DAIRY FOODS DIVISION SYMPOSIUM: INCREASING UTILIZATION OF DAIRY CO-PRODUCTS

0573 Consumer demand, innovation, and opportunity for co-products. B. Graves*, and R. Kapoor, *Dairy Management Inc., Rosemont, IL.*

Due to their superior nutritional quality, dairy ingredients and co-products can play a key role to meet the unmet consumer demand for production of healthy, convenient, and great tasting dairy and dairy-based products that fit the way people live today. The successful introduction of new dairy products, such as Greek yogurt, as well as the increasing production of milk and whey protein concentrates has driven the creation of new co-products like Greek yogurt whey, milk and whey permeates, delactosed-whey, and milk minerals. These co-products need to have value-added utilization to increase the value of farmer's milk, improve sustainable nutrition, and decrease the carbon footprint of dairy products. There are opportunities to develop novel technologies to enhance the utilization co-products to advance our Nation's ability to produce dairy ingredients that cannot only be used in applications such as food aid, nutritional beverages, meal replacers, infant formula, and medical foods but also help food companies fulfill the current consumer trends related to high protein, clean label, and health and wellbeing.

Key Words: whey, permeate, co-products

0574 Permeate use as a sodium replacer/flavor implications. M. Drake*, *Southeast Dairy Foods Research Center, North Carolina State University, Raleigh.*

Whey and milk permeates are co-products of high-protein powder manufacture. Permeates are comprised of minerals, lactose, and organic acids. Permeates contain sodium, but potassium and organic acids contribute salty taste enhancement. As such, permeates provide value added opportunities for solids as well as sodium replacement in many foods. Sensory and chemical properties of permeates from different whey and milk sources and ingredient applications will be addressed.

Key Words: permeate, sodium reduction, dairy foods

0575 Fractionating acid whey into value-added ingredients. K. E. Smith*, *University of Wisconsin-Madison, Madison.*

There has been a huge expansion in acid whey production due to the rapid growth in Greek yogurt manufacture. Acid whey is difficult to process for many reasons, and whey from Greek yogurt manufacture is no exception. Traditionally, recovery of the whey protein has provided an economic incentive to process whey; however, Greek yogurt whey is especially low in protein as compared to other sources of acid whey, and therefore, it is more difficult to justify the expense of converting the whey into dairy ingredients as opposed to disposal. The objective of our research is to find economical methods to recover/convert the nonprotein components in Greek yogurt acid whey into value added ingredients. Membrane filtration has been used for many decades in the dairy industry to fractionate components. Our focus is on reducing the calcium content of the UF permeate from Greek yogurt acid whey through the use of novel nanofiltration membranes. Calcium can interfere with the production of ingredients, such as crystalline lactose and hydrolyzed lactose syrups. Excessive calcium incorporation into the lactose crystal results in crystalline lactose that does not meet specifications for U.S. food grade lactose, and hydrolyzed lactose syrups with high mineral contents may taste salty. Nanofiltration membranes traditionally are able to permeate monovalent ions like chloride, while retaining divalent ions such as calcium. The membranes evaluated in our study had been modified such that calcium could also permeate. Our results indicated lactose and calcium permeated the novel NF membranes to differing degrees as compared to the control NF membrane that did not permeate either component. Varying temperature, pressure, and concentration of the starting permeate during NF resulted in changes in the relative permeation of lactose and calcium. Using a modified NF membrane, we were able to concentrate permeate from Greek yogurt acid whey to approximately 25% total solids. A lactase enzyme with an acidic pH optimum was then added to produce a dairy syrup with enhanced sweetness and a reduced salty flavor as compared to a control made with a traditional NF membrane. The ability to economically remove calcium from the UF permeate should enable processors to recover value from the permeate of products like Greek yogurt acid whey.

Key Words: acid whey, membrane processing, nanofiltration

0576 Demineralization of delactosed permeate and acid whey. J. K. Amamcharla*, *Food Science Institute, Animal Sciences and Industry, Kansas State University, Manhattan.*

