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XIX 15-05 LOW-FAT MOZZARELLA AS INFLUENCED BY MICROBIAL EXOPOLYSACCHARIDES, PREACIDIFICATION, AND WHEY PROTEIN CONCENTRATE

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Low-fat Mozzarella cheeses containing 6% fat were made by preacidification of milk, preacidification combined with exopolysaccharide- (EPS-) producing starter, used independently or as a coculture with non-EPS starter, and preacidification combined with whey protein concentrate (WPC) and EPS. The impact of these treatments on moisture retention, changes in texture profile analysis, cheese melt, stretch, and on pizza bake performance were investigated over 45 d of storage at 4°C. Preacidified cheeses without EPS (control) had the lowest moisture content (53.75%). These cheeses were hardest and exhibited greatest springiness and chewiness. The meltability and stretchability of these cheeses increased most during the first 28 d of storage. The moisture content in cheeses increased to 55.08, 54.79, and 55.82% with EPS starter (containing 41.18 mg/g of EPS), coculturing (containing 28.61 mg/g of EPS), and WPC (containing 44.23 mg/g of EPS), respectively. Exopolysaccharide reduced hardness, springiness, and chewiness of low-fat cheeses made with preacidified milk in general and such cheeses exhibited an increase in cohesiveness and meltability. Although stretch distance was similar in all cheeses, those containing EPS were softer than the control. Cocultured cheeses exhibited the greatest meltability. Cheeses containing WPC were softest in general; however, hardness remained unchanged over 45 d. Cheeses made with WPC had the least increase in meltability over time. Incorporation of WPC did not reduce surface scorching or increase shred fusion of cheese shreds during pizza baking; however, there was an improvement in these properties between d 7 and 45. Coating of the cheese shreds with oil was necessary for adequate browning, melt, and flow characteristics in all cheese types.

XIX 16-05 ENHANCED LACTOSE CHEESE MILK DOES NOT GUARANTEE CALCIUM LACTATE CRYSTALS IN FINISHED CHEDDAR CHEESE

A. J. Blake, J. R. Powers, L. O. Luedecke and S. Clark
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Three experimental batches of Cheddar cheese were manufactured in duplicate, with standardization of the initial cheese-milk lactose content to high (5.24%), normal (4.72%, control), and low lactose (3.81%). After 35 d of aging at 4.4°C, the cheeses were sub-

jected to temperature abuse (24 h at 21°C, unopened) and contamination (24 h at 21°C, packages opened and cheeses contaminated with crystal-containing cheese). After aging for 167 d, residual cheese lactose (0.08 to 0.43%) and L(+)-lactate concentrations (1.37 to 1.60%) were high and D(–)-lactate concentrations were low (<0.03%) for all cheeses. No significant differences in lactose concentrations were attributable to temperature abuse or contamination. No significant differences in L(+)- or D(–)-lactate concentrations were attributable to temperature abuse. However, concentrations of L(+)-lactate were significantly lower and D(–)-lactate were significantly higher in contaminated cheeses than in control cheeses, indicating inoculation (at d 35) with heterofermentative nonstarter lactic acid bacteria able to racemize L(+)-lactate to D(–)-lactate. The fact that none of the cheeses exhibited crystals after 167 d demonstrates that high cheese milk or residual lactose concentrations do not guarantee crystal formation. Contamination with nonstarter lactic acid bacteria can significantly contribute to D(–)-lactate accumulation in cheese.

XIX 17-05 ASTRINGENCY OF BOVINE MILK WHEY PROTEIN

H. Sano, T. Egashira, Y. Kinekawa and N. Kitabatake
J. of Dairy Sci. 88(7): 2312. 2005.

Whey protein solutions at pH 3.5 elicited an astringent taste sensation. The astringency of whey protein isolate (WPI), the process whey protein (PWP) that was prepared by heating WPI at pH 7.0, and the process whey protein prepared at pH 3.5 (aPWP) were adjusted to pH 3.5 and evaluated by 2 sensory analyses (the threshold method and the scalar scoring method) and an instrumental analysis (taste sensor method). The taste-stimulating effects of bovine and porcine gelatin were also evaluated. The threshold value of astringency of WPI, PWP, and aPWP was 1.5, 1.0, and 0.7 mg/mL, respectively, whereas the gelatins did not give definite astringency. It was confirmed by the scalar scoring method that the astringency of these proteins increased with the increase in protein concentration, and these proteins elicited strong astringency at 10 mg/mL under acidic conditions. On the other hand, the astringency was not elicited at pH 3.5 by 2 types of gelatin. A taste sensor gave specific values for whey proteins at pH 3.5, which corresponded well to those obtained by the sensory analysis. Elicitation of astringency induced by whey protein under acidic conditions would be caused by aggregation and precipitation of protein molecules in the mouth.

XIX 18-05 USE OF CHITOSAN TO PROLONG MOZZARELLA CHEESE SHELF LIFE

C. Altieri, C. Scrocco, M. Sinigaglia and M. A. Del Nobile
J. of Dairy Sci. 88(8): 2683. 2005.

This study was undertaken to evaluate the feasibility of using chitosan, a natural antimicrobial substance, to improve the preservation of a very perishable cheese. The effectiveness of chitosan to inhibit the growth of spoilage microorganisms in Mozzarella cheese was studied during refrigerated storage. A lactic acid/chitosan solution was added directly to the starter used for Mozzarella cheese manufacturing. Mozzarella cheese samples were stored at 4°C for about 10 d and microbial populations as well as the pH were

monitored. Results demonstrated that chitosan inhibited the growth of some spoilage microorganisms such as coliforms, whereas it did not influence the growth of other microorganisms, such as Micrococcaceae, and lightly stimulated lactic acid bacteria.

