Sensory evaluation of whey fermented beverages with buttermilk and Brazilian Cerrado fruit. R. T. Pfrimer1, L. Damasceno1, C. F. Cardoso2, T. V. de Almeida1, J. C. R. S. More1, E. Arnhold1, E. S. Nicolaú1, and C. Gebara*1, 1. Food Research Center, School of Veterinary Medicine and Animal Science, Federal University of Goiás, Goiânia, Goiás, Brazil, 2. School of Agronomy, Federal University of Goiás, Goiânia, Goiás, Brazil, 3. School of Veterinary Medicine and Animal Science, Federal University of Goiás, Goiânia, Goiás, Brazil.

The formulations with higher milk concentration (50%) and lower visual syneresis presented higher notes (P < 0.05) for appearance and texture. The formulations with higher pulp concentration (20%) obtained higher notes (P < 0.05) for aroma. All formulations presented scores between 6 and 9 ("like slightly" to "like extremely") for color and flavor. All beverages were well accepted by consumers and the scores were about 7 ("like moderately") for overall impression and scores about 4 ("I probably would buy") for purchase intention. Beverage with 50% milk/44% whey buttermilk and 6% pulp was best accepted by consumers and had better cost-benefit. The estimated cost for production of 180 mL of this formulation was US$0.32. This product is an example of proposal made by the 2030 Agenda, and can be classified as sustainable, functional, nutritional and technological properties besides its health benefits. Cagaita (Eugenia dysenterica) pulp was used to flavoring the beverages. It is an appreciated fruit of Brazilian Cerrado with functional properties and produced by local family farmers. The sensory profile of the samples was evaluated by 100 untrained panelists and the attributes evaluated were appearance, color, flavor, texture and overall impression, using a 9-point hedonic scale, where 1 = dislike extremely and 9 = like extremely. The purchase intention was measured on a 5-point score, where 1 = definitely would not buy and 5 = definitely would buy. The result was evaluated by ANOVA and adjust.fdr mean comparison test (P < 0.05). The formulations with higher milk concentration (50%) and lower visual syneresis presented higher notes (P < 0.05) for appearance and texture. The formulations with higher pulp concentration (20%) obtained higher notes (P < 0.05) for aroma. All formulations presented scores between 6 and 9 (“like slightly” to “like extremely”) for color and flavor. All beverages were well accepted by consumers and the scores were about 7 (“like moderately”) for overall impression and scores about 4 (“I probably would buy”) for purchase intention. Beverage with 50% milk/44% whey buttermilk and 6% pulp was best accepted by consumers and had better cost-benefit. The estimated cost for production of 180 mL of this formulation was US$0.32. This product is an example of proposal made by the 2030 Agenda, and can be classified as sustainable, functional, nutritional and technological aspects of foods and contribute to sustainable development. The use of exotic fruits with functional characteristics has also gained attention on food market, and cagaita, a Brazilian Cerrado fruit, has gained attention due its antioxidants properties. The aim of this work was the development and characterization of different formulations of whey-fermented beverages with buttermilk and cagaita pulp (Eugenia dysenterica). Using simplex-centroid mixture design, 7 formulations were defined with different concentrations of whey buttermilk mix (W/B) between 30-44%, milk (M) between 36 and 50% and cagaita pulp (C) between 6 and 20%. Physico-chemical and microbiological characteristics were determined by official methods. The results were evaluated by ANOVA and Pearson correlation test and mean values were compared by Scott-Knott’s test (P < 0.05). Beverages presented moisture between 80.50 and 82.81%, ash between 0.47 and 0.67%, protein between 1.59 and 2.00%, lipids between 1.18 and 2.70%, carbohydrates between 13.37 and 15.32% and total energy value between 72.75 kcal and 85.01 kcal, pH 3.96 and 4.47, acidity was between 0.36 and 0.58%. Milk concentration shows positive correlation with protein and lipids whereas W/B mixture shows negative correlation, therefore beverages with higher W/B and lower M had the lowest protein and lipids. The higher W/B and C, the higher moisture of beverages. All beverages had LAB content above 6 log_10cfu/mL and, for Salmonella spp. and coliforms, the beverages were within the Brazilian law standard and for food safety. The developed products presented expected physico-chemical and microbiological characteristics and were safe for consumption. Besides, these beverages are low cost dairy foods, by using dairy industry coproducts and still have functional characteristics conferred by whey, buttermilk and cagaita pulp.

Key Words: fermented milk, functional ingredients, exotic fruit
respectively. The entire experiment was repeated 8 times. Results were evaluated by ANOVA and Tukey’s test mean comparison (P < 0.05). All results obtained were according to standards for raw milk. There were no differences in fat, protein, casein, lactose, total solids, milk urea-nitrogen and SCC between preservatives. The 3 bronopol-based preservatives were used during 14 d of refrigerated storage and did not affect milk evaluated parameters. However, in practice P3 leads to analytical disorders, considering tablets dissolution time and interruptions on equipment operation, making its usage more difficult. Therefore, we recommend evaluation of bronopol-based preservatives and its convenience before electronic analysis.

