Dairy Foods Processing Symposium: Emerging Processing Technologies to Improve Quality and Functionality of Dairy Ingredients

287 Opportunities for novel dairy ingredients—End-user perspective. P. Upreti*, Nestle R&D Center Inc., Solon, OH.

Dairy ingredients are frequently used for enhancing flavor, texture, appearance, and nutrient-density of finished products. These ingredients often excite marketers because of the ability to make product-claims and create competitive gaps. At present, with the changing consumer preferences and awareness, these ingredients can play even more significant role because of their nutritious and wholesome connotation and consumer-friendly labeling.

The presentation will provoke fellow academic researchers and dairy industry associates to ensure the new dairy ingredients and processes maintain the cleaner-label aspects and transparency expected by consumers from the novel dairy ingredients. This presentation will also highlight the opportunities to consider wholesomeness of dairy ingredients, in conjunction with “simple-to-explain” in-process transformations, in order to create novelty. Such discoveries, their development, and (ultimately) deployment takes time; so patience and persistence are key to successfully launch in the marketplace the products that are nutritious and flavorful.

Key Words: dairy, processing, ingredient

406 High-pressure-jet spray-drying to create novel dairy products. F. Harte*, Department of Food Science, Pennsylvania State University, University College, PA.

High-pressure technologies are gaining relevance throughout the Food and Dairy Industries. This presentation will review current state of the art in high hydrostatic pressure (HPH), high-pressure homogenization (HPH), and high-pressure-jet processing (HPJ). It will focus on the effect of HPJ on milk proteins and the potential to create milk powders with targeted functionality. Research in HPJ is showing that the physicochemical properties of dairy powders—from flow properties to interfacial properties—can be modified by nonthermal processes that are amicable with current ‘clean label’ trends among consumers. This presentation will also highlight the need for better understanding the basic structure-function properties of the casein protein fraction as a unique means toward the development of the next generation of dairy-based ingredients.

Key Words: nonthermal, casein, structure-function

407 Use of forward osmosis as a non-thermal method of concentration for the manufacture of high quality milk concentrates and powders. C. I. Moraru*, Cornell University, Ithaca, NY.

Concentration is commonly used in the manufacture of condensed milk or milk powders, and it can be achieved by thermal evaporation or, more recently, reverse osmosis (RO). Thermal evaporation is energy intensive, leads to undesirable product quality changes, and the outgrowth of spores in the concentration units. RO is affected by membrane fouling, and limited achievable final product concentration. Forward osmosis (FO) is emerging as an attractive nonthermal method of concentration, which is less prone to fouling and can achieve higher concentration levels compared with RO. This presentation will discuss practical aspects related to FO concentration of whole and skim milk, in terms of concentration level and final product quality. Pasteurized skim and whole milk (Cornell Dairy, Ithaca, NY) were concentrated at 4°C and 15°C using a micro pilot-scale FO unit (Ederna, France), equipped with a modified spiral-wound cellulose triacetate membrane. Potassium lactate 60 °Brix was used as draw solution, and a vacuum evaporator was used for its regeneration (Evaled, Italy). The cumulative water flux for RO and FO was determined gravimetrically. Batches of 8L of milk were concentrated in triplicate, and their physico-chemical properties evaluated. The water flux during FO decreased exponentially with time, while sample concentration, evaluated using a refractometer, increased exponentially. Flux values were comparable for both types of milk, although the decrease in flux for whole milk was slightly more pronounced than for skim milk. For whole milk, flux values of 0.656 L/(m2h) after 8h at 15°C and 0.784 L/(m2h) at 4°C, while for skim milk flux values of 0.96 L/(m2h) after 7h at 4°C and 0.87 L/(m2h) after 7h at 15°C were obtained. FO processing of both skim and whole milk had virtually no impact on the color and overall quality of the final product. Overall, the experimental data suggests that FO can be a very attractive alternative to thermal concentration or RO concentration of milk.

Key Words: forward osmosis, nonthermal concentration, concentrated milk

408 Innovations in micro- and nano-bubble technology to improve dairy powder functionality. J. Annamcharla*, Food Science Institute/Animal Sciences and Industry, Kansas State University, Manhattan, KS.

High-protein dairy powders such as milk protein concentrates (MPC) and milk protein isolates (MPI) are added to a variety of dairy and food products to improve the nutritional, sensory, and functional properties. Various factors such as processing conditions, the composition of the powder, storage conditions, and dissolution conditions affect the overall solubility of MPC and MPI. MPCs have the best possible solubility instantly after production and the solubility decreases as the storage time and temperature increases. Moreover, it was reported that increasing the protein content from 85% to 90% led to an overall reduction in solubility. The MPC and MPI must be soluble to give the products the desired characteristics. In this work, it is proposed that the microstructure of MPC powders can be altered using nano- and micro-bubbles (MNB) to improve the reconstitution properties of the MPC powder. In recent years, MNB are gaining interest due to their wide applications in a variety of fields. The physical properties of MNBs are different from those of milli-scale bubbles. The milli-bubbles rise very rapidly, burst on the liquid-air interface, and disappear. On the other hand, the MNBs are stable for considerably long periods. The objective of the present work was to modify the microstructure of the MPC powder particles to create channels for subsequent movement of water during rehydration. The presentation will compare the dissolution properties of MPC powders obtained by the conventional spray drying process as well as the proposed MLB process.

Key Words: micro- and nano-bubbles, microstructure, high-protein dairy powders
Single droplet drying—A new technology for optimization of drying conditions for dairy ingredients. L. E. Metzger* and H. N. Vora, South Dakota State University, Brookings, SD.

As a result of their extended shelf-life, dried dairy ingredients are a major product category produced for global markets. During the development of dairy ingredients, several drying trials are typically conducted to determine optimum drying conditions. The results of these trials can be critical in determining optimum dryer design. However, these trials can be expensive and time consuming. An alternative that has recently been developed is the use of a new technique called single droplet drying (SDD). The SDD technique involves a single droplet suspended on the tip of a glass filament, where changes in droplet diameter, mass, and temperature are measured during drying. This makes it possible to create a pictorial view of the drying process. Once the drying process is complete, particle morphology can be determined using microscopy or the rehydration behavior can be visually studied. A predictive model generated using SDD can then be used to optimize the drying conditions and dryer design. The modeling will help reduce costly plant trials and accelerate the development of new ingredients with novel functionalities.

Key Words: single droplet drying, drying kinetics