528 Opening address and framing of the Teagasc-Moorepark/University College Cork Cheese Symposium. P. Kindstedt*, University of Vermont, Burlington, VT.

In 2015, under the leadership of ADSA Past President Scott Rankin, the ADSA Board of Directors approved a strategic initiative that posits an overarching goal “to attract and foster the best minds affecting the global dairy discipline through increasing the strength of our community.” International members represent a key constituency within the ADSA community. The Teagasc-Moorepark/University College Cork Cheese Symposium arose out of this strategic initiative as an action item aimed at strengthening a sense of community for our international members. The basic concept is to use organizationally defined symposia to encourage partnerships between ADSA and international organizations that are known for their outstanding research in dairy food science. The ultimate goal of such partnerships is to afford our international colleagues new and welcoming opportunities to work and learn together with our North American ADSA members and industry partners in areas of mutual benefit. dwindling resources to support basic research in dairy food science are affecting scientists globally, yet the need for basic dairy food research to meet global challenges, and the need to leverage global intellectual and infrastructural resources for the broader good, have never been greater. The Teagasc-Moorepark/University College Cork Cheese Symposium is a pilot effort that aims to (1) showcase some of the finest cutting-edge cheese science globally; (2) serve as a venue to encourage scientist-to-scientist connections and explore potential opportunities for international partnership at the organizational level; and (3) offer the cheese industry a platform to shape/influence future cheese research. An example of a positive outcome of this pilot effort would be a partnership that is mutually beneficial on both sides of the Atlantic, that strengthens the ADSA international community, and that demonstrates the potential for replication with other international organizations that are known for their outstanding research in dairy food science.

Key Words: cheese, science, international

529 How has cheese science evolved? Lessons learned for future challenges. P. F. Fox*, University College Cork, Dublin, Ireland.

This article presents a brief history of cheese, a description of the Irish cheese industry, a history of research on cheese, the research of the author on cheese and suggested aspects of cheese that warrant further research.

Key Words: cheese, Ireland

530 Biochemical, textural, and functional changes in cheese during ripening. P. L. H. McSweeney*, University College Cork, Cork Ireland.

The biochemical pathways through which flavor compounds develop in cheese during ripening are conventionally grouped into 3 major pathways: (i) proteolysis and amino acid catabolism, (ii) lipolysis and fatty acid metabolism and (iii) the metabolism of lactose and of lactate and citrate. Considerable work has been done in University College Cork over recent decades, together with our colleagues in Teagasc Moorepark and elsewhere, into pathways of proteolysis including study of the role of indigenous enzymes, effect of novel coagulants and identification of the many peptides that are produced from the caseins during ripening. More recently, the effect of oxidation-reduction potential on cheese ripening has also been studied and shown to influence the production of certain volatile flavor compounds. The ripening of hard cheeses such as Cheddar is a slow and expensive process and so its acceleration has attracted considerable work in recent years. Many approaches to accelerated ripening have been investigated, but elevated temperatures have been shown to be the simplest and most effective. Seminal work done in Cork in the 1950s and 1960s into the milk salts system has been extrapolated to cheese in more recent years when it was discovered that the softening of Cheddar cheese early in ripening was correlated closely to the equilibrium between soluble and casein-bound calcium, which corresponds to the equilibrium that exists between soluble and colloidal calcium in milk. Further research has indicated that it is possible to modify cheese texture by controlling this equilibrium. Recent work on the functionality of low-fat cheese has concentrated on the use of hydrocolloids to improve its texture. Translucency is functional property of low-fat cheese that has also been studied in some depth. Factors that affect this parameter include temperature, levels of total and insoluble calcium, TiO2, homogenization and addition of annatto. This presentation will provide an overview of the results of our work on the ripening of Cheddar cheese.

