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CONDENSED MILK STORAGE AND EVAPORATION AFFECT THE FLAVOR OF NONFAT DRY MILK

C.W. Park & M.A. Drake
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Currently, NDM processors have 2 options for milk concentration up to 30% solids: evaporation (E) or reverse osmosis (RO). The objective was to determine the effect of condensed milk storage and milk concentration method (E vs. RO) on the flavor of NDM and investigate mechanisms behind flavor differences. For experiment 1, skim milk was pasteurized and concentrated to 30% solids by E or RO and then either stored for 24 h at 4°C or concentrated to 50% solids by E and spray dried immediately. To investigate mechanisms behind the results from experiment 1, experiment 2 was constructed. In experiment 2, pasteurized skim milk was subjected to 1 of 4 treatments: control (no E), heated in the evaporator without vacuum, E concentration to 30% solids, or E concentration to 40% solids. The milks were then diluted to the same solids content and evaluated. Volatile compounds were also measured during concentration in the vapor separator of the evaporator. Sensory properties were evaluated by descriptive sensory analysis and instrumental volatile compound analysis was conducted to evaluate volatile compounds. Interaction effects between storage and method of concentration were investigated. In experiment 1, E decreased sweet aromatic flavor and many characteristic milk flavor compounds and increased cardboard and cooked flavors in NDM compared with RO. Liquid storage increased cardboard flavor and hexanal and octanal and decreased sweet aromatic flavors and vanillin concentration. Results from experiment 2 indicated that the characteristic milk flavors and their associated volatile compounds were removed by the vapor separator in the evaporator due to the heat and vacuum applied during concentration. These results demonstrate that off-flavors are significantly reduced when RO is used in place of E and storage of condensed milk is avoided.

THE EFFECT OF SPRAY-DRYING PARAMETERS ON THE FLAVOR OF NONFAT DRY MILK AND MILK PROTEIN CONCENTRATE 70%

C.W. Park, M.A. Stout & M.A. Drake
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Unit operations during production influence the sensory properties of nonfat dry milk (NFDM) and milk protein concentrate (MPC). Off-flavors in dried dairy ingredients decrease consumer acceptance of ingredient applications. Previous work has shown that spray-drying parameters affect physical and sensory properties of whole milk powder and whey protein concentrate. The objective of this study was to determine the effect of inlet temperature and feed solids concentration on the flavor of NFDM and MPC 70% (MPC70). Condensed skim milk (50% solids) and condensed liquid MPC70 (32% solids) were produced using pilot-scale dairy processing equipment. The condensed products were then spray dried at either 160, 210, or 260°C inlet temperature and 30, 40, or 50% total solids for NFDM and 12, 22, or 32% for MPC70 in a randomized order. The entire experiment was replicated 3 times. Flavor of the NFDM and MPC70 was evaluated by sensory and instrumental volatile compound analyses. Surface free fat, particle size, and furosine were also analyzed. Both main effects (30, 40, and 50% solids and 160, 210, and 260°C inlet temperature) and interactions between solids concentration and inlet temperature were investigated. Interactions were not significant. In general, results were consistent for NFDM and MPC70. Increasing inlet temperature and feed solids concentration increased sweet aromatic flavor and decreased cardboard flavor and associated lipid oxidation products. Increases in furosine with increased inlet temperature and solids concentration indicated increased Maillard reactions during drying. Particle size increased and surface free fat decreased with increasing inlet temperature and solids concentration. These results demonstrate that increasing inlet temperatures and solids concentration during spray drying decrease off-flavor intensities in NFDM and MPC70 even though the heat treatment is greater compared with low temperature and low solids.

PREDICTING THE DISTRIBUTION OF WHEY PROTEIN FOULING IN A PLATE HEAT EXCHANGER USING THE KINETIC PARAMETERS OF THE THERMAL DENATURATION REACTION OF B-LACTOGLOBULIN AND THE BULK TEMPERATURE PROFILES