XIX 19-05 SENSORY CHARACTERISTICS AND RELATED VOLATILE FLAVOR COMPOUND PROFILES OF DIFFERENT TYPES OF WHEY

F. J. Gallardo-Escamilla, A. L. Kelly and C. M. Delahunty
J. of Dairy Sci. 88(8): 2689. 2005.

To characterize the flavor of liquid whey, 11 samples of whey representing a wide range of types were sourced from cheese and casein-making procedures, either industrial or from pilot-plant facilities. Whey samples were assessed for flavor by descriptive sensory evaluation and analyzed for headspace volatile composition by proton transfer reaction-mass spectrometry (PTR-MS). The sensory data clearly distinguished between the samples in relation to the processes of manufacture; that is, significant differences were apparent between cheese, rennet, and acid wheys. For Mozzarella and Quarg wheys, in which fermentation progressed to low pH values, the starter cultures used for cheese making had a significant influence on flavor. In comparison, Cheddar and Gouda wheys were described by milk-like flavors, and rennet casein wheys were described by "sweet" (oat-like and "sweet") and thermally induced flavors. The volatile compound data obtained by PTR-MS differentiated the samples as distinctive and reproducible "chemical fingerprints". On applying partial least squares regression to determine relationships between sensory and volatile composition data, sensory characteristics such as "rancid" and cheese-like odors and "caramelized milk," yogurt-like, "sweet," and oat-like flavors were found to be related to the presence and absence of specific volatile compounds.

XIX 20-05 ANALYZING A BIOTERROR ATTACK ON THE FOOD SUPPLY: THE CASE OF BOTULINUM TOXIN IN MILK

L.M. Wein and Y. Liu
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The researchers developed a mathematical model of a cows-to-consumers supply chain associated with a single milk processing facility that is the victim of a deliberate release of botulinum toxin. Because centralized storage and processing lead to substantial dilution of toxin, a minimum amount of toxin is required for the release to do damage. Irreducible uncertainties regarding the dose-response curve prevented the quantifying of the minimum effective release. However, if terrorists can obtain enough toxin, and this may well be possible, then rapid distribution and consumption result in several hundred thousand poisoned individuals if detection from early symptomatics is not timely. Timely and specific in-process testing has the potential to eliminate the threat of this scenario at a cost of <1 cent per gallon and should be pursued aggressively. Investigation of improving the toxin inactivation rate of heat pasteurization without sacrificing taste or nutrition is warranted.

XIX 21-05 REGULATORY ASPECTS OF ULTRAFILTERED MILK AND ULTRAFILTERED MILK INGREDIENTS

C. P. Frye

2005 IFT Technical Presentation

Membrane filtration technology is being used to produce liquid ultrafiltered (UF) milk. Milk protein concentrate (MPC) is produced by the subsequent evaporation and drying of ultrafiltered skim milk. The higher level of the milk protein casein in ultrafiltered milk and MPC provides the benefits of improved consistency of the finished cheese composition and increased cheese yield when used as an ingredient in cheese. Ice cream formulated with ultrafiltered milk results in a creamier mouthfeel and smoother texture. The use of ultrafiltered milk as an ingredient in yogurt, dairy beverages, and other foods can achieve nutritional attributes of reduced sugar, lower carbohydrate, and increased protein content. Government regulations rather than food formulation dictate if ultrafiltered milk can be added as an ingredient to dairy products and foods that are subject to federal standards of identity. The U.S. Food and Drug Administration's (FDA) regulations for food standards prescribe processing procedures, composition, allowed ingredients, and required nomenclature of the product. Interpretation of the FDA regulations finds that ultrafiltered milk does not meet the definition of milk, since the removal of minerals and lactose results in a product that is nutritionally and compositionally different than milk or concentrated milk. Therefore, in order for ultrafiltered milk to be allowed as an ingredient in a food subject to federal standards of identity, the standard must specifically permit ultrafiltered milk or the ingredients added to achieve a nutrient content claim allowed under FDA's food labeling regulations. Ultrafiltered milk and MPC can be used as a functional ingredient in foods that are not subject to federal standards of identity.

XIX 22-05 CHEMISTRY AND FUNCTIONALITY OF WHEY PROTEINS

E. A. Foegeding

2005 IFT Technical Presentation

The functional properties of whey proteins can be divided into three areas. The first is their surfactant properties and applications in foams and emulsions. Whey proteins form elastic interfacial films that provide structure and stability in foams. Molecular mechanisms explaining how whey proteins function in foams will be discussed. The second functional application is gelation, where denatured whey proteins form gel networks capable of holding large quantities of water and forming an elastic solid. Recent work has shown that small peptides from extensive hydrolysis of whey proteins can form strong, elastic gels. The gelation mechanism of peptides will be contrasted with the well established gelation mechanism for whey proteins. It is sometimes desirable to prevent protein aggregation. This is indeed the case in protein-containing drinks where a stable, dispersed protein phase is required. The whey protein alpha-lactalbumin has some unique properties that make it functional in this application. The chemistry of denaturation and aggregation of alpha-lactalbumin will be discussed. As our understanding of molecular mechanisms responsible for functional properties becomes more complete, there will

continue to be opportunities for “designer ingredients” based on combinations of whey proteins and/or enzymatic modifications.