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XVII 27-03 RHEOLOGICAL PROPERTIES OF CONCENTRATED SKIM MILK: IMPORTANCE OF SOLUBLE MINERALS IN THE CHANGES IN VISCOSITY DURING STORAGE

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Properties of condensed milks prior to spray drying dictate to a large extent the functionality of the resulting milk powder. Rheological properties of concentrated skim milk, with total solids content of 45% but different mineral content, were studied as a function of shear rate and storage time at 50°C. These milks are proposed as a model to study the effects of minerals on rheology and age gelation of condensed milk prior to drying. During storage of the concentrated milk, the apparent viscosity, particularly after 4 hr., increased markedly at all shear rates studied. The yield stress also increased steeply after 4 hr. of storage at 50°C. The changes in apparent viscosity of concentrated milk stored for up to 4 hr. were largely reversible under high shear, but irreversible in samples stored for longer time. The appearance of yield stress suggested the presence of reversible flocculation arising from weak attraction between casein micelles, with a transition from reversible to irreversible aggregation during storage. Particle size analysis confirmed irreversible aggregation and fusion of casein micelles during storage. Gradual reduction of mineral content of concentrated milks resulted in a marked decrease in the apparent viscosity and casein micelle aggregation during storage, while addition of minerals to milk had the opposite effect. The results demonstrated that the soluble mineral content is very important in controlling the storage-induced changes in the rheology of concentrated milks.

XVII 28-03 USE OF DRY MILK PROTEIN CONCENTRATE IN PIZZA CHEESE MANUFACTURED BY CULTURE OR DIRECT ACIDIFICATION

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The objectives of this study were: 1) to compare pizza cheese made by culture acidification using standardized whole milk (WM) plus skim milk (SM) versus WM plus MPC; and 2) compare cheese made using WM + MPC by culture acidification to that made by direct acidification. The experimental design is as follows: vat 1 = WM+ SM + culture (commercial thermophilic lactic acid bacteria), vat 2 = WM + MPC + culture, and vat 3 = WM + MPC + direct acid (2% citric acid). Each cheese milk was standardized to a

protein-to-fat ratio of ~1.4. The experiment was repeated three times. Yield and composition of cheeses were determined by standard methods, whereas the proteolysis was assessed by urea polyacrylamide gel electrophoresis (PAGE) and water-soluble N contents. Meltability of the cheeses was determined during 1 mo of storage, in addition to pizza making. The addition of MPC improved the yields from $10.34 \pm 0.57\%$ in vat 1 cheese to $14.50 \pm 0.84\%$ and $16.65 \pm 2.23\%$, respectively, in vats 2 and 3 cheeses. The percentage of fat and protein recoveries showed insignificant differences between the treatments, but TS recoveries were in the order, vat 2 > vat 3 > vat 1. Most of the compositional parameters were significantly affected by the different treatments. Vat 2 cheese had the highest calcium and lowest lactose concentrations. Vat 3 cheese had the best meltability. Vat 1 cheese initially had better meltability than vat 2 cheese; however, the difference became insignificant after 28 d of storage at 4°C. Vat 3 cheese had the softest texture and produced large-sized blisters when baked on pizza. The lowest and highest levels of proteolysis were found in vats 2 and 3 cheeses, respectively. The study demonstrates the use of MPC in pizza cheese manufacture with improved yield both by culture acidification as well as direct acidification.

XVII 29-03 STUDIES ON PHYSICOCHEMICAL AND FUNCTIONAL PROPERTIES OF COMMERCIAL SWEET WHEY POWDERS

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The objective of this study was to characterize variation and interrelatedness among primary functional and compositional parameters of commercially available sweet whey powders. Samples representing different plants/processes and cheese types were assayed for foaming capacity, foam stability, pH, protein content, soluble protein, turbidity, color, particle size distribution, lipid, and moisture. Data were analyzed using principal component analysis. Foaming capacity and stability varied from 10 to 220% and 0.1 to 14 min, respectively. Protein content and solubility ranged from 8.5 to 17.6% and 3.7 to 14.1%, respectively. Lipid content of sweet whey powder varied from 0.03 to 2.00%. The two main functional properties, foaming and protein solubility, did not show significant correlation with each other. Foaming properties showed a positive correlation to particle size and L* or lightness value, and negative correlation to lipid content. Protein solubility showed positive correlation with protein content and negative correlation with turbidity of the sample. Foaming behavior, protein, and particle size attributes were the main variables responsible for grouping of samples. Sweet whey powders from the same dairy plants were grouped together. The direct or indirect significance of these relationships to processing is detailed in this study.

XVII 30-03 FUNCTIONALITY OF EXTRUSION—TEXTURIZED WHEY PROTEINS

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Only 50% of whey proteins are used in foods. In order to increase their usage, texturizing WPC, WPI, and whey albumin is proposed to create ingredients with new functionality. Extrusion processing texturizes globular proteins by shearing and stretching them into aligned or entangled fibrous bundles. In this study, WPC, WPI, and whey albumin were extruded in a twin screw extruder at approximately 38% moisture content (15.2 ml/min, feed rate 25 g/min) and, at different extrusion cook temperatures, at the same temperature for the last four zones before the die (35, 50, 75, and 100°C, respectively). Protein solubility, gelation, foaming, and digestibility were determined in extrudates. Degree of extrusion-induced insolubility (denaturation) or texturization, determined by lack of solubility at pH 7 for WPI, increased from 30 to 60, 85, and 95% for the four temperature conditions 35, 50, 75, and 100°C, respectively. Gel strength of extruded isolates increased initially 115% (35°C) and 145% (50°C), but gel strength was lost at 75 and 100°C. Denaturation at these melt temperatures had minimal effect on foaming and digestibility. Varying extrusion cook temperature allowed a new controlled rate of denaturation, indicating that a texturized ingredient with a predetermined functionality based on degree of denaturation can be created.