P. Blanpain-Avet, C. Andre, M. Khaldi, L. Bouvier, J. Petit, T. Six, R. Jeantet, T. Croquennec & G. Delaplace
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Fouling of plate heat exchangers (PHE) is a severe problem in the dairy industry, notably because the relationship between the build-up of protein fouling deposits and the chemical reactions taking place in the fouling solution has not yet been fully elucidated. Experiments were conducted at pilot scale in a corrugated PHE, and fouling deposits were generated using a model β-lactoglobulin (β-LG) fouling solution for which the β-LG thermal denaturation reaction constants had been previously

determined experimentally. Then 18 different bulk temperature profiles within the PHE were imposed. Analysis of the fouling runs shows that the dry deposit mass per channel versus the ratio R = kunf/kagg (with kunf and kagg representing, respectively, the unfolding and aggregation rate constants computed from both the identification of the β-LG thermal denaturation process and knowledge of the imposed bulk temperature profile into the PHE channel) is able to gather reasonably well the experimental fouling mass data into a unique master curve. This type of representation of the results clearly shows that the heat-induced reactions (unfolding and aggregation) of the various β-LG molecular species in the bulk fluid are essential to capture the trend of the fouling mass distribution inside a PHE. This investigation also illustrates unambiguously that the release of the unfolded β-LG (also called β-LG molten globule) within the bulk fluid (and the absence of its consumption in the form of aggregates) is a key phenomenon that controls the extent of protein fouling as well as its location inside the PHE.

INFLUENCE OF RAW MILK QUALITY ON PROCESSED DAIRY PRODUCTS: HOW DO RAW MILK QUALITY TEST RESULTS RELATE TO PRODUCT QUALITY AND YIELD?

S.C. Murphy, N.H. Martin, D.M. Barbano & M. Wiedmann
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This article provides an overview of the influence of raw milk quality on the quality of processed dairy products and offers a perspective on the merits of investing in quality. Dairy farmers are frequently offered monetary premium incentives to provide high-quality milk to processors. These incentives are most often based on raw milk somatic cell and bacteria count levels well below the regulatory public health–based limits. Justification for these incentive payments can be based on improved processed product quality and manufacturing efficiencies that provide the processor with a return on their investment for high-quality raw milk. In some cases, this return on investment is difficult to measure. Raw milks with high levels of somatic cells and bacteria are associated with increased enzyme activity that can result in product defects. Use of raw milk with somatic cell counts >100,000 cells/mL has been shown to reduce cheese yields, and higher levels, generally >400,000 cells/mL, have been associated with textural and flavor defects in cheese and other products. Although most research indicates that fairly high total bacteria counts (>1,000,000 cfu/mL) in raw milk are needed to cause defects in most processed dairy products, receiving high-quality milk from the farm allows some flexibility for handling raw milk, which can increase efficiencies and reduce the risk of raw milk reaching bacterial levels of concern. Monitoring total bacterial numbers in regard to raw milk quality is imperative, but determining levels of specific types of bacteria present has gained increasing importance. For example, spores of certain spore-forming bacteria present in raw milk at very low levels (e.g., <1/mL) can survive pasteurization and grow in milk and cheese products to levels that result in defects. With the exception of meeting product specifications often required for milk powders, testing for specific spore-forming groups is currently not used in quality incentive programs in the United States but is used in other countries (e.g., the Netherlands).

ANTIOXIDANT ACTIVITY OF MILK PROTEIN HYDROLYSATE IN ALLOXAN-INDUCED DIABETIC RATS

S. Awad, M.I. El-Sayed, A. Wahba, A. El Attar, M.I. Yousef & M. Zedan
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They investigated the effects of milk protein concentrate (MPC) and milk protein concentrate hydrolysate (MPCH) as antioxidant agents in rats. Six groups of healthy (non-diabetic) and type-II diabetic rats were used: (1) healthy rats (control), (2) alloxan-induced rats (diabetic control group), (3) healthy rats treated orally with MPC, (4) diabetic rats treated orally with MPC, (5) healthy rats treated orally with MPCH, and (6) diabetic rats treated orally with MPCH. We concluded that treatment with MPC or MPCH reduced the level of thiobarbituric acid reactive substances in healthy and diabetic rats. Treatment with MPC or MPCH improved activities of antioxidant enzymes (catalase, superoxide dismutase, reduced glutathione, glutathione-S-transferase, and glutathione peroxidase) in healthy and diabetic rats. From the present data, we concluded that both MPC and MPCH contain potent antioxidants and could improve the health of rats or other animals with diabetes mellitus.

