Dairy Foods Symposium: Microbiology and flavor of cheese: Impact of Lower Salt-In-Moisture Content of Low Fat and Reduced Sodium Cheeses

296 How model cheese composition, texture and structure influence aroma and salt mobility, release and perception. A. Saint-Eve*, M. Panouille, I. Deleris, C. Trelea, and I. Souchon, *UMR 782 Genie et Microbiologie des Procedes Alimentaires, INRA, AgroParisTech, 78850 Thiverval-Grignon, France.*

To limit the impact of food on health issues as obesity, hypertension, or coronary diseases, the reduction of salt or fat content in food products without modifications of organoleptic properties remains a real industrial challenge. A better understanding of the mechanisms involved in release and perception could lead to a better formulation of diet dairy products. In this context, model dairy products with different contents of ultrafiltration retentate milk powder, milk fat and rennet were studied to better understand and quantify the role of texture and structure on physicochemical and sensory properties. The characterization of dairy products was performed by sensory methods (profile, time-intensity and temporal dominance of sensations) and by rheological (small amplitude oscillation tests, compression and texture profile analysis), structural (confocal microscopy) and physicochemical methods (determination of aroma and salt partition properties and diffusion coefficients). Salt and aroma releases in mouth (in vivo conditions) were also followed respectively by in-nose measurement (proton transfer reaction-mass spectrometry) or by measuring the evolution of saliva conductivity during consumption. A preponderant effect of fat on aroma and salty perceptions was observed, in agreement with aroma compounds and salt behaviour during in vitro and in vivo measurement.
However, relating sensory perception and food product properties is a complex issue, because of the variety of phenomena occurring in the mouth during consumption (dilution with saliva, break-down during mastication etc.). To identify main mechanisms explaining release in mouth, mechanistic models, based on the description of mass transfer of salt and aroma compounds in the mouth and taking both physiological and physicochemical parameters into account, have been developed. From the predicted release kinetics of stimuli (in agreement with experimental data), the respective roles of physiological parameters and of product properties can be established.

Key Words: modeling, release, flavor

297 Flavor development in low fat cheese. M. A. Drake*, *Southeast Dairy Foods Research Center, North Carolina State University, Raleigh.*

Flavor and flavor development in Cheddar cheeses with a fat reduction greater than 50% are markedly altered from full fat cheese. Similar alterations in flavor are noted with sodium reductions below 20%. Both a lack of flavor and the presence of off-flavors are generally noted and these changes are due to differences in flavor release as well as changes in the biochemistry of flavor development. Recent studies have highlighted homofuraneol and phenyl compounds (phenylacetic acid and phenylacetaldehyde) as sources of meaty/burnt/brothy and rosy off-flavors in low fat and reduced sodium cheeses. Concentrations and odor activity values of these compounds increased in Cheddar cheese with increased fat reduction. Addition of sodium gluconate to low fat cheeses decreased levels of these compounds up to 50% but did not impact sensory perception. Decreasing sodium in low fat Cheddar cheeses increased bitterness and aromatic off-flavors but interactions were noted between starter culture and salt concentration suggesting that strain selection would be beneficial for sodium reduction. Collectively, these results confirm the complexity of cheese flavor development and that a combination of approaches will be required to optimize cheese flavor with fat and/or sodium reduction.

Key Words: cheese flavor, fat reduction, sodium reduction

298 Influence of salt-in-moisture on starter and nonstarter lactic acid bacteria. J. L. Steele*[1] and J. R. Broadbent[2], [1]*University of Wisconsin-Madison, Madison,* [2]*Utah State University, Logan.*

The microbiota of ripening Cheddar cheese consists of the starter lactic acid bacteria (LAB) and non-starter LAB (NSLAB). Starter LAB are intentionally added to milk at the beginning of cheese manufacture, while non starter LAB (NSLAB) are adventitious microorganisms. These organisms have primary roles in the development of cheese flavor. Unfortunately, the mechanisms by which these organisms influence cheese flavor remain, in large part, unknown. This has made the development of cheeses with non-traditional compositions difficult, as it has not been possible to predict how changes in cheese composition would influence cheese flavor development. For example, flavor development in low-fat or low-sodium Cheddar cheeses is consistently troubled by a lack of desirable or characteristic Cheddar flavor, and by the emergence of pronounced undesirable "off-flavors." It is interesting to note that in both of these cheeses with non-traditional compositions the salt-in-moisture level is significantly reduced compared with Cheddar cheese with traditional composition. There are 2 primary hypotheses for how cheese composition can influence the development of cheese flavor: 1) that the microbiota of cheeses with non-traditional composition differs from that of cheeses with traditional composition; 2) that the microbiota is similar in both the traditional and non-traditional cheeses, but that the physiology of the SLAB and/or NSLAB is significantly different and hence they produced significant flavor compounds. Previous research in our groups and other groups worldwide have demonstrated that cheeses with intrinsic properties less restrictive to microbial growth accommodate a wider diversity of NSLAB, supporting the first hypothesis. Research is currently underway to evaluate the second hypothesis.

