369 Use of cold microfiltration retentates for standardization of milks for pizza cheese: Impact on yield and functionality. S. Govindasamy-Lucey*, J. Jaeggi, M. Johnson, T. Wang, and J. Lucey, *University of Wisconsin*, *Madison*.

Non pasta-filata mozzarella (pizza) cheese was manufactured with milk (12.1% TS, 3.1% casein, 3.1% fat) standardized with cold microfiltered (MF) retentates. Non-ceramic MF membranes were used to process cold (<7°C) skim milk. MF and diafiltration resulted in at least ~35% of serum protein removal from the MF retentate. Cheesemilks were obtained by blending MF retentate (16.4% TS, 11.0% casein, 0.4% fat) with whole milk (12.1% TS, 2.4% casein, 3.4% fat). Control cheese was made with partially-skimmed milk (10.9% TS, 2.4% casein, 2.4% fat). Initial trials with MF fortified cheeses resulted in ~ 2-3% lower moisture (45%) than control cheese (~47-48%). Procedures were then altered to obtain similar moisture content in all cheeses. Two types of MF cheeses were produced; one with pre-acidification of milk to pH 6.4 (pH6.4MF) and another made from milk pre-acidified to pH 6.3 (pH6.3MF). Moisture content of MF cheeses was increased by using lower setting temperature, increasing curd size and lower wash water temperature. Cheese functionality was assessed using dynamic low-amplitude oscillatory rheology (DLAOR) and performance on pizza. The coagula were cut at the same firmness. Use of lower pre-acidification pH resulted in shorter coagulation time. Nitrogen recoveries were significantly higher in MF fortified cheeses. Fat recoveries were highest in the pH6.3MF cheese than the control or the pH6.4MF cheese. Moisture-adjusted cheese yield was significantly higher in the two MF-fortified cheeses. Maximum loss tangent (LTmax) values (from the DLAOR test) were not significantly different in the three cheeses and the LTmax value increased during ripening. Temperature for LTmax was highest in control and was lower in pH6.3MF cheese than pH6.4MF cheese. Temperature for LTmax decreased with age for all three cheeses. TCA-soluble nitrogen levels were similar in all three cheeses. Performance on pizza was similar for all cheeses.

Key Words: Cheese Yield, Texture, Functionality

370 The effect of cheese temperature on the texture and shredding of mozzarella. K. Lim*, A. Bostley, and C. Chen, *Wisconsin Center for Dairy Research*, *Madison, WI.*

For mozzarella the primary texture attributes related to acceptable shredding are firmness and adhesiveness. The firmer and less adhesive the mozzarella, the higher the Shred Grade (an indicator of shredded cheese quality). The objective of this study was to investigate if decreasing the cheese temperature at shredding would lead to higher shred quality. Mozzarella was manufactured at the WI Center for Dairy Research using a typical manufacturing methods, stored at 7.2°C and then tempered to -1.1, 1.7, 4.4 and 7.2°C prior to shredding and texture evaluations. Cheeses were shredded using an Urschell CC-D shredder and texture evaluated at 2 and 6 weeks of age. Shredded cheese quality was determined by Shred Grade which is derived from shredded cheese size distribution, size measurements and characteristics. The texture attributes of firmness and adhesiveness were determined using the Sensory Spectrum method (15-point product-specific reference scale, 11 trained panelists). Data were statistically analyzed using ANOVA. We observed a significant difference in firmness as cheese temperature decreased for 2 and 6-week old mozzarella. No differences were noted in the adhesiveness of cheeses at the temperatures evaluated. Although lowering cheese temperatures resulted in a firmer cheese, this did not guarantee greater shredded cheese quality. For 2-week old mozzarella, the cheeses shredded at lower temperatures (which were firmer) had significantly higher Shred Grade scores. At 6 weeks, cheese shredding quality did not differ with shredding temperature (even though cheese firmness did). Shredded cheese quality decreases at sensory adhesive scores above 5. The mean adhesive scores were 5.4 and 6.8 for 2 and 6 week old cheeses respectively. Authors speculate that at 2 weeks, shredded cheese quality increased with decreasing temperature due to the firmer texture and adhesive scores that did not surpass 5. At 6 weeks, adhesiveness values surpassed the critical value 5, thus overriding any benefits of a firmer texture.

