

Dairy Foods Symposium: New Approaches to Lower Sodium in Cheese and Techniques to Address Quality Challenges

209 Sodium reduction and public health—Why, how much, and current trends. J. Nicholls*, *National Dairy Council, Rosemont, IL*

To address sodium overconsumption, public health programs aimed at reducing sodium intakes of Americans have gained momentum in recent years. These include public education campaigns, regulatory approaches, standards for marketing and advertising to children, and voluntary industry programs for sodium reduction. The Dietary Guidelines for Americans recommends intakes of 2,300 mg sodium per day for most Americans and 1,500 mg per day for certain population groups. These recommendations are based on the links between high sodium intake, high blood pressure, and increased risk for cardiovascular disease. Sodium intakes of the majority of Americans exceed recommendations with average intakes of about 3,300 mg sodium per day. The Dietary Guidelines also recommend Americans consume 3 servings of dairy foods per day including milk, yogurt and cheese, and based on national survey data, cheese is among top sources of sodium in the diets of Americans. To understand what sodium reduction and public health efforts mean for cheese, dairy's role in the diet, key efforts underway to reduce sodium in the food supply, specific sodium reduction guidelines, and what to expect in coming years will be reviewed. Authoritative reports including the 2010 Institute of Medicine on Strategies to Reduce Sodium Intake in the United States and the Dietary Guidelines for Americans will be reviewed and put into context. Voluntary sodium reduction programs and regulations including USDA regulations for sodium reduction in school meals and proposed regulations for sodium content of "competitive" foods sold in schools will also be reviewed. Emphasis will be placed on policies and programs to reduce sodium intake by Americans and an understanding of the current environment relevant to dairy foods.

Key Words: sodium reduction, cheese, Dietary Guidelines for Americans

210 Lower sodium cheeses—Consumer acceptance and flavor differences. M. A. Drake*, *North Carolina State University, Raleigh.*

Sodium reduction is a key issue in the dairy industry as salt plays a crucial role in flavor and ripening of Cheddar cheese. This presentation will address the effect of sodium reduction on cheese flavor, studies to minimize these effects and consumer perception of sodium reduction in Cheddar cheese. Salt reduction as little as 30% alters cheese ripening and flavor development with increased development of sulfur, brothy and rosy flavors and bitter taste concurrent with volatile compound changes. Off-flavors are magnified in lower sodium reduced fat cheeses due to changes in volatile compound thresholds due to fat reduction. Sodium reduction effects vary with different starters suggesting that careful selection of starter culture strains can alleviate some of these effects. Sodium cation substitution with other cations such as potassium controls water activity similar to sodium chloride. Volatile compound effects were not evident up to 50% substitution although trained sensory panelists documented increased bitter taste and metallic mouthfeel with 25% substitution. Consumer interest in sodium reduction was lower than interest in fat reduction emphasizing the need for parity in sensory properties. Consumer liking scores were not different up to 50% substitution of potassium for sodium with either full fat or 50% reduced fat cheeses. These results suggest that a 25–30% sodium reduction in Cheddar cheese is readily achievable by substitution of potassium for sodium.

Key Words: cheese, sodium reduction, flavor

211 Lower sodium cheeses—Changes in the microbiology and safety. D. J. McMahon*, *Western Dairy Center, Utah State University, Logan.*

With the interest in reducing sodium content of foods for dietary reasons there has been a concern expressed about how reducing sodium content of cheese affects its microbiology and consequent safety. Lowering the level of salt addition to cheese changes the amount of whey expulsion after salting and so cheese manufacturing needs to be altered to maintain moisture targets. Cheddar cheese with 33% reduction in salt will lower the salt-in-moisture (S/M) content from ~4.7% to 3.2%, while a cheese with salt reduction to meet low sodium food regulations will have S/M <2.0%. This greatly reduces the use of salt content of cheese as a microbiology hurdle for controlling bacterial growth. This presentation will address the impact of sodium reduction on cheese microflora from the aspect of cheese ripening and survival of pathogens. When S/M is lowered in either full fat or low fat cheddar cheese, the lactococcal starter cultures survive for a longer time and the nonstarter lactic acid bacteria take longer to reach high levels and become the predominant culturable bacteria in cheese. Similarly, when potassium chloride was substituted for sodium chloride, there is a tendency for the lactococci to remain dominant for longer times, which is indicative of potassium ions subjecting the starter bacteria to less stress than high levels of sodium ions. There are also various metabolic pathways that can be expected to be upregulated or downregulated when potassium is substituted for sodium. When cheddar cheese was made with normal (1.8% salt) and low (0.7%) salt contents and then inoculated with *Listeria monocytogenes* and stored at 4, 10 and 21°C (for 3, 3 and 1 mo, respectively) the viable count decreased by about one log at regular salt levels and 0.5 log in low salt cheese at all temperatures, and at both high and low pH. When similar cheese was inoculated with *Salmonella* there was about 3 log reduction in *Salmonella* counts in all cheeses.