Key Words: cheese ripening, proteolysis, cheese texture

531 The cheese microbiome and its relevance to industry. P. D. Cotter*, 1Teagasc Food Research Centre, Moorepark, Fermoy, Cork, Ireland, 2APC Microbiome Institute, Cork, Ireland.

Recent advances in next-generation DNA sequencing have revolutionised our understanding of numerous microbial environments. These approaches have been employed with increasing frequency to study food-associated microbiota, including cheese. Initially many such studies were curiosity driven, but are now beginning to be used to investigate the microbial basis for microbial related food quality and safety issues. Here we describe our research in this area, with a particular focus on our investigation of the cheese-pinking phenomenon. The nucleic-acid based approaches used for this study revealed a microbial basis for this phenomenon and, armed with this knowledge, can provide a means of preventing/controlling the problem.

Key Words: cheese, microbiome, DNA


Cheese, a product of microbial fermentation may be defined as a protein matrix entrapping fat, moisture, minerals and solutes as well as dispersed bacterial colonies. The cheese matrix is an immensely complex and dynamic system, particularly during ripening. Knowledge gaps persist relating to the influence of manufacture parameters on structural and physicochemical characteristics of the matrix, on levels of inhomogeneity of these parameters within individual cheese blocks and in turn on their influence on the metabolic activity of entrapped bacteria. The advent of recent and more sophisticated analytical techniques, particularly in the fields of microstructure, microscopy and flow cytometry, now offers the opportunity to gain a deeper understanding of these factors during cheese ripening. This review considers levels of
inhomogeneity of physico-chemical parameters such as pH observed at local level within cheese matrices and the influence of manufacture processes, including salting, on the in situ metabolic activity of starter bacteria within the cheese matrix. In addition it explores the influence of supplementation of curd with milk fat globule membrane material on subsequent cheese microstructure, ripening and sensory quality. Overall, a greater understanding of the influence of cheese manufacture parameters on microstructure and starter metabolic activity will facilitate the manufacture of cheeses with enhanced quality and consistency.

Key Words: cheese, microstructure, bacterial metabolic activity

533 Effect of dairy cow diet on the milk composition and processing characteristics of milk. A. Gulati1, T. P. Guinee*1, M. A. Fenelon1, J. J. McManus2, and E. Lewis3, 1Teagasc Food Research Centre Moorepark, Fermoy, Co. Cork, Ireland, 2Department of Chemistry, National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland, 3Teagasc, Animal & Grassland Research and Innovation Centre Moorepark, Fermoy, Co. Cork, Ireland.

The effect of diet on the composition, rennet gelation and heat stability of bovine milk from a spring-calved dairy herd was evaluated during 2015 and 2016. Fifty 4 cows (mean calving date, mid-February) from the Institute’s herd were allocated to one of 3 dietary treatments. Each treatment group comprised 18 cows and the groups were balanced with respect to age, lactation number, genetic merit and breed. The 3 dietary treatments were imposed from mid-February (1 d in lactation, DIL 1) to November (DIL 300): grazing grass-only pasture (G), grazing grass-clover pasture (GC) or indoors-offered total mixed ration (TMR). In 2015, milk samples were collected from each of the 3 treatments at 3 week intervals during the period June-November (133–294 DIL) and analyzed for gross composition, protein profile (reversed phase HPLC), casein micelle size (Malvern Zetasizer Nano ZS), rennet gelation (low-strain oscillation rheometry) characteristics at pH 6.55 and heat stability (140°C) over the pH range 6.2 – 7.2. In 2016, samples were again collected from each of the diet treatments and evaluated for Mozzarella cheesemaking characteristics in mid- (May–Jun, 94–115 DIL) and late- (Oct-Nov, 234–262 DIL) lactation. Results from 2015 showed that diet significantly affected milk composition (contents of true protein, total calcium, ionic calcium, casein micelle size) and rennet-gelation. Cheesemaking studies in showed that diet significantly affected Mozzarella yield, while having little, or no, effect on composition, texture of unheated cheeses, and cooking characteristics of heated cheese.

