reduced sodium content. The first objective of the present study was to develop a reduced fat reduced sodium Cheddar cheese (RFC) with modified manufacturing protocol to render a cheese that (after 1 wk of ripening) has a similar texture to full fat regular sodium Cheddar cheese. The second objective of the present study was to formulate a low-sodium-reduced-fat process cheese (LSRF) utilizing RFC and other ingredients so as to achieve a process cheese with a reduced fat and a reduced sodium content that has similar sensory and textural properties to commercial process cheeses. Results from the present project have indicated a successful production of LSRF. The final chemical properties of LSRF including its moisture, fat, sodium, and potassium were 50%, 10%, 280 mg/100g, and 1277 mg/100g respectively. Utilization of RFC as the cheese base facilitated in preventing LSRF from having a rubbery and crumbly texture typically associated with reduced fat process cheeses. One of the highlights of LSRF is the elimination of the bitter-metallic off-flavor that is typically found in reduced sodium products where potassium chloride is used as a salt substitute. Another highlight of LSRF is the enhanced cheese flavor notes that help in overcoming the typical bland flavor associated with low sodium and/or low fat cheeses. Along with RFC, that formed the major ingredient for LSRF, other ingredients such as tri-potassium citrate, maltodextrin, guar gum, and water provided LSRF with desirable texture. The ingredients that aided in enhancing the sensory properties of LSRF included a variety of cheese flavors, savory flavor-enhancer, potassium chloride based salt substitute, sugar, and lactic acid. The present approach was successful in producing a sliceable process cheese with a low sodium content (140 mg/serving) and up to 67 % reduced fat content without significantly affecting its sensory and textural properties.

245 Influence of starter bacteria and salt to moisture ratio on calcium lactate crystal formation. S. Agarwal*, J. R. Powers, S. Chen, B. G. Swanson, and S. Clark, *Washington State University*, *Pullman*.

Occurrence of L(+)-lactate crystals in hard cheeses continues to be an expense to the cheese industry. Salt tolerance of starter bacteria and salt to moisture ratio (S/M) in cheese dictates final pH of cheese, which can influence CLC formation. The research investigates the effects of (S/M) and starter bacteria on cheese pH and occurrence of CLC. A commercial starter was selected based on its sensitivity to S/M below and above 4.0 S/M. Cheddar cheese was made using either whole milk (3.25% protein, 3.85% fat, 4.74% lactose) or whole milk supplemented with ultrafiltered milk and cream (4.5% protein, 5.3% fat, 4.78% lactose). Calculated amounts of salt were added at milling (pH 5.40 ± 0.02) to obtain cheeses with low (3.5) and high (4.5) S/M. The cheeses were either vacuum packaged or gas flushed with CO2 and aged at 7.2oC for 3 months. Total and soluble calcium, lactic acid and pH were measured and CLC were observed in all cheeses for 3 months. Low and high salt concentrated milk cheeses (LSCMC and HSCMC), had 36% higher total calcium (1219 mg/100g and 1257 mg/100g cheese, respectively), than low and high salt whole milk cheeses (LSWMC and HSWMC; 908 mg/100g and 917 mg/100g of cheese, respectively). Soluble calcium was 29% higher in LSWMC and LSCMC (438 mg/100g and 454 mg/100g cheese, respectively) compared to HSWMC and HSCMC (339 mg/100g and 354 mg/100g cheese, respectively). Concentration of lactic acid in high salt cheeses ranged from 0.70 to 0.74%, while that in low salt cheeses ranged from 1.86 to 1.97% at the end of 3 months. CLC were observed in all low salt cheeses but highest intensity of CLC were observed in cheeses made with milk with high protein concentration and gas flushed packaging. These results confirm that occurrence of CLC formation is dependent on cheese milk concentration and cheese pH, which can be influenced not only by S/M but also by cheese microflora.

Key Words: Calcium Lactate Crystals, Starter Bacteria, Cheddar Cheese

246 Utilization of plant proteinase from Jack fruit *(Artocarpus integrifolis)* to accelerate the ripening of RAS cheese slurry as a functional food. E. E. El Tanboly* and M. A. El Hofi, *National Research Center*, *Dokki, Cairo, Egypt*.