**Key Words:** bronopol, milk preservation, electronic analysis

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**T87**  
**Proteomic analysis on whey proteins of Guanzhong goat milk.** Y. Sun*1, C. Wang1, X. Sun1, and M. Guo2,1.  
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Guanzhong goat is one of the major dairy goats in China and its milk is also a major milk supply for the Chinese dairy industry. Whey protein has a balanced nutritional value and certain biological functions. To explore the proteomics of Guanzhong goat whey, whey fraction was separated from goat mature milk, and analyzed using iTRAQ-coupled LC-MS/MS. A total of 368 whey proteins were identified and quantified in the serum fraction, of which only 7% belong to goat, whereas 57% pertain to sheep, and 36% are homologous to bovine. The identified proteins were categorized according to their biological processes, cellular components, and molecular function based on their gene ontology annotation. The main biological processes involved were response to regulation of biological functions, metabolic process, and response to stimulus. The most general cellular components was extracellular (37%), and the most common molecular functions was protein binding, representing 46%. The data could provide important information for understanding the composition and unique biological properties of goat milk.

**Key Words:** milk proteomics, whey protein, Guanzhong goat

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**T88**  
**Preservation of lactase activity in a gastric environment.**  
J. F. Flanagan*, J. Simmons, J. R. Boone, C. Elkins, and K. Clinger, David Lipscomb University, Nashville, TN.

Approximately 70% to 75% of the world’s adult population cannot fully utilize dairy due to varying degrees of lactase deficiency. With the high incidence of lactose intolerance in the population there is a need for reliable utilization of oral lactase enzyme. In a 2010 literature review, the effectiveness of prehydrolyzed milk products or lactase was questioned. Problems with study design, source of enzyme, and dosage were cited. The aim of our study was to explore the effects of pH and temperature on lactase kinetics to determine a more effective delivery method. Four antacids were investigated as modifiers of simulated stomach acid. The effects of antacid pretreatment on lactase preservation in acid (HCl) were evaluated at 4°C and 37°C using a spectrophotometric assay. This assay measured the appearance of o-nitrophenol from the hydrolysis of o-nitrophenyl-β-galactoside (ONPG) as a substrate. Using the same model, data from simultaneous addition of antacid with lactase to an acidic solution were generated. Glucose production from lactose was monitored with a handheld glucometer to determine the effectiveness of exogenous lactase under varying in vitro conditions. Three of 4 antacids were found to raise the pH of an acidic medium to within a sufficient working range (approx. 5.5–7.5) at all tested volumes. Sodium bicarbonate (NaHCO₃) was observed to neutralize acid fastest. Lactase enzyme was found to hydrolyze lactose approximately 1.6 times faster at 37°C compared with 4°C. Using an ONPG assay, NaHCO₃-containing antacids proved effective at enzyme preservation when added to acid simultaneously with lactase. When added to 100mL of 0.1M HCl, a combined lactase/NaHCO₃ preparation in whole milk (240mL) yielded glucose concentrations of 202 ± 23.5 mg/dL at 5mins and 520 ± 30.7 mg/dL at 10 min. In contrast, an antacid-free preparation yielded values less than the minimum detectable concentration of the glucose meter, 20 mg/dL. In our pursuit to find an effective lactase preparation and delivery method, we suggest a lactase-sodium bicarbonate pairing to allow for immediate lactase-lactose interaction within the stomach while still avoiding any acid-mediated enzyme degradation.

**Key Words:** lactase, antacid

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**T89**  
**Changes in structure and antioxidant activity of β-lactoglobulin by ultrasound and enzymatic treatment.** S. Ma1, C. Wang1, and M. Guo*2,1.  
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Effects of ultrasound (20–40% amplitudes at 45–55°C) and enzymatic (pepsin and trypsin) treatment on structure and antioxidant activity of β-lactoglobulin were studied. Changes in structure of β-lactoglobulin were investigated using spectroscopy techniques and changes in antioxidant activity were measured by chemical and cellular-based assays. Ultrasound treatment had considerable impact on the structure of β-lactoglobulin and increased the susceptibility of β-lactoglobulin to both pepsin and trypsin proteolysis. Intrinsic fluorescence intensity of β-lactoglobulin was increased by ultrasound and then decreased after following enzymatic treatment. Compared with control, the β-lactoglobulin after ultrasound and enzymatic treatments showed significantly higher oxygen scavenging activities in Caco-2 cells models, ABTS (2,2’-Azinobis-3-ethylbenzthiazoline-6-sulphonate) radical scavenging activity and oxygen radical absorbance capacity (P < 0.05). Results indicated that ultrasound treatment increased the proteolysis of β-lactoglobulin by both pepsin and trypsin and improved the antioxidant activity of the protein and its proteolytic products.

**Key Words:** β-lactoglobulin, ultrasound treatment, proteolysis

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**T90**  
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The consumption of dairy proteins, particularly those from whey, has been shown in interventional studies to have beneficial effects on glucose metabolism. It has been proposed that the antiadipic properties of whey protein may be attributable to its content of bioactive peptides which, upon being released during digestion, can modulate hormones, enzymes and/or organ systems involved in glycemia regulation. In particular, recent studies have suggested that milk protein-derived peptides can inhibit the activity of the dipeptidyl-peptidase IV (DPP-
T91 Physicochemical modifications of MFGM proteins during temperature processing of milk. F. Yu*, J. Ortega-Anaya, and R. Jimenez-Flores, The Ohio State University, Columbus, OH.