EVALUATION OF WHEY, MILK, AND DELACTOSED PERMEATES AS SALT SUBSTITUTES

S.T. Smith, L. Metzger, & M.A. Drake
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Whey and milk permeates are by-products of high-protein dairy powder manufacture. Previous work has shown that these permeates contribute to salty taste without contributing significantly to sodium content. The objective of this study was to explore the sensory characteristics and compositional analysis of permeates from different milk and whey streams and a low-sodium product application made from them. Skim milk, Cheddar, cottage, and Mozzarella cheese whey permeates were manufactured in triplicate, and delactosed whey permeate was obtained in triplicate. Composition (protein, fat, solids, minerals) was conducted on permeates. Organic acid composition was determined using HPLC. Volatile compounds were extracted from permeates by solid phase microextraction with gas chromatography-mass spectrometry. A trained sensory panel documented sensory attributes of permeates and cream of broccoli soups with and without salt or permeates followed by consumer acceptance testing (n = 105) on the soups. Cottage cheese whey permeate contained a higher lactic acid content than other permeates, which has been shown to contribute to a higher salty taste. Cottage cheese whey permeate also contained potato or brothy and caramel flavors and sour and salty tastes, whereas delactosed whey permeate had high intensities of cardboard and beefy or brothy flavors and salty taste. Milk, Cheddar, and Mozzarella cheese whey permeates were characterized by sweet taste and cooked milky flavor. Permeates with higher cardboard flavor had higher levels of aldehydes. All permeates contributed to salty taste and to salty taste perception in soups; although the control soup with added salt was perceived as saltier and was preferred by consumers over

permeate soups. Soup with permeate from cottage cheese was the least liked of all soups, likely due to its sour taste. All other permeate soups scored at parity for liking. These results demonstrate the potential for milk, whey, and delactosed permeates from different whey streams to be used as salt substitutes in product applications.

EFFECT OF CASEIN TO WHEY PROTEIN RATIOS ON THE PROTEIN INTERACTIONS AND COAGULATION PROPERTIES OF LOW-FAT YOGURT

L.L. Zhao, X.L. Wang, Q. Tian & X.Y. Mao
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In this study, they investigated the effect of casein (CN) to whey protein (WP) ratios (4:1, 3:1, 2:1, and 1:1) on gelation properties and microstructure of low-fat yogurt made with reconstituted skim milk with or without addition of whey protein concentrate. The rheological properties (storage modulus, G′; yield stress; and yield strain) of the obtained low-fat yogurt were greatly enhanced, the fermentation period was shortened, and the microstructure became more compact with smaller pores as the CN:WP ratio decreased. When CN:WP was 2:1 or 1:1, the obtained yogurt coagulum showed higher G′ and greater yield stress, with more compact crosslinking and smaller pores. In addition, the more of skim milk powder was replaced by whey protein concentrate, the more disulfide bonds were formed and the greater the occurrence of hydrophobic interactions during heat treatment, which can improve the rheological properties and microstructure of low-fat yogurt.

EFFECT OF STANDARDIZING THE LACTOSE CONTENT OF CHEESEMILK ON THE PROPERTIES OF LOW-MOISTURE, PART-SKIM MOZZARELLA CHEESE

A.C. Moynihan, S. Govindasamy-Lucey, M. Molitor, J.J. Jaeggi, M.E. Johnson, P.L.H. McSweeney & J.A. Lucey
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In this study, they explored an alternative approach: adjusting the initial lactose concentration in the milk before cheesemaking. We adjusted the concentration of substrate available to form lactic acid. We added water to decrease the lactose content of the milk, but this also decreased the protein content, so we used ultrafiltration to help maintain a constant protein concentration. We used 3 milks with different lactose-to-casein ratios: one at a high level, 1.8 (HLC, the normal level in milk); one at a medium level, 1.3 (MLC); and one at a low level, 1.0 (LLC). All milks had similar total casein (2.5%) and fat (2.5%) content. We investigated the composition, texture, and functional and sensory properties of low-moisture, part-skim Mozzarella manufactured from these milks when the cheeses were ripened at 4°C for 84 d. All cheeses had similar pH values at draining and salting, resulting in cheeses with similar total calcium contents. Cheeses made with LLC milk had higher pH values than the other cheeses throughout ripening. Cheeses had similar moisture contents. The LLC and MLC cheeses had

lower levels of lactose, galactose, lactic acid, and insoluble calcium compared with HLC cheese. The lactose-to-casein ratio had no effect on the levels of proteolysis. The LLC and MLC cheeses were harder than the HLC cheese during ripening. Maximum loss tangent (LT), an index of cheese meltability, was lower for the LLC cheese until 28 d of ripening, but after 28 d, all treatments exhibited similar maximum LT values. The temperature where LT = 1 (crossover temperature), an index of softening point during heating, was higher for MLC and LLC cheese at 56 and 84 d of ripening. The LLC cheese also had lower blister color and less stretch than MLC and HLC cheese. Adjusting the lactose content of milk while maintaining a constant casein level was a useful technique for controlling cheese pH, which affected the texture, functionality, and sensory properties of low-moisture, part-skim Mozzarella cheese.

