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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 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

T99 Effect of hydrocolloids on the water-holding capacity of Greek style yogurt. S. A. Ibrahim*, R. Gyawali, and T. Zimmerman, *North Carolina A&T State University, Greensboro, NC.*

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 has 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 dominant sweet taste, then by bitter and metallic tastes by TDS and TCATA. Sucralose 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. Zhou[1,2], X. Qu[1], N. Zheng[1], C. Su[1], J. Wang*[1], and H. Soyeurt[1], [1]*Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China,* [2]*Statistics, 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

T102 Aptamer-based fluorescence-quenching assay for detection of aflatoxin M_1 in milk samples. Q. Qiao[1,2], F. Wen[1,3], L. Chen[1,3], J. Cheng[2], H. Zhang[1,3], S. Li[1,3], N. Zheng[1,3], and J. Wang*[1,3], [1]*State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China,* [2]*Agricultural University, Hefei, China,* [3]*Milk and Milk Product Inspection Center of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.*

Aflatoxin M_1 (AFM_1), 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 AFM_1 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 AFM_1/aptamer complex. To construct the aptasensor, AFM_1 aptamers were modified with FAM and its complementary DNA (cDNA) was modified by TAMRA quenching group. Without adding AFM_1, AFM_1 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 AFM_1, the structure switch of AFM_1 aptamer was induced according to the formation of AFM_1/aptamer 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 AFM_1 by monitoring the fluorescence enhancement. Under optimized conditions, this assay exhibited a linear response to AFM_1 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 AFM_1, 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 M_1, aptasensor, fluorescent

T103 Modulation of intestinal epithelial permeability in differentiated Caco-2 cells exposed to aflatoxin M_1 and ochratoxin A individually or collectively. Y. N. Gao[1,2], J. Q. Wang*[1,2], C. C. Luo[1,2], and N. Zheng[1,2], [1]*State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China,* [2]*Milk Product Risk Assessment Laboratory of China Ministry of Agriculture (Beijing), Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China.*

Although aflatoxin M_1 (AFM_1) is the only mycotoxin with an established maximum residue limit (MRL) in milk worldwide, it's common to find the co-occurrence of AFM_1 and ochratoxin A (OTA) in milk. The gastrointestinal tract (GIT) is the first tissue 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 M_1 (AFM_1) 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 AFM_1 (0.12 and 12 μ*M*) and OTA (0.2 and 20 μ*M*) individually or collectively increased the paracellular flux of lucifer yellow and fluorescein isothiocyanate (FITC)-dextrans (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 immunofluorescent analysis revealed that AFM_1, OTA, and their combination decreased the expression levels of tight junction (TJ) proteins and disrupted their structures, namely, claudin-3, claudin-4, occludin, and zonula 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 AFM_1 and OTA on intestinal barrier function were more significant ($P < 0.05$) than those of AFM_1 and OTA alone, yielding additive or synergistic effects. The additive or synergistic effects of AFM_1 and OTA on intestinal barrier function might affect human health, especially in children, and toxin risks should be considered.

Key Words: mycotoxins, intestinal epithelial cells, permeability

T104 Quantitative PCR coupled with sodium dodecyl sulfate and propidium monoazide for detection of viable *Staphylococcus aureus* in milk. L. Dong[1,2], H. Liu[1,2], L. Meng[1,2], N. Zheng[1,2], and J. Q. Wang*[1,2], [1]*Key Laboratory of Quality & Safety Control for Dairy Products of Ministry of Agriculture, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China,* [2]*Milk 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