MFGM as a complex mixture of proteins and phospholipids, abundant in the buttermilk and can be used in pharmaceutical and functional food applications. The proteins in the MFGM have been shown to have bioactive properties that are beneficial for human health. Two of these proteins, lactadherin (PAS 6/7) and Butyrophilin (BTN), have gained attention due to their antiviral, anticoagulant, anti-inflammatory properties, as well as the ability to control milk fat globule secretion. The protein aggregation and conformational changes that induced by temperature changes are important factors to determine the protein functionality. The objective is to study the temperature effects on buttermilk and the effect on physicochemical properties of PAS 6/7 and BTN. Cream obtained from local raw milk was churned in our laboratory and different heat treatments (4°C, LTT, HTST, and 90°C for 10 s) were applied before and after churning to additionally assess the temperature effects on the proteins. This procedure was repeated by triplicate to assess variability. After each treatment, size exclusion methodologies were used to recover enriched protein extracts and dynamic light scattering analysis (DLS) was used to obtain particle size and the oligomeric state in solution. The zeta-potential was measured to determine charge changes. Fractionation of proteins by membrane filtration (100 and 30 kDa) showed the proteins suffered aggregation and interaction with whey proteins (SDS-PAGE); however, instead of associating with larger proteins under 4°C, whey proteins started to associate among themselves under HTST. To overcome this, gel filtration chromatography with Sephacryl S200 HR was used to maintain proteins native state. Before DLS and zeta-potential analysis, the isolated fraction was analyzed by native- and SDS-PAGE to identify PAS 6/7 and BTN, and assess the native oligomeric state and interaction with whey proteins. All results were analyzed by ANOVA. The results show the effect of temperature on MFGM, where maximum complexity was found in heating before churning, and indicate the need to better understand the effect of heat treatment on minor components of milk.

Key Words: milk fat globule membrane (MFGM), protein, thermal

T92 Localization of milk gangliosides in emulsion monolayers that resemble the milk fat globule membrane outer leaflet.

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Currently, the localization of sialic acid containing glycolipids in the outer leaflet of the milk fat globule membrane (MFGM) is stated to be in regions of the MFGM not occupied by microdomains, highly ordered lipid structures formed from the interactions of sphingomyelin (SM) and cholesterol (CH) compounds. This contrasts with many reports in the literature describing the presence of gangliosides in microdomains in the outer leaflet of living cell membranes. Gangliosides are bioactive sialic acid containing glycolipids found in many dairy products. The outer leaflet of the MFGM is derived from the outer leaflet of the membrane of mammary cells, so one would hypothesize that MFGM microdomains could contain gangliosides. The uncertainty behind the mechanisms behind the mismatch in current data between ganglioside localization in MFGMs and living cells creates some skepticism of the currently reported data on this topic. In this work, oil-in-water emulsions were created where the predominant lipids present in the outer leaflet of the MFGM (phosphatidylcholine [PC], SM, and CH) were used as emulsifiers, and varying amounts of the predominant gangliosides (GM3 and GD3) in milk were added to observe their location within the MFGM-like emulsification monolayer. Localization was determined using a FV3000 fluorescent confocal microscope. Localization of non-microdomain forming lipids was done with the use of various fatty acid tail labeled PC probes added to the initial emulsifier mixtures before the creation of the emulsion. The commonly used rhodamine-phosphatidylethanolamine (Rho-PE) probe was not used in this work since PE is not significant present in the outer leaflet of the MFGM. Ganglioside localization was observed with the use of a wheat germ agglutinin probe coupled to an Alexa Fluor dye. Current preliminary data suggests that ganglioside localization is dependent on the emulsifier composition, which suggests that ganglioside localization might not be universal to all MFGMs.

Key Words: gangliosides, milk fat globule membrane (MFGM), confocal microscopy

T93 The potential of milk production and consumption for improving nutrition of smallholder dairy households in Ethiopia. H. Didanna*1, A. Wossen2, T. Worako1, and B. Shano1, 1Wolaita Sodo University, Sodo, Ethiopia, 2Addis Ababa University, Addis Ababa, Ethiopia.

Evidences on potential of milk consumption in preventing malnourishment vis-à-vis market-oriented/intensifying smallholder dairy-producing areas are scant. Hence, this study explored the consumption habits of fresh bovine milk in the dairy-producing households. Data were collected from a survey of 200 dairy households and key informant interviews. The results revealed that the amount of self-consumed fresh milk per farm and day by producer families varied from 0.5 to 5 L per day. The majority consumed and traded milk at the same time. The practice of treating milk before consumption differed significantly across production systems. Eighty-four percent of the dairy producers boiled milk before consumption, and 8.5% of the respondents did not consume fresh but rather fermented/sour milk (ergo) as most of them had symptoms of lactose intolerance. Based on United States Department of Agriculture recommendations, the daily requirement is 10–15 cups if on average 5 of the family members are drinking milk. Hence, there was a lack of 1.40–2.85 L of milk, which is insufficient to satisfy the nutrition requirement from dairy foods. However, there are ample experiences of dairy farming, local availability, milk production, and culture of milk
consumption. There is scope to improve nutrition through consuming sufficient quantities of milk by the milk-producing households and balancing the staple foods (teff and wheat) in the area. Improving milk productivity will increase the levels of milk consumption, which in turn would have great potential as a cost-effective and sustainable household food production strategy for malnourished children.

