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SHORT COMMUNICATION: ISOLATION OF A WHEY FRACTION RICH IN α-LACTALBUMIN FROM SKIM MILK USING TANGENTIAL FLOW ULTRAFILTRATION

B. Holland, J. Kackmar & M. Corredig
J. of Dairy Sci. 95(10): 5604. 2012.

The objective was to evaluate the potential for separating α-lactalbumin from pasteurizeed milk by using tangential flow membrane filtration. Filtration was carried out with a Purosep 7000 series membrane filtration unit (SmartFlow Technologies) with a regenerated cellulose membrane at 26°C and a transmembrane pressure of 186 kPa. The protein in the permeate was >80% α-lactalbumin, and this product could be used as a value-added ingredient in nutritional products.

EFFECT OF NACL ADDITION DURING DIAFILTRATION ON THE SOLUBILITY, HYDROPHOBICITY, AND DISULFIDE BONDS OF 80% MILK PROTEIN CONCENTRATE POWDER

X.Y. Mao, P.S. Tong, S. Gualco & S. Vink
J. of Dairy Sci. 95(7): 3481. 2012.

They investigated the surface hydrophobicity index based on different fluorescence probes [1-anilinonaphthalene-8-sulfonic acid (ANS) and 6-propionyl-2-(*N*,*N*-dimethylamino)-naphthalene (PRODAN)], free sulfhydryl and disulfide bond contents, and particle size of 80% milk protein concentrate (MPC80) powders prepared by adding various amounts of NaCl (0, 50, 100, and 150m*M*) during the diafiltration process. The solubility of MPC80 powder was not strictly related to surface hydrophobicity. The MPC80 powder obtained by addition of 150m*M* NaCl during diafiltration had the highest solubility but also the highest ANS-based surface hydrophobicity, the lowest PRODAN-based surface hydrophobicity, and the least aggregate formation. Intermolecular disulfide bonds caused by sulfhydryl-disulfide interchange reactions and hydrophobic interactions may be responsible for the lower solubility of the control MPC80 powder. The enhanced solubility of MPC80 powder with addition of NaCl during diafiltration may result from the modified surface hydrophobicity, the reduced intermolecular disulfide bonds, and the

associated decrease in mean particle size. Addition of NaCl during the diafiltration process can modify the strength of hydrophobic interactions and sulfhydryl-disulfide interchange reactions and thereby affect protein aggregation and the solubility of MPC powders.

BITTER TASTE INHIBITING AGENTS FOR WHEY PROTEIN HYDROLYSATE AND WHEY PROTEIN HYDROLYSATE BEVERAGES

P. Leksrisompong, P. Gerard, K. Lopetcharat & M.A. Drake
J. of Food Sci. 77(8): S282. 2012.

Whey protein hydrolysates (WPH) are known for bioactivity and functionality, but WPH also have a distinct bitter taste. Identification of effective bitter taste inhibiting agents for WPH would broaden the use of this ingredient. The objective of this study was to evaluate the effectiveness of 24 documented bitter taste inhibitors for WPH. Two spray-dried WPH with different levels of hydrolysis (DH) were evaluated with each potential inhibitor. Quinine hydrochloride (quinine) was presented as a control with each WPH. Percent bitter taste inhibition was reported relative to quinine bitterness. Effective bitter taste inhibitors were subsequently evaluated in WPH beverages with vanilla and chocolate flavoring followed by descriptive analysis. The compounds evaluated did not inhibit bitter taste of quinine and the 2 WPH in a similar manner ($P < 0.05$). Effective bitter taste inhibitors ($P < 0.05$) of both WPH were sucralose, fructose, sucrose, adenosine 5' monophosphate (5'AMP), adenosine 5'monophosphate disodium (5'AMP Na_2), sodium acetate, monosodium glutamate, and sodium gluconate. Sodium chloride inhibited bitter taste of WPH with high DH but not WPH with low DH. Amino acids (l-Lysine, l-arginine) inhibited bitter taste of quinine but not WPH. All effective inhibitors in rehydrated WPH were also effective in the beverage applications. Sweeteners (fructose, sucralose, and sucrose) enhanced vanilla and chocolate flavors in beverages. Most salts and a nucleotide, while effective for bitter taste inhibition, suppressed vanilla and chocolate flavors and potentiated other flavors (that is, sour aromatic), and basic tastes (salty, sour).

INFLUENCE OF STORAGE, HEAT TREATMENT, AND SOLIDS COMPOSITION ON THE BLEACHING OF WHEY WITH HYDROGEN PEROXIDE

A.J. Fox, X.E. Li, R.E. Campbell, P.D. Gerard & M.A. Drake
J. of Food Sci. 77(7): C798. 2012.

