g. Cheese weight increased after brining at 3, 6 or 10°C. Cold storage prevented fermentation and the pH remained constant, while at 22°C the pH dropped as low as pH 4.1. At 3°C the cheese matrix expanded (20 to 30%) while at 22°C there was a contraction and a 13 to 18 g/100g loss in weight ($P<0.05$). Expansion of the protein matrix at 3°C was reversed by changing to 22°C. However, contraction of the protein matrix, was not reversed by changing to 3°C and the cheese volume remained less than what it was initially.

Key Words: protein, cheese, brining

437 Impact of the addition of salts on the textural and rheological properties of nonfat cheese. J. A. Stankey*[1], M. E. Johnson[2], and J. A. Lucey[1], [1]*University of Wisconsin, Department of Food Science, Madison*, [2]*Wisconsin Center for Dairy Research, Madison*.

Several salts ($CaCl_2$, NaCl, and NaSCN) were screened in a small-scale method to observe the textural and rheological impact on a nonfat (NF) cheese. Direct acid NF cheese was made (pH 5.6, 58% moisture), sliced into discs (diameter = 50mm, thickness = 2mm) and frozen (-20°C) until use. A synthetic Cheddar cheese aqueous phase buffer (pH 5.4) was modified to reflect the NF cheese composition. Salts were added to buffer at varying concentrations. Thawed slices were wrapped in cheesecloth and incubated (6 h at 25°C) in glass petri dishes with 50 mL of buffer on a shaker. Post-incubation samples were air dried and equilibrated in airtight bags for 18h at 5°C prior to analysis. Small amplitude oscillatory shear properties were measured while heating from 5 to 85°C at the rate of 1°C/min and parameters measured were dynamic moduli and loss tangent (LT). Hardness was determined by texture profile analysis and uniaxial compression. Acid-base buffering was measured to observe changes in insoluble calcium phosphate (CCP). Moisture content decreased as salt concentration increased. The LT values were higher (indicating higher meltability) and occurred at lower temperatures for cheeses incubated in high concentrations of NaSCN compared to control cheeses. The reverse was observed for cheeses incubated in high concentrations of $CaCl_2$. Hardness decreased in cheeses subjected to buffers with high concentrations of NaSCN. High concentrations of NaCl in buffers solubilized some residual CCP in cheese. NaSCN had little effect on CCP, whereas buffers with high concentrations of $CaCl_2$ increased CCP levels strengthening the protein

matrix thus decreasing meltability. High NaSCN cheeses may weaken the protein matrix at higher temperatures due to the chaotropic effect of SCN^-, which by perturbing water structure may reduce hydrophobic interactions weakening casein interactions. Heating typically strengthens hydrophobic interactions but the addition of SCN^- may have disturbed these interactions. This study shows that the addition of NaSCN and $CaCl_2$ influenced the texture and rheology of NF cheese.

Key Words: nonfat cheese, texture, rheology

438 Comparison of mono- and poly-unsaturated fatty acid compositions between reduced-fat and full-fat goat milk cheeses during three months aging. W. Nouira[1], Z. Guler[2], J. H. Lee[1], T. H. Terrill[1], G. Kannan[1], and Y. W. Park*[1], [1]*Fort Valley State University*, *Fort Valley, GA*, [2]*Mustafa Kemal University*, *Hatay, Turkey*.

Consumers demand for reduced-fat dairy products has remarkably increased in recent years. Research on reduced or low fat cow milk products has been numerous, while such studies on goat milk products have been scarce. Three batches each of skim milk (SM) and whole milk (WM) cheeses were manufactured using a bulk goat milk from the University milking herd consisted of Saanen, Alpine, and Nubian breeds to compare the characteristics of monounsaturated and polyunsaturated fatty acid (MUFA and PUFA) compositions and their ratios between the two types of caprine milk cheeses. Cream was separated from the whole milk by a cream separator (Model 17584, Clair Co., Austria) before manufacture of SM cheeses. Both SM and WM cheeses were aged for three months at 4°C, and fatty acid compositions of the goat cheeses were quantified using a GC-MS (Trace DSQ-GC Ultra, Thermo Electron Corp. Austin, TX) equipped with a GC column (SP 2390; 60m x 0.25mm x 0.2um, Supelco, St. Louis, MO). Mean total fatty acid concentrations (mg/g) of SM and WM cheeses were 7.92 and 24.2. Respective mean (%) of MUFA and PUFA for 0, 1 and 3 months aged WM cheeses were: 16.6, 5.07; 24.1, 4.40; 21.1, 2.29, while corresponding means (%) of SM cheeses were 7.52, 1.68; 8.38, 1.83; 7.03, 2.10, indicating that PUFA contents of both cheeses were significantly lower than MUFA, probably due to the high oleic acid content. MUFA:PUFA ratios for 0, 1, and 3 months aged SM and WM cheeses were 4.47, 3.27; 4.57, 5.47; 3.34, 9.21, suggesting the ratios variably changed with a significant reduction in PUFA in WM cheese after 3 month aging. The respective total unsaturated:saturated fatty acid ratios for SM and WM cheeses of 0, 1 and 3 month periods were 0.11, 0.30; 0.12, 0.40; 0.10, 0.32, showing the WM cheeses had higherpercent unsaturated fatty acid than SM counterparts.