Key Words: bovine milk, intensive milk production systems, small-holder dairying

T94 Acid-induced gel properties of dry-heated low-heat nonfat dry milk. K. S. Alan* and K. Schmidt, Kansas State University, Manhattan, KS.

Different foods, such as bread incorporate high heat nonfat dry milk (HH) to their formulation to improve their texture and mouthfeel. Exposing low heat nonfat dry milk (LH) to a radio frequency dielectric heat (RF DH) treatment can enhance the acid-gelling properties of dairy proteins to a point where they can provide or exceed the gelling properties of HH. The aim of this study was to apply a RF DH treatment to LH to improve its gelling properties while maintaining solubility and color. A RF DH unit was used to heat LH to 85°C and held for 3 or 6 h (85/3, 85/6). HH, which was not RF DH-treated was the control and used to compare the gelling properties against the RF DH-treated samples. As powders, samples were evaluated for solubility (NSI), soluble aggregate formation, and color. As GDL acidified gels, evaluations included water holding capacity (WHC), syneresis, firmness, and cohesiveness. Three replicates were conducted and evaluated using one-way ANOVA. Significant means of the RF DH-treated LH were compared against HH using the Dunnett’s method. All tests were determined at a P ≤ 0.05. Results showed that the gels made from 85/3 and 85/6 maintained good solubility, ~4% and 2.6% greater than the HH, respectively. However, the RF DH treatment increased the yellowness by 6.5% and 13.4%, respectively. Based on the ΔE values, this color change was not visible for consumers. The 85/3 and 85/6 gels were ~20% and 30% more firm and ~7% and 8% more cohesiveness, respectively compared with the HH gel. However, the WHC was significantly lower (~15% and 13%) and the syneresis was significantly higher (~90% and 163%), respectively when compared with the HH gel. The formation of soluble aggregates during the dry heat treatment may contribute to the improved gel firmness and cohesiveness observed in the present study. These results suggest that RF DH treating LH at 85°C for 3 h can alter proteins to have similar firmness and cohesiveness as the HH gels without drastically affecting their solubility and color. The LH that was RF DH-treated at 85°C for 6 h exhibited improved firmness and cohesiveness of the acid-induced gels, but it had lower quality parameters such as increased syneresis while exhibiting more yellowness vs. the 85/3 sample.

Key Words: radiofrequency dielectric heating, acid-induced gels, low-heat nonfat dry milk

T95 Power ultrasound as a tool to modify texture properties of protein enriched acid milk gels. A. O. Körzendörfer*, J. Hinrichs, and S. Nöbel, University of Hohenheim, Institute of Food Science and Biotechnology, Stuttgart, BW, Germany.

There is still a rising demand for fermented milks like Greek yogurt and skyr. Nutrition-conscious consumers appreciate the high protein content up to 10%, whereas products commonly contain no fat. The consistency is creamy and thick without the need for stabilizers. Typically, the milk is acidified in tanks forming a gel that is finally broken up by stirring and concentrated by separation. This process generates large amounts of acid whey that is undesired due to environmental concerns. A novel approach to avoid acid whey is to concentrate the milk before fermentation, however, resultant gels are firm so that stirring in the vat and further processing is difficult. It is also challenging to produce a smooth texture. We hypothesize that power ultrasound during fermentation is a tool to soften the gel as sound waves cause cavitation and strong shear forces in the fluid. Skim milk was concentrated to a protein content of 10% by reverse osmosis and heated to 95°C for 5 min. Milk was fermented in jars (140 g) at 44°C until pH 4.6. During acidification, samples were treated with a sonotrode (20 kHz, 200 W). The sonication was performed at different pH (5.5–5.1) for 100 s in pulsation to prevent temperature rise. Immediately after fermentation, gels were stirred using a rheometer with a vane geometry. The maximum torque required to break the set gel was recorded. Gel firmness was measured by penetration tests. Afterward, gels were processed into stirred products and analyzed (water-holding capacity, rheology, particle size). Short-term sonication at pH 5.2 reduced the maximum torque required to break the gel and the firmness by 21% (P < 0.001) and 26% (P < 0.001), respectively. Treatments at higher pH values did not result in a softening of the gel. Samples sonicated at pH ≤ 5.2 exhibited a reduced water-holding capacity. Furthermore, the Sauter mean diameter was decreased from 40.8 ± 2.0 µm (control) to 30.1 ± 1.8 µm due to sonication at pH 5.2, and the maximum shear stress was lowered by 14%. We conclude that power ultrasound affects the network structure by softening the gel and offers the potential to improve Greek yogurt production.