ISOLATION AND CHARACTERIZATION OF ANTI-INFLAMMATORY PEPTIDES DERIVED FROM WHEY PROTEIN

Y. Ma, J. Liu, H. Shi & L. Yu
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The present study was conducted to isolate and characterize anti-inflammatory peptides from whey protein hydrolysates using alcalase. Nine subfractions were obtained after sequential purification by ultrafiltration, Sephadex G-25 gel (GE Healthcare, Uppsala, Sweden) filtration chromatography, and preparative HPLC. Among them, subfraction F4e showed the strongest inhibitory activity on interleukin-1β (IL-1β), cyclooxygenase-2, and tumor necrosis factor-α (TNF-α) mRNA expression in lipopolysaccharide-induced RAW 264.7 mouse macrophages. Eight peptides, including 2 new peptides—Asp-Tyr-Lys-Lys-Tyr (DYKKY) and Asp-Gln-Trp-Leu (DQWL)—were identified from subfractions F4c and F4e, respectively, using ultra-high performance liquid chromatography-quadrupole-time-of-flight mass spectrometry. Peptide DQWL showed the strongest inhibitory ability on IL-1β, cyclooxygenase-2, and TNF-α mRNA expression and production of IL-1β and TNF-α proteins at concentrations of 10 and 100 μg/mL, respectively. Additionally, DQWL treatment significantly inhibited nuclear factor-κB activation by suppressing nuclear translocation of nuclear factor-κB p65 and blocking inhibitor κB kinase phosphorylation and inhibitor κB degradation together with p38 mitogen-activated protein kinase activation. The study suggests that peptide DQWL has anti-inflammatory potential; further confirmation using an in vivo model is needed.

COMPOSITION AND FUNCTIONALITY OF WHEY PROTEIN PHOSPHOLIPID CONCENTRATE AND DELACTOSED PERMEATE

M.A. Levin, K.J. Burrington & R.W. Hartel
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Whey protein phospholipid concentrate (WPPC) and delactosed permeate (DLP) are 2 coproducts of cheese whey processing that are currently underused. Past research has shown that WPPC and DLP can be used together as a functional dairy ingredient in foods such as ice cream, soup, and caramel. However, the scope of the research has been limited to 1 WPPC supplier. The objective of this research was to fully characterize a range of WPPC. Four WPPC samples and 1 DLP sample were analyzed for chemical composition and functionality. This analysis showed that WPPC composition was highly variable between suppliers and lots. In addition, the functionality of the WPPC varies depending on the supplier and testing pH, and cannot be correlated with fat or protein content because of differences in processing. The addition of DLP to WPPC affects functionality. In general, WPPC has a high water-holding capacity, is relatively heat stable, has low foamability, and does not aid in emulsion stability. The gel strength and texture are highly dependent on the amount of protein. To be able to use these 2 dairy products, the composition and functionality must be fully understood.

WHEY PROTEIN PHOSPHOLIPID CONCENTRATE AND DELACTOSED PERMEATE: APPLICATIONS IN CARAMEL, ICE CREAM, AND CAKE

M.A. Levin, K.J. Burrington & R.W. Hartel
J. of Dairy Sci. 99(9): 6948. 2016.

Whey protein phospholipid concentrate (WPPC) and delactosed permeate (DLP) are 2 coproducts of cheese whey processing that are currently underutilized. Past research has shown that WPPC and DLP can be used together as a functional dairy ingredient in foods such as ice cream, soup, and caramel. However, the scope of the research has been limited to a single WPPC supplier. The variability of the composition and functionality of WPPC was previously studied. The objective of this research was to expand on the previous study and examine the potential applications of WPPC and DLP blends in foods. In ice cream, WPPC was added as a natural emulsifier to replace synthetic emulsifiers. The WPPC decreased the amount of partially coalesced fat and increased the drip-through rate. In caramel, DLP and WPPC replaced sweetened condensed skim milk and lecithin. Cold flow increased significantly, and hardness and stickiness decreased. In cake, DLP and WPPC were added as a total replacement of eggs, with no change in yield, color, or texture. Overall, WPPC and DLP can be utilized as functional dairy ingredients at a lower cost in ice cream and cake but not in chewy caramel.