Key Words: cheese, salt, microbiology

212 Process cheese products—Approaches to manufacturing consumer acceptable process cheese products with less sodium.

L. E. Metzger* and A. Kommineni, *South Dakota State University, Brookings.*

Process cheese products are an integral part of the American diet. However, these products contain a substantial amount of sodium (1265 to 1540 mg/100 g). The major sources of sodium in process cheese products are sodium based emulsifying salts, sodium chloride, and natural cheese. In a typical formulation emulsifying salts contribute 45% of the sodium whereas natural cheese and sodium chloride contribute 30 and 25% of the sodium, respectively. Consequently, various strategies that target one or more of the sodium sources in process cheese products can be used to decrease the level of sodium. The simplest and first strategy is to remove sodium chloride in the formulation. In a typical formulation if all of the sodium chloride is removed, the sodium content can be reduced from 1500 mg/100g to approximately 1100 mg/100 g. In addition to removing sodium chloride from the formulation, a variety of salt substitutes can be used to increase the perceived salty flavor of process cheese products with less than 1100 mg of sodium/100 g. Salt

substitutes utilize potassium chloride in combination with a masking agents or bitterness blockers. Masking agents and bitterness blockers are required when potassium chloride is used in a formulation because potassium chloride can result in bitter off-flavors. To produce process cheese with a sodium content below 1100 mg/100 g a portion of the sodium based emulsifying salts in the formulation must also be replaced with a potassium based emulsifying salt. Using a combination of removal of sodium chloride and addition of potassium based salt substitutes and potassium based emulsifying salts it possible to produce process cheese products with a sodium content below 1100 mg/100 g. However, process cheese products with this level of sodium have an extremely bland flavor and are perceived by consumers as having a flavor that is not typical of process cheese.

Key Words: process cheese, reduced sodium, salt substitutes

213 Unwanted gas formation in cheese—Newer information on causes and determining the composition of the cheese microbiota.
J. Steele*, *University of Wisconsin-Madison, Madison.*

Cheese contains microorganisms that are not intentionally added during manufacture. The organisms present in this adventitious microbiota can have significant, beneficial and detrimental effects on cheese quality. One detrimental impact this microbiota can have is the production of

slits and cracks, which is related to gas production by the adventitious microbiota. A wide variety of microorganisms have been associated with this defect, including yeasts, *Clostridium tyrobutyricum*, obligately heterofermentative lactobacilli, *Leuconostoc* sp., *Propionibacteria* sp., and coliforms. However, recently cheeses with slits and cracks not containing detectable levels of these organisms have been sporadically observed. This research project evaluated the ability of *Lactobacillus curvatus* LCF1, a facultatively heterofermentative lactobacilli, to cause this defect. *L. curvatus* LCF1 when present at 4.5 log cfu/g in cheese on d 1 of ripening resulted in slits and cracks within 3 mo. Chemical analysis of the cheeses indicate that the addition of *L. curvatus* LCF1 resulted in higher levels of acetate and lactic acid and accelerated reductions in the levels of citrate and galactose. Culture independent analysis of the influence of *L. curvatus* LCF1 addition on the cheese microbiota was conducted by automated ribosomal intergenic spacer analysis and high throughput DNA sequencing. The results demonstrate that the addition of *L. curvatus* LCF1 resulted in a greater microbial diversity within the cheese matrix. Model fermentations conducted with added citrate and lactose demonstrated that these 2 substrates contribute to gas production by *L. curvatus* LCF1. Collectively, these results suggest that *L. curvatus* is capable of causing slits and cracks in cheese, when present at high levels and if the cheese contains sufficient levels of lactose and citrate.

Key Words: cheese defects, lactobacilli, cheese composition