Key Words: strained yogurt, Greek yogurt, gelation


This work aimed to evaluate physical chemical and sensory properties of yogurt enriched with tamarind pulp. Tamarind is a tropical fruit very appreciated in Brazil but its use is underestimate. Three formulations of yogurt with tamarind pulp (2, 4, and 6%) were prepared and analyzed (water-holding capacity, rheology, particle size). The sensory evaluation used a 9-point structured hedonic scale with 50 non-trained tasters. The results were analyzed by ANOVA and the Tukey test at 5% of significance to verify the interactions between the averages. For pH, humidity and ash, there were no statistical differences with averages of 76.53% ± 3.41 and 0.47 ± 0.05%, respectively. For sensory evaluation, there were no significant differences between analyzed parameters. The lowest score was to sample 2% (7.71) and the highest was to sample 6% (8.89), but all formulations got notes higher than 7.0 indicating the acceptance of this treatments. The higher score (8.72 ± 0.38) was obtained by 6%, followed by 4% with 8.64 ± 0.52 and 2% of tamarind pulp with 8.45 ± 0.36. All formulations attending to Brazilian legislation and were accepted by tasters showing that this product could be commercialized in the Brazilian market.

Key Words: dairy product, quality control, food composition
T98  Pectin and whey protein concentrate reduces acid whey generation in Greek style yogurt.  R. Gyawali*, T. Zimmerman, and S. A. Ibrahim, North Carolina A&T State University, Greensboro, NC.

The production of Greek and Greek style yogurt (GSY) generates large amounts of an environmentally harmful waste product known as acid whey. Because disposal of this waste product is an expensive process, the Greek yogurt industry is searching for a solution to decrease the production of acid whey. The purpose of this study was thus to investigate the effects of pectin and whey protein concentrate (WPC) on the generation of acid whey during GSY production. Acid whey production was measured by calculating the water holding capacity (WHC). First, pectin (0.05%) and WPC (1%) were added to skim milk for the production of GSY. The yogurt mixes were then heated at 90°C for 10 min, inoculated with 3.0% of starter culture, incubated at 40°C for 4 h (pH ∼4.6), and then refrigerated overnight at 5°C. A control yogurt sample was prepared without the addition of these ingredients. The yogurt made with pectin and WPC had a significantly higher WHC (P < 0.05) and lower syneresis than the control. The WHC of yogurt with both pectin and WPC was ~56%, which was 23% higher than the control (33%). Similarly, yogurt supplemented with both pectin and WPC exhibited 15% less susceptibility to syneresis compared with the control. Native PAGE analysis revealed an interaction between pectin and the WPC. Pectin hinders the formation of large oligomeric aggregates of whey protein, which correlates with an increase in WHC and a decrease in syneresis. Our results demonstrated that ingredients such as pectin and WPC could be used as additives to lower the generation of acid whey in the production of Greek style yogurt.

Key Words: acid whey, Greek yogurt, pectin


Greek style yogurt (GSY) has become popular in the United States and now accounts for more than one-third of total yogurt sales. The popularity of GSY has resulted in a concomitant increase in the production of an unwanted byproduct known as acid whey that cannot be readily utilized nor disposed of easily. Hydrocolloids help bind the water and are promising additives that could be useful in reducing the quantity of acid whey in the production of GSY. In this study, we investigated the effect of hydrocolloids on acid whey production of GSY. Nonfat yogurt samples were manufactured using hydrocolloids (gums and proteins). Gum arabic (GA), Inulin (IN), and Pectin (PE) at 0.01, and 0.05% (wt/vol), whey protein concentrate (WPC), whey protein isolate (WPI) at 0.5 and 1.0% (wt/vol) were mixed slowly into milk at 50°C with agitation. Milk without supplementation served as a control sample. The yogurt mixes were heated at 90°C for 10 min, inoculated with 3.0% starter culture, incubated at 40°C for 4 h (pH 4.6) and, then refrigerated overnight at 4°C. The next day, each sample was centrifuged (1300 g, 10 min) and acid whey production was measured by calculating the water holding capacity (WHC). An ANOVA of the data was performed using a completely randomized design and the Tukey test was used to determine statistically different groups. Our results showed that yogurt prepared with gum pectin and whey proteins significantly reduced acid whey production compared with the control sample (P < 0.001). The highest WHC was 39.71 ± 0.51, 50.23 ± 0.23, and 48.86 ± 0.24% in yogurt with pectin 0.05%, WPC 1.0%, and WPI 1.0%, respectively compared with the control (34.95 ± 0.97%). Our results demonstrate that hydrocolloids such as pectin and whey protein can reduce acid whey and could have industrial applications for the production of GSY.

Key Words: hydrocolloid, acid whey, Greek style yogurt

T100  Comparison of natural sweeteners in low carbohydrate whey protein bars.  H. M. Keefer* and M. A. Drake, North Carolina State University, Raleigh, NC.