XVII 31-03 FUNCTIONAL PROPERTIES OF WHEY, WHEY COMPONENTS, AND ESSENTIAL AMINO ACIDS: MECHANISMS UNDERLYING HEALTH BENEFITS FOR ACTIVE PEOPLE (REVIEW)

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Whey proteins and amino acid supplements have a strong position in the sports nutrition market based on the purported quality of proteins and amino acids they provide. Recent studies employing stable isotope methodology demonstrate the ability of whey proteins or amino acid mixtures of similar composition to promote whole body and muscle protein synthesis. Other developing avenues of research explore health benefits of whey that extend beyond protein and basic nutrition. Many bioactive components derived from whey are under study for their ability to offer specific health benefits. These functions are being investigated predominantly in tissue culture systems and animal models. The capacity of these compounds to modulate adiposity, and to enhance immune function and anti-oxidant activity presents new applications potentially suited to the needs of those individuals with active lifestyles. This paper will review the recent literature that describes functional properties of essential amino acids, whey proteins, whey-derived minerals and other compounds and the mechanisms by which they may confer benefits to active people in the context that exercise is a form of metabolic stress. The response to this stress can be positive, as with the accretion of more muscle and improved functionality or greater strength. However, overall benefits may be compromised if immune function or general health is challenged in response to the stress. From a mechanistic standpoint, whey proteins, their composite

amino acids, and/or associated compounds may be able to provide substrate and bioactive components to extend the overall benefits of physical activity.

XVII 32-03 THE ROLE OF DAIRY INGREDIENTS IN ENHANCING IMMUNITY

L. Stevenson and G. Knowles
Aust. J. Dairy Tech. 58, pg. 135

Milk contains bioactive molecules that have the potential to either increase or decrease aspects of humoral and cellular immunity. However, most research on immune-modulation by milk ingredients has been conducted on *ex vivo* cells and tissues. It is likely that only a few ingredients that show potential in *ex vivo* assays will show efficacy in intact animals and be suitable to be incorporated into products. However, it is encouraging that in animal models some of these molecules are effective in combating infections, cancers and immune pathologies. Modulating the immune system is potentially dangerous and safety of modified foods or their ingredients must not be ignored, especially if a food is fortified with a single protein that has been shown to have *quasi* pharmaceutical properties. There are many situations where immune health is threatened; sometimes it is a corollary of accompanying diseases, sometimes it is the consequence of life's choices. Consumers may take them to reduce their risk of contracting infections, lessen symptoms, or as supplements to improve therapy of established treatments, especially those for chronic conditions. These scenarios present different challenges to prove efficacy. However, there is a niche for dairy products that can provide passive protection. These products may be restricted in target but are easier to produce and to apply quality control procedures. Regulations pertaining to food labeling, safety and health claims are changing and becoming ever more demanding. Misleading information will be scrutinized. Therefore, to satisfy anticipated regulations, future research should focus on defining the abilities of ingredients to affect the health and wellness of consumers.

XVII 33-03 USING A PORTABLE REAL-TIME PCR ASSAY TO DETECT SALMONELLA IN RAW MILK

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The purpose of this study was to determine the efficacy of a portable real-time PCR system in detecting *Salmonella* spp. in raw milk. The 200 bulk milk samples chosen for this study constituted a subset of the samples for a larger study; this subset contained 24 samples that were culture positive for *Salmonella* and 176 that were culture negative. Milk was both plated directly on selective agar and plated after enrichment in selective media. Presumptive *Salmonella* colonies were isolated by direct culturing of five samples, while *Salmonella* was isolated from the remaining 19 positive samples only after enrichment. Presumptive *Salmonella* isolates were serotyped, and isolates from 22 samples were confirmed to be *Salmonella* isolates. PCR assays of culture-positive milk prior to enrichment yielded no evidence of *Salmonella*. DNA extracts of bacterial pellets from the enriched samples were analyzed for *Salmonella* by real-time PCR with the Ruggedized Advanced Pathogen Identification Device (RAPID). Fifty-four samples from the enrichment pellets tested positive for *Salmonella* by real-time PCR. Two samples that

tested positive for Salmonella by culture and serotyping tested Salmonella negative by real-time PCR. Serotyping identified isolates from these samples as Salmonella Montevideo. All DNA extracts of Salmonella Montevideo isolates tested positive for Salmonella by real-time PCR. Thirty-three samples tested negative by culture and positive by real-time PCR. These results indicate that the portable real-time PCR system appears to be a useful tool for detecting Salmonella in raw milk. Additionally, the combination of enrichment and real-time PCR techniques used in this study can yield results in 24 hr, compared with the 48 to 72 hr required for traditional culture.