294 Mid-infrared analysis of Cheddar cheese. B. Margolies* and D. Barbano, Cornell University, Ithaca, NY.

Our objective was to develop a rapid method for measuring fat, protein, solids, and salt content of Cheddar cheese using a mid-infrared (MIR) transmittance analysis. Currently, quality assurance is done using near-infrared (NIR). For MIR analysis, Cheddar cheese (about 9 g) was blended with a sodium metasilicate solution (about 85 g). Cheese was blended to a uniform particle size (about 3 to 4 mm). The blended cheese (4°C) was added to a sodium metasilicate solution at 60 to 65°C in a stainless steel blender jar. 3 drops of a silicone based antifoam were added, and the mixture was blended for 15 s at low speed followed by 45 s at high speed. The blended sample was poured into a 60-mL snap-lid plastic vial and placed in a 40°C water bath before analysis using a MIR milk analyzer. An infrared spectra and conductivity reading were collected for each sample. Measurement of fat and protein were done using traditional wavelengths used for milk analysis. Salt measurement was a combination of infrared traditional wavelengths and conductivity. Total solids was determined by a summation of fat, protein, and salt. Reference values for cheese solids were determined directly by forced air oven drying and salt was determined by a silver nitrate titration (Volhard method). The same solution of cheese/sodium metasilicate analyzed on the MIR was analyzed using Mojonner ether extraction and Kjeldahl total nitrogen to obtain reference values for fat and protein content. Calibration slope and intercept adjustment for each component were done using linear regression. Standard error of predictions (SEP) for fat, protein, solids, and salt were generally less than 0.20. Typical SEP values for NIR for cheese fat, moisture, and protein are >0.3. MIR analysis of cheese may offer a more accurate alternative to NIR testing for routine quality control testing in a cheese factory, while reducing the amount of reference chemistry testing required to achieve a good calibration relative to that of NIR.

Key Words: mid-infrared, near-infrared, Cheddar cheese

295 Cholesterol, fatty acid profile, and mineral content of commercial cheeses predicted by near-infrared transmittance spectroscopy. CL. Manuelian*, S. S. Curró, M. Penasa, and M. De Marchi, University of Padova, Legnaro, Padova, Italy.

Cheese supplies bioactive peptides, fatty acids (FA), minerals, and vitamins essential for human health. Common laboratory analyses of these components are expensive and time consuming. Near-infrared spectroscopy is a rapid, objective, non-destructive, and cheap method to determine several composition traits. However, heterogeneity of cheese, and low concentration of FA and minerals make their prediction difficult. This study aimed to develop prediction models for cholesterol, FA profile, and mineral content of commercial European cheeses using near infrared transmittance (NIT) spectroscopy. A total of 145 ground cheese samples from different dairy species and ripening time (fresh to 24 mo) were scanned with a NIT spectrophotometer every 2 nm from 850 to 1,050 nm wavelength. Sample spectra were matched with absolute content of cholesterol, FA, and mineral reference data to develop prediction models. Modified partial least squares regressions were validated through external validation after dividing the data in calibration (75%) and external validation (25%) sets. Cheese moisture, fat, protein, total solids, and cholesterol averaged 43.24 ± 0.97%, 27.24 ± 0.47%, 24.87 ± 0.54%, 56.76 ± 0.97%, and 0.07 ± 0.001%, respectively. Cholesterol content was inadequately predicted, exhibiting a coefficient of determination of external validation (R²ExV) of 0.50 and a residual prediction deviation of external validation (RPDExV) of 1.36. Satisfactory models were developed for saturated, unsaturated, monounsaturated, and polyunsaturated FA, and myristic, palmitic, oleic, and some minor FA (R²ExV from 0.87 to 0.97, RPDExV from 2.74 to 4.73). Promising predictions were obtained for Ca, Na, P, S, Mg, Zn, and Cu (R²ExV from −0.94 to 0.83; RPDExV from −3.73 to 2.35). Results of the present study are a prelude to the at-line utilization of prediction models for the most abundant cheese FA and minerals.

Key Words: milk, principal component analysis, lipids

296 Is fatty acid composition of retail cheeses influenced by the scale of production? E. Vargas-Bello-Pérez*, C. Geldsetzer-Mendoza2, M. S. Morales2, P. Toro-Mujica1, M. A. Fellenberg1, R. A. Ibáñez1, and P. Gómez-Cortés3, 1Departamento de Ciencias Animales, Facultad de Agronomía e Ingeniería Forestal, Pontificia Universidad Católica de Chile, Santiago, Chile, 2Departamento de Fomento de la Producción Animal, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile, 3Instituto de Investigación en Ciencias de la Alimentación, Universidad Autónoma de Madrid, Nicolás Cabrera 9, Madrid, Spain.