Key Words: goat cheese, reduced-fat, fatty acid ratios

439 Distribution of fat in comminuted cheese at varying fat levels and storage times using laser scanning confocal microscopy and textural analysis. W. R. McManus*, N. Garg, and D. J. McMahon, *Western Dairy Center, Utah State University*, *Logan*.

This study examined the microstructural and textural variations of cheese made from comminuted cheese curd and control (non-comminuted) cheese curd. Cheese was produced at increasing fat concentrations of 3, 8, 13, 18, 23, 28, and 33% using stirred-curd Cheddar cheese methods. A portion of the curd was comminuted in a bowl chopper to particle size of about 2 to 4 mm, and then filled into hoops and pressed. Cheese was stored at 6°C and analyzed at 2, 4, 8, 12, and 24 wk using laser scanning confocal microscopic imaging and texture profile analysis using 60% compression. Cheese was stained with 0.1% Nile Red for fat, and 0.01% fluorscein isothiocyanate for protein. As fat level decreased, the fat droplets dispersed within the curd particles decreased in size. At high fat levels, the curd particle junction were devoid of fat because of fat loss from the curd particles during cheesemaking. When the curd was comminuted prior to pressing, free fat was observed between the curd particles. As fat level in the cheese decreased, there was a decrease in inter-particle fat. Differences in texture were observed based on treatment and fat level. Springiness was influenced by fat level ($P<0.0001$) but not by curd treatment. Cohesiveness was different among fat levels ($P<0.0001$) and curd treatment ($P<0.001$). For control cheeses the cohesiveness increased from 0.305 for the 33% fat cheese to 0.786 for the 3% fat cheese. For cheeses with fat contents of 13 to 33% fat, comminuting the curd caused a decrease in cohesiveness, while for cheeses with 3 and 8% fat it caused a increase in cohesiveness. This change in cohesiveness was related to the quantity of fat observed between the curd particles. In the low fat cheeses the fat was observed primarily as small droplets entrapped in the protein matrix of the curd particles, with only a very small amount of fat being released onto the curd particle surface during the comminuting process. At higher fat levels, the fat was observed as larger pools of fat, which could more easily be released during comminuting.

Key Words: cheese, cohesiveness, low fat

440 Development of various paneer based spreads. H. G. Ramachandra Rao* and H. Arun Kumar, *Dairy Science College, Hebbal*, *Bangalore, Karnataka, India*.

Paneer, heat-acid coagulated Indian soft cheese, used mainly for making culinary dishes. Paneer was made by heating whole milk to 90°C, cooled to 70-75°C and coagulated by addition of 1% citric acid and whey drained out through a stainless steel mesh to obtain paneer curd. Salt (1.5%) and stabilizer (0.5%) are added and mixture was subjected to grinding by using mixer-grinder. The moisture % was 65%, exhibited excellent spreading property at 7°C. Dairy spreads generally are high in fat, saturated fatty acids and cholesterol, but poor in spreadability at low temperatures. An attempt has been made to develop various types of paneer based spreads with low fat and low cholesterol, but exhibits good spreadability. Incorporation of 10% WPC or 5% sodium caseinate or 5% soy flour during product preparation resulted in higher yield, better functional properties and nutritional value compared to control (paneer curd was grinded to obtain spread). Replacement of milk fat with vegetable oils at 25% level was highly acceptable with improved body and texture (as determined by using texture analyzer) and spreadability. Sensory analyses of spreads were determined by using a panel of 5 experienced judges. Incorporation of spices such as pepper, clove, cinnamon and their combinations (pepper and clove, clove and cinnamon and cinnamon and pepper) in the form of powder at 1 per cent level resulted in better flavour scores. Pepper and mixture of pepper and clove-flavored paneer spreads recorded highest overall acceptance scores. Among various keeping quality studies undertaken, mere vacuum treatment of paneer spreads resulted in extension of storage up to 35 days at 7±1°C, as against 14 days in control. Microwave treatment of spreads under similar conditions of temperature resulted in extension of keeping quality up to 63 days. Further, when product was subjected to vacuum treatment followed by microwave heating the product was quite stable upto 77 days at 7±1°C. Cheese spreads are not popular in India, probably due to food habits. Therefore paneer type of product with slight modification, with better functionality to improve their utilization was developed in this study.

Key Words: paneer, spreadability, vegetable oil