Key Words: Mozzarella, Shredding, Texture

371 The use of fat replacers in low-fat fresh kashar cheese: composition, proteolysis and yield. N. Koca*[1,2] and M. Metin[1], [1]*Ege University*, *Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Kashar cheese is a semi-hard cheese produced by heating and stretching its curd and is one of the most consumed cheeses in Turkey. It is classified as fresh and mature in terms of ripening level. The low-fat fresh kashar cheeses (about 70% fat reduction) were produced by using two protein-based fat replacers (1.0% w/w Simplesse®D-100 and 1.0% w/w Dairy-Lo™) and one carbohydrate-based fat replacer (5.0% w/w Raftiline®HP) in order to determine their effects on the composition, proteolysis and yield. Cheese samples were analyzed for yield on the 1st day, for composition on the 7th day and for proteolysis on the 1st, 7th, 30th, 60th and 90th days of storage. Full-fat and low-fat cheeses were also produced as control. The moisture contents of the cheeses made with fat replacers were significantly higher than those of the low fat control cheese whereas protein contents were significantly lower ($P<0.01$). Although all fat replacers significantly increased the value of moisture in non-fat substance (MNFS) and the yield of cheese ($P<0.01$), the MNFS value for low fat cheese with Simplesse®100 (63.43%) was higher than that of full fat cheese (63.28%) and the yield (8.08%) was similar to that of full fat cheese (8.09%). About a 70% fat reduction for the low-fat control cheese resulted in a 24% decrease in yield compared to the full fat cheese. The use of Simplesse®100 and Raftiline®HP increased the water-soluble nitrogen content ($P<0.05$) whereas Dairy-Lo™ had no significant effect ($P>0.05$). However, the 12% TCA soluble nitrogen content was not significantly affected by using fat replacers ($P>0.05$). One of the most important strategies for improving the functional properties of low fat cheese is to increase its moisture content sufficiently to provide a moisture to protein ratio or MNFS value that is equal to or higher than its full fat counterpart. As a result, the use of Simplesse®100 for the production of low-fat fresh kashar cheese was found technologically the most successful due to its ability to increase both the moisture content and yield of cheese.

Key Words: Low Fat Cheese, Kashar, Yield

Extension Education: Cow Comfort on Commercial Dairy Operations

372 Maximizing cow comfort on dry lot dairies. D. Armstrong*[1], J. Smith[2], and M. VanBaale[1], [1]*University of Arizona*, *Tucson*, [2]*Kansas State University*, *Manhattan*.

Dry lot dairy farms are frequently built in hot semi-arid climates where in the summer months they experience 30 to over 150 days of heat stress annually. Although most of these areas experience low annual rainfall (less than 38 cm.), moisture can restrict dry lying area for animals. Corrals need to have a 2 to 2.5% slope to provide adequate drainage and depending upon the annual evaporation rate, an area of 46 to 70 sq. m/cow. To provide adequate cow comfort, corrals need to be maintained by removing excessive dry manure from the corral. The excess dry manure needs to be removed several times a year depending on when rain or snow is expected. Walking distance of cows from the corral to the milking parlor should be minimized in the dairy design. Observations in hot weather indicate one-way lane walking distances from the corral to the milking parlor should be less than 365m for 2X milking, 274m for 3X milking, and 183m for 4X. Methods of reducing heat-stress in different parts of the dairy farm will depend upon the number of heat-stress days in the area where the

farm is located. Shade should be provided for all milking cows, dry cows and replacement animals from 0 to 5 months of age. In areas of extreme heat-stress, shade should be provided for all replacement animals. In an AZ trial, a 6% increase in milk production was observed from providing 3.7 sq. m of solid shade/cow. An additional AZ trial indicated that shade over the feed line increased milking production 3% because feed intake increased. Adding evaporative type cooling systems under the shade has increased milk production 6 to 14% depending on the stage of lactation, level of heat-stress and the design of the cooling system. Evaporative cooling systems for corral cooling can vary from $150 to $450/cow. The use of spray line over the feed line in a 1980s CA trial increased milk production and reproductive efficiency. The recent use of soaker lines which decrease the effect of high natural air flow has increased the cooling response in free-stall barns, but there are no data for dry lot dairies. The cost and effectiveness of cooling cows in hot semi-arid climates will vary depending upon the number of days of heat stress.

Key Words: Cow comfort, Dry Lot, Heat stress

373 Practical methods for reducing heat stress on dairy operations. J. F. Smith*[1], D. V. Armstrong[2], M. J. Brouk[1], J. P. Harner[1], and M. J. VanBaale[2], [1]*Kansas State University*, *Manhattan*, [2]*University of Arizona*, *Tucson*.