Protein bar consumption by Americans has increased in recent years as there is an interest for natural non-nutritive sweeteners. Each sweetener has unique temporal properties that can influence sensory properties. The objective of this study was to characterize the temporal sensory properties of low carbohydrate whey protein bars with different sweeteners using 3 temporal methods: Time Intensity (TI), Temporal Dominance of Sensations (TDS), and Temporal Check-All-That-Apply (TCATA). A category survey of commercial protein bars (n = 12) was conducted to identify a target sweet taste intensity. Subsequently, protein bars were formulated with whey protein isolate (WPI), fiber syrup, shortening, and each sweetener. Iso-sweet concentrations for each sweetener (sucralose, sucrose, fructose, stevia, monk fruit) in WPI bars were established using magnitude estimation scaling (n = 8 panelists, 3 replications) followed by confirmation by alternative forced choice tests (n = 40). Sweetener blends were subsequently created with reduced bitter and metallic tastes. Temporal sensory profiling (TI, TDS and TCATA) was conducted on protein bars with each sweetener and sweetener blend by a trained panel (n = 8). Consumer acceptance testing was conducted on selected sweeteners in bars. Data were analyzed by appropriate univariate analyses. Protein bars sweetened with fructose or sucrose were characterized by initial intense sweetness that quickly faded. Sucralose displayed a sweet taste profile that was most similar to fructose or sucrose, but differed by metallic taste and lingering sweetness after expectoration. Monk fruit and stevia were slower in sweet taste onset (P < 0.05) and were characterized by bitter and metallic aftertastes and lingering sweetness. These sweeteners were characterized by initial sweet taste, then by bitter and metallic tastes by TDS and TCATA. Sucrose and a blend of monk fruit with fructose were the most similar to sucrose sweetened bars (P > 0.05), and these bars were preferred by consumers (P < 0.05). Knowledge of the temporal properties of non-nutritive sweeteners and the effects of the food matrix on sweeteners are important to understand how sugar reduction and/or sweetener replacement will affect the sensory properties of protein bars.

Key Words: protein bar, sweetener, flavor

T101  Contamination and spatial distribution of Pb, As, and Cd contents in Chinese cow raw milk.  X. Zhou1,2, X. Qu1, N. Zheng1, C. Su1, J. Wang*, and H. Soyeurt1, 1Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, 2Statistics, Informatics and Applied Modeling lab, Agrobiochem Department, Gembloux Agro-Bio Tech, University of Liège, Liège, Belgium.

Due to environmental pollution, heavy metals such as Pb, As, and Cd may contaminate raw milk and can involve serious systemic health problems if they are consumed in excessive concentrations. This study investigated the spatial distribution of Pb, As, and Cd in raw milk produced in the 10 main milk producing areas in China. The contents of Pb, As, and Cd in 996 raw milk samples [i.e., 100 milk samples per area except for 2 area (n = 97, n = 99)] were measured by ICP-MS after
microwave-assisted acid digestion. Non-parametric Kruskal-Wallis test were performed to study the differences of Pb, As, and Cd between areas. Spearman correlations were calculated to assess the relationships between the studied heavy metals. Then, the spatial distribution of Pb, As, Cd was studied by ordinary kriging estimates within the studied areas. Cross-validation was used to assess the robustness of the distribution map. Mean values of Pb, As, and Cd were 1.75, 0.31 and 0.06 μg/L of milk, respectively. Levels of Pb in 1.20% (12,996) of collected samples were above the maximum residue limit (MRL) imposed by the European Union (0.02 mg/kg). All samples were below the Chinese MRL (i.e., 0.05 mg/kg for Pb, 0.1 mg/kg for As). High coefficient of variation were obtained within area suggesting a large variability of those metal contents in milk within regions. This shows the need to conduct a reflection about the best way to collect samples if this kind of pollution in milk want to be studied on a long period. Pb-Cd, As-Cd, Pb-As showed positive significant correlations in 9, 6, and 5 areas, respectively. Correlation values ranged between 0.20 and 0.60. However, these correlations changed between areas suggesting different pollution origins. Based on the ordinary kriging estimates, Pb, As, and Cd showed different spatial patterns following the studied area. Based on the cross-validation, the root mean square error was not closed to the average standard error in some areas. This leads potentially to wrong predictions. The high density of sample collection may lead to this result. Further studies could implement a more appropriate sample collection to clarify the relationships between the contamination of raw milk by heavy metals and the herd environment.

**Key Words:** heavy metals, milk, spatial distribution

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**T102** Aptamer-based fluorescence-quenching assay for detection of aflatoxin M₁ in milk samples. Q. Qiao¹,², F. Wen¹,³, L. Chen¹,³, J. Cheng², H. Zhang¹,³, S. Li¹,³, N. Zheng¹,³, and J. Wang*¹,³, ¹State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²Agricultural University, Hefei, China, ³Milk and Milk Product Inspection Center of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.

Aflatoxin M₁ (AFM₁), one of the most toxic of the mycotoxins, is a global concern for feed and food contamination. A simple and fast aptasensor for the detection of AFM₁ was developed based on structure-switching signaling aptamer. The principle of the aptasensor is based on fluorescent signal change because of the formation of an AFM₁/aptamer complex. To construct the aptasensor, AFM₁ aptamers were modified with FAM and its complementary DNA (cDNA) was modified by TAMRA quenching group. Without adding AFM₁, AFM₁ aptamers hybridized with cDNA, resulting in quenching of the aptamer fluorescence due to the proximity of the fluorescent group of aptamer to the quenching group of cDNA. After adding AFM₁, the structure switch of AFM₁ aptamer was induced according to the formation of AFM₁/uptamer complex. The changes in the structure of the aptamer released the cDNA, resulting in fluorescence recovery of the aptamer, which enabled the quantitative detection of AFM₁ by monitoring the fluorescence enhancement. Under optimized conditions, this assay exhibited a linear response to AFM₁ in the range of 5–100 ng/mL with a detection limit down to 1.7 ng/mL. The assay was also applied to 2 brand infant formula rice flour samples spiked with a dilution series of AFM₁, obtaining satisfactory recoveries from 96.4 to 103.6% and 95–102.8%, respectively. The results demonstrated that this detection technique had a significant potential for high-throughput, and quantitative determination of mycotoxin levels in dairy products.