The objective of the present study was to assess if the scale of production of dairy plants has an effect on the fatty acid (FA) composition of retail cheeses. Cheese samples (n = 60) were obtained from local retail stores during summer season (Santiago, Chile). Retail samples consisted of Gouda (n = 18), Chanco (n = 11) and Mantecoso (n = 31) cheeses. Cheeses were manufactured from 8 different district regions from Chile: Coquimbo, Valparaíso, O’Higgins, Bio-Bio, Araucanía, Los Lagos, Los Ríos and Metropolitana. Samples were classified based on the scale of dairy plant production: small-scale (<3500 L milk/d; n = 18) and large-scale (>3500 L milk/d; n = 42). Samples were analyzed for FA composition by gas chromatography-flame ionization detector (GC-FID) and consequent principal component analysis (PCA). In average, cheeses (g/100g total FAME) resulted in 73% of saturated FA, 23% of monounsaturated FA, and 3% of polyunsaturated FA. PCA of the FA data yielded 2 significant principal components (PC), which accounted for 74% of the total variance in the data set. PC1 was related to saturated FA (C8:0, C10:0, C15:0, C16:0 and C17:0) and monounsaturated FA (C14:1). Mantecoso cheese samples were clearly discriminated from the rest along PC1. In contrast, PC2 differentiated Chanco and Gouda cheeses by polyunsaturated FA (C20:2 and C22:6n3). Moreover, Mantecoso cheeses obtained from large-scale production plants were related to increased levels of saturated FA, whereas those from Chanco and Gouda cheeses from small-scale dairy plants were associated with increased contents of monounsaturated and polyunsaturated FA. Our data partly showed that the FA composition of retail cheeses is influenced by the scale of production; however, further research considering FA composition of cheese milk as well as on-farm management practices will be required to further understand the origin of the observed differences in this study. This study was sponsored by a research grant from Pontificia Universidad Católica de Chile (Proyecto Puente P1608).

Key Words: buffalo, cow, trace mineral

297 Impact of green tea polyphenols on functionality and sensory acceptability of buffalo milk Cheddar cheese. M. A. Muritza*, I. Hafiz*, and M. Anees-ur-Rehman1, 1Institute of Food
Green tea is a rich source of polyphenols, predominantly flavonoids having antioxidant properties. The objective of the study was to assess the impact of green tea extract addition on composition, functionality and sensory acceptability of buffalo milk Cheddar cheese. The cheddar cheese was manufactured from buffalo milk standardized at 4% fat content. The tea extract was added as 0.1, 0.2 and 0.3% in milk. The cheese samples along with a control were prepared in triplicates and ripened at 6–8°C for 4 mo. The cheese was analyzed for basic composition, phenolic content, texture profile, color and sensory perception during storage. The addition of extract did not influence the protein, fat and minerals content. The moisture in cheese was reduced significantly with the increase in extract concentration. The mean phenol retention coefficient was found 0.70 and non-significant increase was found with respect to extract concentration. The extract addition also affected the cheese color with slight decrease in lightness (L* value) and increase in redness (a* value) and yellowness (b* value). Regarding texture profile, cheese hardness increased while springiness and cohesiveness decreased significantly with the increased concentration of extract. On sensory evaluation (9-point hedonic scale), as the concentration of extract increased, the scores awarded for flavor, color and texture of cheese decreased but product was greatly acceptable (scores >6) up to the extract level of 0.2%. The influence on color and flavor was due to the color and flavor of the extract however, the alteration in texture shows the interaction of extract with casein matrix and its retention in final product. Hence, it was concluded that green tea extract increases the antiradical activity of cheese and extract up to 0.2% of milk can adequately be carried through Cheddar cheese to get its nutritional and health impacts.

Key Words: buffalo milk, Cheddar cheese, green tea polyphenols

299 Effects of different commercial proteolytic enzymes used in the production of enzyme-modified cheese on the cheese ripening parameters. G. Govec¹, P. Salum², D. Bas³, P. Kendirci³, and Z. Erbay*⁵, ¹Department of Food Engineering, Institute of Natural and Applied Sciences, Adana Science and Technology University, Adana, Turkey, ²Department of Food Engineering, Institute of Natural and Applied Sciences, Cukurova University, Adana, Turkey, ³Department of Food Engineering, Faculty of Engineering, Cankiri Karatekin University, Cankiri, Turkey, ⁴Department of Gastronomy and Culinary Arts, Faculty of Tourism, Katip Çelebi University, Izmir, Turkey, ⁵Department of Food Engineering, Faculty of Engineering and Natural Sciences, Adana Science and Technology University, Adana, Turkey.

Cheese is the most remarkable dairy product due its variability, high market coverage and flavor. An important ratio of worldwide cheese production is used as an ingredient for the production of other foods. The main reason for using the cheese as ingredient is its flavor. Unique flavor of cheese is developed during the ripening period. The ripening is a high-cost process and standardization of the product is not easy. It is possible to develop and intensify cheese flavor in a short time period under controlled conditions by the aid of enzymatic reactions. The product obtained with this method is called enzyme modified cheese (EMC). In the production of EMC, proteolytic and lipolytic enzymes are used. However, the enzyme type and incubation time differ according to the targeted cheese flavor and these parameters should be determined with experimental studies. In this study, the effects of proteolytic enzymes on the cheese ripening parameters were determined. Fresh white cheese was used as raw material and 5 different commercial enzymes including endopeptidases (Neutrase and Promod 215MDP) and exopeptidases (Flavorzyme, Flavorpro 937MDP and Flavorpro Umami 852MDP) were tested at 4 different incubation times (12, 24, 36 and 48 h). The soluble nitrogen fractions (nitrogen solubile in water, trichloroacetic acid, phosphotungstic acid and total free amino acid contents) were analyzed and ripening indices (ripening extension, ripening depth and free amino acid indices) were calculated. Results showed that all ripening parameters changed significantly during incubation period (P < 0.05). The ripening extension index varied in the range of 46.2–77.9%, while the ripening depth index and the free amino acid index values were calculated in the range of 25.9–67.4% and 8.0–34.4%, respectively. Exopeptidases showed higher proteolysis rates. The highest rate for ripening was obtained by Flavorpro Umami 852MDP, followed by Flavorzyme.

Key Words: enzyme-modified cheese, ripening, proteolysis