The residual annatto colorant in liquid whey is bleached to provide a desired neutral color in dried whey ingredients. This study evaluated the influence of starter culture, whey solids and composition, and spray drying on bleaching efficacy. Cheddar cheese whey with annatto was manufactured with starter

culture or by addition of lactic acid and rennet. Pasteurized fat-separated whey was ultrafiltered (retentate) and spray dried to 34% whey protein concentrate (WPC34). Aliquots were bleached at 60 °C for 1 h (hydrogen peroxide, 250 ppm), before pasteurization, after pasteurization, after storage at 3 °C and after freezing at ‟20 °C. Aliquots of retentate were bleached analogously immediately and after storage at 3 or ‟20 °C. Freshly spray dried WPC34 was rehydrated to 9% (w/w) solids and bleached. In a final experiment, pasteurized fat-separated whey was ultrafiltered and spray dried to WPC34 and WPC80. The WPC34 and WPC80 retentates were diluted to 7 or 9% solids (w/w) and bleached at 50 °C for 1 h. Freshly spray-dried WPC34 and WPC80 were rehydrated to 9 or 12% solids and bleached. Bleaching efficacy was measured by extraction and quantification of norbixin. Each experiment was replicated 3 times. Starter culture, fat separation, or pasteurization did not impact bleaching efficacy ($P > 0.05$) while cold or frozen storage decreased bleaching efficacy ($P < 0.05$). Bleaching efficacy of 80% (w/w) protein liquid retentate was higher than liquid whey or 34% (w/w) protein liquid retentate ($P < 0.05$). Processing steps, particularly holding times and solids composition, influence bleaching efficacy of whey.

ALTERNATIVE BLEACHING METHODS FOR CHEDDAR CHEESE WHEY

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J. of Food Sci. 77(7): C818. 2012.

Residual annatto colorant (norbixin) in fluid Cheddar cheese whey can be bleached. The 2 approved chemical bleaching agents for whey, hydrogen peroxide (HP) and benzoyl peroxide (BP), negatively impact the flavor of dried whey protein. The objective of this study was to evaluate alternative methods for bleaching liquid whey: ultraviolet radiation (UV), acid-activated bentonite (BT), and ozone (OZ). Colored Cheddar cheese whey was manufactured followed by pasteurization and fat separation. Liquid whey was subjected to one of 5 treatments: control (CT) (no bleaching; 50 °C, 1 h), HP (250 mg/kg; 50 °C, 1 h), UV (1 min exposure; 50 °C), BT (0.5% w/w; 50 °C, 1 h), or OZ (2.2g/h, 50 °C, 1 h). The treated whey was then ultrafiltered, diafiltered, and spray-dried to 80% whey protein concentrate (WPC80). The entire experiment was replicated 3 times. Color (norbixin extraction and measurement), descriptive sensory, and instrumental volatile analyses were conducted on WPC80. Norbixin elimination was 28%, 79%, 39%, and 15% for HP, BT, UV, and OZ treatments, respectively. WPC80 from bleached whey, regardless of bleaching agent, had lower sweet aromatic and cooked/milky flavors compared to unbleached CT ($P < 0.05$). The HP and BT WPC80 had higher fatty flavor compared to the CT WPC80 ($P < 0.05$), and the UV and OZ WPC80 had distinct mushroom/burnt and animal flavors. Volatile compound results were consistent with sensory results and confirmed higher relative

abundances of volatile aldehydes in UV, HP, and OZ WPC80 compared to CT and BT WPC80. Based on bleaching efficacy and flavor, BT may be an alternative to chemical bleaching of fluid whey.

BACTERIAL DIVERSITY IN DRIED COLOSTRUM AND WHEY SOLD AS NUTRACEUTICAL PRODUCTS

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J. of Food Sci. 77(7): M359. 2012.

The microbial communities were analyzed from commercially available dried dairy nutraceutical products, including 4 brands of dried colostrum, 2 brands of dried whey, and 1 brand of nonfat dry milk. A culture-dependent 16S rRNA sequencing approach was utilized to elucidate the identity of individual isolates recovered from each dried dairy product. Approximately 69% of all bacterial isolates were members the genus of *Bacillus*, while approximately 14% of all bacterial isolates were identified as members of the genus *Pseudomonas*. Members of the *Kocuria, Microbacterium, and Enterococcus* genera were identified as well.

EFFECT OF DIFFERENT TREATMENTS ON THE ABILITY OF α-LACTALBUMIN TO FORM NANOPARTICLES

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J. of Dairy Sci. 95(11): 6204. 2012.