**Key Words:** aflatoxin M₁, aptasensor, fluorescent

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**T103** Modulation of intestinal epithelial permeability in differentiated Caco-2 cells exposed to aflatoxin M₁ and ochratoxin A individually or collectively. Y. N. Gao¹,², J. Q. Wang*¹,², C. C. Luo¹,², and N. Zheng¹,², ¹State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²Milk Product Risk Assessment Laboratory of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.

Although aflatoxin M₁ (AFM₁) is the only mycotoxin with an established maximum residue limit (MRL) in milk worldwide, it’s common to find the co-occurrence of AFM₁ and ochratoxin A (OTA) in milk. The gastrointestinal tract (GIT) is the first barrier to come into contact with food contaminants, such as mycotoxins, and intestinal epithelial cells are most affected. The GIT barrier is constituted by intercellular tight junction (TJ) proteins that localize to the apical domain of epithelial cells. Aflatoxin M₁ (AFM₁) and ochratoxin A (OTA) are mycotoxins commonly found in milk; however, their effects on intestinal epithelial cells have not been reported. In the present study, we show that AFM₁ (0.12 and 12 μM) and OTA (0.2 and 20 μM) individually or collectively increased the paracellular flux of lucifer yellow and fluorescein isothiocyanate (FITC)-dextran (4 and 40 KDa) and decreased transepithelial electrical resistance values in differentiated Caco-2 cells after 48 h of exposure, indicating increased epithelial permeability. Immunoblotting and immunofluorescence analysis revealed that AFM₁, OTA, and their combination decreased the expression levels of tight junction (TJ) proteins and disrupted their structures, namely, claudin-3, claudin-4, occludin, and zona occludens-1 (ZO-1), and p44/42 mitogen-activated protein kinase (MAPK) partially involved in the mycotoxins-induced disruption of intestinal barrier. The effects of a combination of AFM₁ and OTA on intestinal barrier function were more significant (P < 0.05) than those of AFM₁ and OTA alone, yielding additive or synergistic effects. The additive or synergistic effects of AFM₁ and OTA on intestinal barrier function might affect human health, especially in children, and toxic risks should be considered.

**Key Words:** mycotoxins, intestinal epithelial cells, permeability

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**T104** Quantitative PCR coupled with sodium dodecyl sulfate and propidium monoazide for detection of viable Staphylococcus aureus in milk. L. Dong¹,², H. Liu¹,², L. Meng¹,², N. Zheng¹,², and J. Q. Wang*¹,², ¹Key Laboratory of Quality & Safety Control for Dairy Products of Ministry of Agriculture, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²Milk Product Risk Assessment Laboratory of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.

*Staphylococcus aureus* has been frequently reported as an agent leading to outbreaks of disease in raw milk. The conventional quantitative PCR (qPCR) are unable to differentiate DNA of viable *Staph. aureus* from dead ones. The aim of this study was to use sodium dodecyl sulfate (SDS) and propidium monoazide (PMA) coupled with lysostaphin to detect viable *Staph. aureus*. The cell suspensions were treated with SDS.
and PMA before DNA extraction, because SDS could enhance DNA intercalating ability to dead cells of PMA. The lysostaphin was applied to improve the effectiveness of DNA extraction. The reliability and specificity of this method were further determined by the detection of Staph. aureus in spiked milk. The results showed that there were significant differences between the SDS-PMA-qPCR and qPCR when a final concentration of 200μg/mL of lysostaphin was added in DNA extraction (P < 0.001). A standard curve with a good linear relationship (R² = 0.9983, amplification efficiency = 96%) was obtained when lysostaphin was applied at a final concentration of 200 μg/mL. The viable Staph. aureus could be effectively detected when SDS and PMA concentrations were 100 ppm and 40 μM, respectively. Compared with conventional qPCR, the SDS–PMA–qPCR assay coupled with lysostaphin was more specific and sensitive. Therefore, this method could detect the number of viable Staph. aureus accurately.

**Key Words:** propidium monoazide, sodium dodecyl sulfate, Staphylococcus aureus

**T105 Occurrence of tetracyclines, quinolones, lincomycin and streptomycin in milk in China’s market.** B. Du¹,², F. Wen¹, Y. Zhang¹, N. Zheng¹, S. Li³, F. Li³, and J. Wang*¹, ¹Key Laboratory of Quality & Safety Control for Dairy Products of Ministry of Agriculture, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²College of Pastoral Agriculture Science and Technology, Lanzhou University, Lanzhou, China.