The aim of the present work was to search for a novel plant proteinase enzyme from Jack fruit *(Artocarpus integrifolis)* as a source of protolytic enzymes to accelerate the ripening of Ras cheese slurry as a functional food. Plant proteinase would be natural products, which can be easily extracted at relatively low cost and no legal barriers. This enzyme was subjected to a purification scheme composed of ammonium sulfate fractionation followed by gel filtration on G-100 Sephadex column and purified proteinase properties was studied such as optimum incubation temperature and optimum incubation time, energy of activation, optimum pH, Thermal and pH stability, Michaelis-constant of (Km) values and Effect of metal ions and chemical reagents on enzyme. Crud extracted proeinase was used to accelerate ripening of Ras cheese slurry with concentration of 1 and 2 ml/100 g curd. Slurries were incubated at 37°C for 7 days. The results indicated that the ripening indices of slurries (SN/TN, tyrosin and tryptiphane) gradually increased as rate of enzyme increased and as ripening period progressed. Also, flavour of all slurries gradually improved during incubation period. At the end of incubation period slurry with 2 ml/100g curd had a high flavour scoring.

Key Words: Jack Fruit (*Artocarpus integrifolis*), Proteinase Enzyme, RAS Cheese Slurry

Egg and Meat Science and Muscle Biology - Livestock and Poultry: Meat Marination

247 Impact of functional ingredients on food safety. S. R. McKee*[1], C. Z. Alvarado[2], and J. W. Bowers[1], [1]*Auburn University*, *Auburn*, [2]*Texas Tech University*, *Lubbock*.

The most commonly used poultry marinades include salt and sodium tripolyphosphates which have been shown to increase meat yield, as well as improve color, water holding capacity, and texture. Recently, several poultry further processing facilities have begun using more acidic (pH ~ 4) type marinades such as sodium lactate (SL), sodium citrate (SC), and sodium diacetate (SD) (alone or in combination) to combat the growth of Listeria monocytogenes in further processed loaves. Since these acidic marinades currently used in turkey further processing have a low pH (~ 4) compared to the previously used salt and sodium tripolyphosphates (~ pH 9), these marinades may alter meat quality attributes. Current research suggest that sodium diacetate can inhibit the growth of LM during refrigerated storage, but the inclusion of this ingredient may alter the product's cohesiveness and

moisture retention. Meat quality traits and microbial analyses from inclusion of LM inhibitors alone and in combination in the formulation of turkey deli loaves and beef franks will be presented.

Key Words: Functional Ingredients in Further Processing, Listera Growth Inhibitors, Food Safety

248 Impact of marination and deboning time on poultry meat tenderness. C. M. Owens*, *University of Arkansas*, *Fayetteville*.

Marination is an increasing popular trend in the meat industry for meat quality enhancement. Sodium chloride or salt, an important component of the meat marinade solution, helps solubilize proteins to increase water-holding capacity, improves tenderness, and enhances flavor. However, there are concerns of increased sodium intake in consumer diets. Studies were conducted to determine the effectiveness of marination and level of salt concentration to improve tenderness and enhance juiciness and flavor of broiler breast fillets. In these studies, fillets were deboned at various times postmortem ranging from 0.25h to 24h postmortem and marinated with varying levels of salt (0 to 1.25%) salt (NaCl) and 0.45% phosphate in a 15% marinade solution. Cooked fillets were subjected to instrumental analyses including the MORS test for assessing tenderness as well as sensory analysis using hedonic and Just About Right scales to assess tenderness, juiciness, saltiness and flavor. All marinated treatments were significantly more tender than non-marinated controls. Using instrumental tenderness analysis, salt concentrations above 1.0% were more tender than other treatments; however, all marinated treatments were significantly more tender than non-marinated controls. Using the hedonic scale, there was no significant difference in marinated products (0.5% to 1.25% salt) for overall impression, flavor, and texture. However, fillets with the higher concentrations of salt (1% and 1.25%) resulted in high percentages of consumers who considered the product too salty. For juiciness and tenderness, a large percentage (>70%) of the consumers considered 0.5%, 0.75%, and 1% treatments to be just about right. The results indicate that marination of pre-rigor deboned meat is effective in producing product similar to marinated post-rigor deboned meat. While meat marinated with higher concentrations of salt may give more desirable levels of tenderness, there is a greater chance of a negative impact on flavor and saltiness in the end product. Furthermore, it is possible to marinate with lower concentrations of salt while still improving meat characteristics and keeping ingredient costs low.