Nanoparticles of bovine a-lactalbumin (α-LA) prepared by desolvation and glutaraldehyde crosslinking are promising carriers for bioactive compunds in foods. The objective of this work was to study the effect of changes in hydrophobic interactions by using different desolvating agents (acetone, ethanol, or isopropanol) and the use of a heat or high-pressure treatment step before the desolvation process on the size, structure, and properties of α-LA nanoparticles. Ina ll cases, a high average particle yield of 99.63% was obtained. Smaller sizes (152.3 nm) nm) can be obtained with the use of acetone as the desolvating agent and without any pretreatment. This is the first time that α-LA nanoparticles in the size range of 100 to 200 nm have been obtained. These nanoparticles, with an isoelectric point of 3.61, are very stable at pH values >4.8, based on their ζ-potential, although their antioxidant activity is weak. The use of the desolvating agent with the smallest polarity index (isopropanol) produced the largest particles (293.4 to 324.9 nm) in all cases. These results support the idea that controlling hydrophobic interactions is a means to control the size of α-LA nanoparticles. No effect of

pretreatment on nanoparticle size could be detected. All types of nanoparticles were easily degraded by the proteolytic enzymes assayed.

COMBINED EFFECT OF HEAT TREATMENT AND IONIC STRENGTH ON THE FUNCTIONALITY OF WHEY PROTEINS

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A 5% (wt/vol) whey protein isolate (WPI) dispersion (pH 6.5) with different concentrations of NaCl was submitted to dynamic heat treatment. Protein dispersions were characterized as to their rheological properties, particle sizes, morphology, denaturation temperatures, and protein surface hydrophobicity. At low ionic strength (<200mmol/kg), gel elastic modulus increased and strongest gel stiffness was achieved. High salt concentrations lead to a weaker gel, whereas no gels at all were formed without salt. The gelation temperature was also influenced by ionic strength and an increase in denaturation temperature and thermal stability was also observed by using differential scanning calorimetry. Additionally, heat-induced changes in secondary structures upon salt augmentation were followed by Fourier transform infrared spectroscopy. Secondary structural elements estimations obtained from amide I assignments were correlated with those from amide III assignments. Upon salt increase, no differences in secondary structure were observed without heating, whereas upon heating and without salt increase, the Fourier transform infrared spectroscopy data revealed an increase in intermolecular α-sheets at the cost of â-turns and random coils, with no change in α-helical structures. However, NaCl addition along with dynamic heat treatment of WPI dispersion showed a stabilizing effect on the secondary structural elements of both amide I and amide III bands. Whey protein isolate dispersions in water were also characterized by transmission electron microscopy by a spherical shape with 2 populations (6 and 70nm). Salt increase alone resulted in the formation of denser aggregates, whereas a transition from spherical/compact protein aggregates to linear ones was observed due to combined salt/heat effect. The important size of these edifices was confirmed by microscopy and light-scattering techniques. Moreover, protein surface hydrophobicity related to the number of hydrophobic sites available decreased significantly. Finally, experimental results demonstrated the strong interaction between ionic strength and dynamic thermal treatment on protein functional properties and their careful adjustment could enable the food industry to effectively use WPI as a gelling agent.

DIFFERENCES IN PARTICLE CHARACTERISTICS AND OXIDIZED FLAVOR AS AFFECTED BY HEAT-RELATED PROCESSES OF MILK POWDER

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Understanding the formation of oxidized flavor will be highly useful in the improvement of milk powder quality. Effects of preheating, concentration and spray-drying on the particle characteristics and the oxidized flavor stability of milk powder were investigated. The surface composition and free radicals were analyzed using x-ray photoelectron spectroscopy and electron spin resonance spectrometry, respectively. The concentrations of selected oxidized volatiles hexanal and 2-heptanone were determined using solid-phase microextraction gas chromatography-mass spectrometry. Levels of hexanal and 2-heptanone in fresh milk powder were higher than those in raw milk and heated milk, which drastically increased with increasing time of storage. Differences in the morphological observations, free fat, and surface composition of fresh milk powder were found among different heat-related processes. During storage, a radical (g value, a characteristic constant whose value serves to identify any given free radical, was 2.0054) was detected in milk powder. The specific population of the radical increased from 2.99×10^7 at 3 mo to 1.23×10^8 at 6 mo of storage. Addition of ascorbic acid in milk powder changed the type of radicals and reduced the oxidation off-flavor. According to the Pearson correlations, not the surface compositions but the morphological characteristics of milk powder particles should be considered in maintaining the stability of oxidized flavor in storage.