Key Words: cheese microbiota, cheese flavor, salt-in-moisture

299 Cheesemaking processes and strategies for manufacture of low fat and reduced sodium cheeses. T. P. Guinee* and K. N. Kilcawley, *Moorepark Food Research Centre, Teagasc, Fermoy, Co. Cork, Ireland.*

Cheese is a concentrated gelled product that structurally consists of a calcium-phosphate casein/para-casein matrix, enclosing fat and moisture. Both the concentration of the matrix and the level of interaction between the casein aggregates making up the matrix are key determinants of the physical properties. The quality of low fat cheese variants is not as acceptable as that of their conventional full-fat counterparts owing to their higher concentration of protein, higher degree of casein fusion, and unbalanced flavor. Hence, a key strategy in the manufacture of low-fat (<6%) fat cheese is to reduce the volume fraction of the casein matrix and to reduce the extent of casein aggregation. This may be achieved by dilution of the protein matrix on increasing moisture via manipulation of a range of process variables: including inter alia: heat treatment of milk, reduction in pH at rennet addition, gel firmness at cut, curd particle size, scalding rate, scald temperature, length of time in vat, pH at whey drainage, salting and milling (Cheddar), rate of cheddaring, and pre-salting before plasticization (pasta-filata cheese). The degree of aggregation is particularly influenced by the ratio of denatured whey protein-to-casein, calcium-phosphate to casein, the ionic strength (affected by the level of NaCl and time of salting), and pH. Reducing the contents of fat and salt in cheese adversely affects both the development and release of key compounds associated with cheese flavor. Moreover, it is important to ensure that the ratios of degradation products of protein and fat per gram of protein or fat, respectively, in low-fat, low-salt cheese are altered to convey flavor perception similar to that of cheeses of normal fat and salt content. The regulation of these factors are critically influenced by the type of starter culture, the level and proteolytic activity of the rennet, curd washing, ripening condition, and rate of curd cooling.

Key Words: cheese, low-fat, low-sodium

300 The effect of intrinsic and extrinsic factors on the fate of pathogens in specialty and lower fat/reduced sodium cheese. J. B. Luchansky*, P. M. Tomasula, D. L. Van Hekken, and A. C. S. Porto-Fett, *USDA/ARS Eastern Regional Research Center*, *Wyndmoor, PA*.

Although the United States maintains one of the most abundant and wholesome food supplies in the world, based on the nature and number of recent illnesses and recalls, we should continue to improve our ability to recover, characterize, and control pathogenic microbes in foods, especially for specialty/ethnic products such as lower fat/reduced salt cheese. Pathogens of primary concern would include *Listeria monocytogenes*, Shiga toxin producing *Escherichia coli*, and *Staphylococcus aureus*. Various intrinsic and extrinsic factors can determine whether or not these microbes die, grow, or merely survive in cheese. A variety of biological (e.g., bacteriophage, bacteriocins), physical (e.g., high pressure processing, pasteurization), and chemical (e.g., organic acids, smoke, oxidizing agents) interventions have been used to better manage pathogenic microbes in cheese. However, salt, moisture, and fat content, as well as temperature, quite arguably have the most significant effect on the fate of pathogens in foods. The ability to optimize salt and fat levels to maintain product safety/quality without causing untoward effects on the attendant sensory properties of lower fat/reduced salt cheese will be the focus of this presentation. With a trend toward consumption of cheese that are more convenient, as well as lower in salt, fat, and preservatives, the sole barriers against microbial contamination, persistence, and/or proliferation may be adherence to Good Manufacturing Practices, formulation, and refrigeration, coupled with enhanced awareness.