Veterinary drugs are generally used to prevent and treat diseases in dairy farming. However, abuse or improper use may lead to veterinary drugs residues remaining in milk, which may cause serious side effects on consumers, such as allergic reactions, drug resistance, and toxicity. Therefore, maximum residue limits (MRL) for veterinary drugs have been set by many authorities in the world, including China to guarantee the safety. Rapid screening methods for multiple residues have been widely used in routine test to find the positive ones for further confirmation. In this study, we examined 148 samples of ultra-high temperature (UHT) milk and 50 samples of pasteurized milk collected from the market in China in 2016, using ELISA-based visualization microarray chip technique to assess contamination with tetracyclines, quinolones, lincomycin, and streptomycin. Results showed that the detection rates of tetracyclines, quinolones, lincomycin, and streptomycin in UHT milk samples were 4.7, 3.3, 2.7, and 15.5%, respectively, and in pasteurized milk samples were 16.0, 4.0, 2.0, and 14.0%, respectively. The maximum concentrations of the tetracyclines, quinolones, lincomycin, and streptomycin in all liquid milk samples were 9.06, 4.06, 7.66, and 8.92 μg kg⁻¹, respectively, which is lower than MRLs set by China, the European Union (EU) and the Codex Alimentarius Commission (CAC).

**Key Words:** milk, veterinary drugs, detection

**T106 Development of a rapid detection method of lactoperoxidase in milk.** W. Du¹,², Y. Zhang¹,², N. Zheng¹,², F. Li³, and J. Wang*¹, ¹State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²Key Laboratory of Quality & Safety Control for Dairy Products of Ministry of Agriculture, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ³Milk Product Risk Assessment Laboratory of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.

Lactoperoxidase (LPO) is one of the most heat resistant enzymes in milk, and is used as an indicator of heat load of dairy products, especially for overpasteurization of milk. The aim of this study was to develop a rapid detection method of LPO activity of overpasteurization milk, which could be used to qualitatively determine the degree of heat load of milk in practice. Based on the principle of enzymatic reaction, LPO activity was determined by color change using potassium iodide and p-phenylenediamine assay. LPO could oxidize iodide ions to iodine when hydrogen peroxide existed in milk, the LPO activity could be assayed according to the color reaction between iodide and starch. Similarly, p-phenylenediamine could also be oxidized in this way. Samples for the tests were raw and different heat treated milk of 72.5°C, 75°C, 80°C, 85°C, 90°C, 95°C, 100°C, 105°C, 110°C, 115°C, and 120°C for 15 S. Three kinds of reagent solutions (starch soluble, potassium iodide, and hydrogen peroxide) were mixed together by shaking. P-phenylenediamine solution and hydrogen peroxide would be mixed in another assay to determine the LPO activity. The results showed that there were noticeable color changes from blue to light blue for raw and heat treated milk from 72.5°C to 80°C, and the color of heat treated milk above 80°C did not change. It was inferred that LPO lost its enzyme activity in the heat-treated milk above 80°C for 15 S. This study contributed new information to developing a LPO activity assay kit for overpasteurization milk test in practice.

**Key Words:** milk, lactoperoxidase, enzyme activity

**T107 Identification and proteolytic activity quantification of Pseudomonas spp. isolated from different raw milks at storage temperatures.** L. Meng¹,², H. Liu¹,², L. Dong¹,², N. Zheng¹,², and J. Wang*¹,², ¹Key Laboratory of Quality & Safety Control for Dairy Products of Ministry of Agriculture, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China, ²Milk Product Risk Assessment Laboratory of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.

The largest proportion of commercial milk products is derived from cows worldwide. Milks from other ruminants are also important culturally and economically. Pseudomonas is frequently linked to milk spoilage under different storage temperatures. Therefore, the aim was to measure proteolytic activity of Pseudomonas spp. isolated from different raw milks under low storage temperatures. Raw milk samples of cows (n = 87), goats (n = 50), buffalos (n = 25), camels (n = 25), and yaks (n = 25) were collected from 5 provinces in China. Pseudomonas was identified by universal 16S rRNA and rpoB gene sequence analyses. Proteolytic activity on milk agar, and quantification via the trinitrobenzensulfonic acid (TNBS) assay at 2°C, 4°C, 7°C, and 10°C were performed to ascertain proteolytic activity of Pseudomonas isolates. The TNBS can react with the released α-amino groups, indicators of protein hydrolysis, with the intensity of the yellow-orange color of reaction products. A total of 143 isolates from cow milk samples, 31 isolates from goat milks, 8 isolates from buffalo milks, 9 isolates from camel milks, and 19 isolates from yak milks were confirmed as Pseudomonas spp. Of Pseudomonas...
isolates, we obtained extracellular peptidase activity from 47 (22.4%) strains at 2°C, 91 (43.3%) at 4°C, 128 (61.0%) at 7°C, and 141 (67.1%) at 10°C. However, proteolytic activity of 79 (37.6%) isolates exceeded 2 μmol of glycine equivalents per mL at 10°C, followed by 61 (29.0%) at 7°C, 28 (13.3%) at 4°C, and 9 (4.3%) at 2°C. The results revealed that a large diversity of *Pseudomonas* spp. were present in different raw milks with the ability to produce peptidases at storage temperatures. Most isolates from cow and yak milks had high proteolytic activity.

In conclusion, our findings highlighted the importance of *Pseudomonas* species as broadly adaptable spoilage organisms in different types of raw milk. Low temperature and short period storage before processing (within 48 h) could reduce peptidase production of *Pseudomonas* spp., but milking hygiene should also be properly controlled.

**Key Words:** raw milk, *Pseudomonas* spp., proteolytic activity