Key Words: Marination, Salt, Tenderness

249 Characterizing the safety and quality of fresh beef cuts subjected to deep muscle marination. M. M. Brashears*, J. C. Brooks, and M. F. Miller, *Texas Tech University*, *Lubbock*.

In May 2005, USDA-FSIS published notice that establishments who produce non-intact beef products must reassess their HACCP plans because outbreaks indicate that *Escherichia coli* O157:H7 is a hazard reasonably likely to occur in these products. USDA-FSIS suggested that processors might also consider applying an allowed antimicrobial agent to the surface of the product prior to processing or tenderization. Research has shown that lactic acid bacteria (LAB) and acidified sodium chlorite (ASC) are effective at reducing pathogens in ground beef. Lactic acid spray (LAS) has also been shown to reduce pathogens when applied to beef trim. Information on the use of these interventions and their effect on the palatability of whole muscle beef products intended for enhancement is limited. Therefore, the objectives of this research were to validate the effectiveness of LAB, ASC, and LAS in reducing *Escherichia coli* O157:H7 and *Salmonella* spp in multi-needle injected and marinated beef strip loins, and to determine their effect on meat palatability. Boneless beef strip loins were transported to Texas Tech University and inoculated with a cocktail mixture of streptomycin-resistant *Escherichia coli* O157:H7. Loins were inoculated at a 10^4 level (high) to determine actual log reductions and a 10^1 level (low) to mimic potential industry levels. One-half of the low and high level inoculated samples were treated with lactic acid bacteria (1×10^9 cfu/g meat), acidified sodium chlorite (1000 ppm) or lactic acid (3%). Control and inoculated loins were vacuum packaged and stored at 2 to 4 °C in the dark for 14 and 21 d. Following the aging period, the remaining low and high level inoculated subprimals were treated with LAB, ASC or LAS. All subprimals were then injected with a brine solution formulated to provide 0.3% sodium chloride, 0.35% phosphate and 0.05% rosemary extract in the final product at a 10% injection level. Additional loins were transported to a separate facility and subjected to the same treatments, storage and enhancement prior to trained sensory panel assessment of flavor, flavor intensity, juiciness and tenderness.

Key Words: Marinate, Beef, Safety

Food Safety - Livestock and Poultry: Cattle and Swine

250 Beef traceability using a dual system based on electronic identification and molecular markers from farm to retailer. J. J. Ghirardi, G. Caja*, M. Hernández-Jover, N. Jiménez, and A. Sánchez, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

A total of 3,657 crossbreed calves on 14 farms in Barcelona and Lleida (Spain) were used to evaluate the efficiency of a dual traceability system based on electronic identification (e-ID), by radiofrequency boluses containing low-frequency (LF; 134.2 kHz) half-duplex 32 mm transponders (Rumitag, Barcelona, Spain), and genetic fingerprinting (DNA) by analyzing specific sets of bovine microsatellites (n = 12) from frozen biopsies. The e-ID of calves was done during the milk-feeding period using either B1 (75 g; 21 × 68 mm; n = 3,057) or B2 (73 g; 18 × 77 mm; n = 600) boluses. High-frequency (HF; 13.56 MHz) read-write inlay transponder (45 × 76 mm; Tiris, Almelo, Holland) were used for transferring e-ID to the carcasses. All animals had official ear tags (OE) made of polyurethane (2 flaps; 10.1 g; Azasa-Allflex, Madrid, Spain). Ear biopsies were taken using biopsying ear tags: E1 (n = 2,562; Biopsytec, Rheinbach, Germany) and E2 (n = 1,095; TypiFix, IDnostic, Switzerland). Calves were intensively fed and slaughtered before 1 yr of age. Blank read-write HF labels were attached to the calf shank before hide removal. Bolus LF code was transferred to the carcass by automatic reading of LF boluses and recording of HF shank labels. Carcass samples (n = 900) were taken using biopsy tubes (n = 357; Biopsytec) or plastic sticks (n = 543; Identigen, Dublin, Irland). Additionally, E2 sticks were used to sample 30 meat cuts randomly taken in nine butcheries. On-farm traceability