The dairy industry is continuously working on novel technologies for producing value added products or ingredients with superior functional and nutritional qualities. Consequently, a coproduct that is relatively low in value is also being produced. It is equally important to look for new ways to increase the market for these coproducts. For example, delactosed permeate (DLP), a coproduct, is obtained after recovering milk proteins and most of the lactose from milk or whey permeate. Milk proteins are removed by using ultrafiltration processes, and lactose is separated by crystallization processes. DLP does not have a standard of identity or a defined composition. The

high moisture content (60 to 75%) and presence of organic acids poses a challenge to use it as a food ingredient without further processing. Researchers have studied the thermodynamics of moisture migration in DLP. Greek yogurt whey is compositionally different from cheese whey and, thus, poses economic and environmental challenges to the dairy industry. Greek style yogurt in the United States is one of the largest growing sectors in the dairy industry. Greek yogurt is produced by removing a part of water and water-soluble components from yogurt. Consequently, a large quantity of Greek yogurt whey (GYW) is being produced as a co-product. The objective of the present work was to present a review of newer knowledge on the manufacture and utilization of dairy co-products. It includes evaluations of the use of magnetic fluid treatment (MFT) and addition of clay minerals as alternative methods for separating valuable DLP and GYW components.

Key Words: demineralization, delactosed permeate, Greek yogurt whey

0577 Advancements in drying lactose and acid whey.
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Aspects involved in the drying of whey and its lactose containing co-products will be highlighted, including lactose crystallization and its influences on lactose crystallization rates and drying efficiency. Glass transition, thermo plasticity, and the sticky line will be defined and discussed in relation to post crystallization in the dryer. Challenges with the Maillard reactions (nonenzymatic browning) and caking of the powder will be discussed. Drying of crystallized lactose, for instance, and the application of the "CrystaLac," a lactose crystallizing evaporator that helps increase yields, will be discussed. Methods of crystal separation and refining will be covered. Details will be shared about how lactose drying is conducted in 2 stages, using a primary attrition dryer with built in powder moisture and size classifier and a secondary stage for after drying and cooling with a fluid bed. Drying of permeate and sweet whey will be covered, including the "HiCon," a high concentration evaporator, the "CCC" Cooling, Concentration, and Crystallizing unit, and the dryer. The influences of lactose crystal sizes on drying efficiency will be covered. Finally, challenges of drying acid whey will be discussed. We will also discuss the crystallization of lactose and sticky components in acid whey and the challenges that we face when drying acid whey. The history of drying acid whey will be summarized. Future possible solutions will be proposed, such as increased crystallization by higher solids, small crystal sizes, membranes to filter out sticky components, humidity control of dryer exhaust air to prevent sticky powder, and the use of a desiccator for decreasing and controlling drying air humidity to be able to dry at lower temperatures.

Key Words: lactose, whey, crystallization, drying, co-products

0578 Lactose derivatives and GOS as prebiotic fibers.
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Lactose is a disaccharide in dairy ingredients and co-products that can be polymerized by both chemical and enzymatic reactions into soluble dietary fiber. Products of each of these manufacturing processes can also be prebiotics if they have demonstrated benefits such as the positive modulation of gut microbiota and improvements in other indicators of digestive health. The enzymatic reaction involves incubating the enzyme β-galactosidase with lactose under specific concentration and temperature conditions to favor the polymerization reaction over hydrolysis. The polymerized product of this reaction is called galactooligosaccharides (GOS). The source of the β-galactosidase enzyme greatly affects the temperature requirements for polymerization, the products of the reaction (the amounts of branching and degree of polymerization), and temperature stability of the enzyme. Polymerization of lactose can also be achieved through reacting acid with lactose during heating. This can be achieved under vacuum or pressure during heating either in batch or continuous processes. The degree of polymerization and branching can vary greatly depending on the reaction conditions. The products of this reaction are called polylactose. This seminar will provide an overview of the production of both types of products and an evaluation of these fibers for prebiotic activity.

Key Words: fiber, polymerization, GOS

EXTENSION EDUCATION

0579 S survey of serum trace mineral concentrations in weaned Montana ram lambs.
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Clinical and subclinical trace mineral deficiencies can limit productivity in western sheep production systems. The objective of the study was to quantify trace mineral status among Montana ram lambs post weaning. Based on prior research investigating forage trace mineral concentrations and trace mineral status in cattle, we hypothesized that clinical and subclinical deficiencies would be most prominent with Zn and Se. To test this hypothesis, serum samples (n = 201) were collected from ram lambs 8 to 10 mo of age (BW 52.8 ± 16 kg) at 21 locations throughout Montana and analyzed for Co, Cu, Fe, Mn, Mo, Se, and Zn. The average concentration and range for each trace mineral analyzed in the serum samples were Co (1.00 ± 0.079 ng/mL, 0.09–6.22 ng/mL), Cu (0.84 ± 0.016 µg/mL, 0.3–1.61 µg/mL), Fe (154.85 ± 3.682 µg/dL, 26–350 µg/