Lactating dairy cows generate significant amounts of energy from digestion of feedstuffs and metabolic processes. When ambient temperatures increase above the thermal neutral zone the dry matter intake, milk production, health and reproduction of dairy cows is compromised. A trial completed in Missouri showed that lactating cows under heat stress decreased intake 6-16% as compared to thermal neutral conditions. In addition to a reduction in feed intake, there is also a 30 to 50% reduction in the efficiency of energy utilization for milk production. The dairy cow can be managed and cooled to minimize the impact of heat stress. Heat stress can be reduced by providing a cooler environment, by soaking the cow and evaporating water off her skin surface or using a combination of these two methods. Evaporative cooling can be used to cool the air around the cow. On dairies, producers have used tunnel ventilation with evaporative pads and combinations of fans and high-pressure sprayers to cool the air around the cow. This method works well in arid climates. As water is evaporated into the air, temperature will drop and humidity will increase. The use of low-pressure sprinkler/soaker and fan systems to effectively wet and dry the cows will increase heat loss from the cow. Evaporating water off the skin works well in humid and arid climates. Dairy cows can be soaked in the holding pen, exit lanes, and on feedlines. The goal should be to maximize the number of wet-dry cycles per hour. Recent research would indicate that a combination of using evaporative cooling to cool the air and a low pressure soaker system to soak the cow can be used to effectively manage heat stress in hot humid climates. Matching the cooling strategy with the climate is essential to manage the impact of heat stress in dairy cattle.

Key Words: Heat stress, Dairy cattle, Milk production

374 Maximizing cow comfort in free-stall facilities. D. Weary*, *University of British Columbia*, *Vancouver, BC, Canada*.

Recent research has shown that cow comfort in free-stall facilities can be assessed using measures of injuries, measures of preference, and measures of usage such as time spent lying down. For example, cows spend more time lying down in well-bedded stalls, and prefer to use these stalls when given a choice. When no choice is available, cows using stalls with little bedding have an increased risk of leg injuries. Poor stall maintenance and overstocking both lead to marked reductions in lying times in free-stall barns. Poor stall design also constrains cow movement when getting up and lying down, sometimes resulting in injuries from contact with stall structures such as the neck rail. Free-stall facilities should not only provide cows a comfortable place to lie down, but also comfortable environments for standing and feeding. To improve stall cleanliness, free stalls are often designed so as to prevent cows from standing fully in the stall. However, these design features increase the time cows spend standing outside of the stall, often on wet concrete. Increased exposure to hard and wet standing surfaces is known to increase the risk of hoof injuries and lameness. Cows prefer to stand on softer flooring surfaces, and these surfaces improve cow mobility. Softer flooring in front of feed bunk also increases the time cattle spend close to the feed. In summary, a number of scientific approaches are now available for assessing cow comfort, and a growing body of research has identified key methods of improving comfort for cows while lying, standing and feeding in free-stall facilities.

Key Words: Injuries, Lameness, Behavior

375 Factors influencing time budgets of dairy cattle. R. Grant*, *W. H. Miner Agricultural Research Institute*, *Chazy, NY*.

Increasingly, we need to incorporate dairy cattle behavioral data into herd management tools. Research must differentiate between individual cow response to a management routine and the economic return for adopting a routine on a whole-herd basis. Time budget analysis is an initial step in evaluating the impact of management on natural behavioral routines. The 24-h time budget represents net response of the cow to her environment, and deviations from benchmarked behavioral patterns represent departures from natural behavior. Consequently, measured differences between natural and observed behaviors serve as a basis for estimating performance, health, and economic loss due to poor management. This presentation provides recent data on major behaviors (eating, resting, and rumination), measured variability in these behaviors, and the key factors influencing them. The typical time budget differs substantially for lower and higher producing cows. Resting appears to be a key behavior and cows have a fixed requirement for resting as shown by several studies. Using available data, a spreadsheet has been developed that evaluates the time budget for cows housed in a free-stall environment that considers availability of resources, milking time, and stocking density. Potential loss in milk yield is calculated for average and superior milk production cattle. Changes in the time budget (primarily resting) are related to milk yield. Admittedly, this model simplifies complicated effects on herd health and productivity into a single estimate of milk loss. Ideally, we need a mechanistic approach to predicting economic consequences of variable resting and eating times. A long-term goal of this research is to incorporate behavioral data into tools such as Cornell Net Carbohydrate Protein System and CPM-Dairy models to better predict animal response to a diet as influenced by cow environment and management.

Key Words: Time budget, Resting, Dairy cattle

376 Animal welfare audits on dairy operations. J. Reynolds*, *University of California*, *Tulare, CA*.

The retail food industry in the US, in response to pressure from animal welfare groups and consumers, has developed a system of on-farm audits to certify farm animal care and welfare. This program has been developed by the Food Marketing Institute (FMI) and the National Council of Chain Restaurants (NCCR) at the request of their respective members, fast food restaurants and grocery stores. Together, FMI and NCCR members account for over 85% of the food sold in the US. FMI and NCCR member companies are expected to purchase products such as milk and meat from farms that have been audited under the FMI/NCCR Animal Welfare Audit Program (AWAP). The history of the program and the structure of the AWAP program will be discussed. The differences between on-farm welfare assessments and audits will be detailed. Other welfare assessments and audit programs will be described.