Key Words: cow, diet, milk

534 Profiling the flavour of dairy products from grass-based versus non-grass based milk production systems. K. N. Kilcawley*, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland.

Dairy products from the milk of cows grazing natural swards rather than those fed preserved forages have perceived ‘added value’ among food producers and consumers based on healthiness, sensory experience and environmental acceptability. To date data to substantiate or reject such perceptions is lacking, especially in relation to sensory perception. The main focus of this presentation is to outline the impact of different forages on the sensory and volatile characteristics of milk and dairy products from on-going research in Ireland. Milk and dairy products were produced from 54 Friesian lactating cows divided into 3 distinct groups; 18 outdoors on perennial ryegrass pasture (grass), 18 outdoors on perennial ryegrass/white clover (grass/clover) and 18 indoors on total mixed ration (TMR) over a season. A chemometric approach was used to correlate volatiles with specific sensory characteristics and to monitor changes in volatiles during dairy processing and/or storage. Overall differences in forage can directly and directly impact on the volatile profiles of dairy products, some of which also affect the sensory characteristics. However, differences in volatile profiles due to forage can also be eliminated or masked during the processing and/or storage of some products. This presentation also focuses on different volatile extraction techniques, advances in gas chromatography mass spectrometry and in data processing in relation to targeted and untargeted volatile analysis of dairy products.


Cheese, of which there are over 1,000 varieties is a nutritious food which when consumed as part of an overall balanced diet can contribute a significant portion of the daily requirements for protein and fat as well as several important minerals and vitamins. Depending on variety a 50g serving can provide between 2 and 19g of protein and 2 and 23g of fat with an associated energy intake of between 56 and 226 kcal. Cheese is a particularly good source of calcium in a bioavailable form and one serving depending on variety can provide up to 400mg of calcium equivalent to 38% of daily needs. Similarly, a serving can provide up to 500IU and 0.19mg of vitamin A and B2 respectively or 10% of daily needs of each vitamin. However, as cheese contains added sodium and it is a relatively high fat energy dense food, there is some concern that its consumption should be limited. NaCl is added to cheese during manufacture and is a necessary part of the process. However, it is generally recommended that sodium intake should not exceed 2,000mg per day and depending on variety a serving of cheese will contribute from 15 to 700mg. Furthermore, most public health organisations currently recommend reduction in total fat and in particular saturated fat in the western diet. In cheese such as Cheddar 66% of the fatty acids are saturated, 30% are monounsaturated and 4% are polysaturated. However, many human studies revealed that cheese intake resulted in lower total and LDL cholesterol concentration, including reduction of triglycerides. Moreover, cheese intake had no impact on cardiovascular health and an inverse correlation between cheese intake and myocardial infarction, as well as an inverse association with the risk of stroke was reported. Most cheeses undergo extensive proteolysis during ripening resulting in the release of a diversity of peptides and amino acids. It has been demonstrated that cheese extracts rich in peptides and amino acids can encode a range of beneficial bioactivities including recent research from our group which reveals antioxidant, satiating and induction of insulin secretion activities. In conclusion, there is increasing evidence that eaten as part of a balanced diet cheese can make an overall positive contribution to nutrition and health.

Key Words: cheese, nutrition, health

536 Interfacing next-generation cheese research with industry needs: A strategic challenge. J. Lucey*, Wisconsin Center for Dairy Research, University of Wisconsin-Madison, Madison, WI.

Over the past hundred years, we have seen remarkable developments in cheese science including aspects like the characterization of milk proteins, rennet coagulation explained, defined starter cultures, advent of genomic techniques, detailed knowledge of the biochemistry of ripening, and control of functionality. These developments have helped to fuel the worldwide growth of the cheese industry, as well as the tremendous increase in the size of manufacturing plants. The needs of industry
depend on the country, as well as the type of company, and its cheese
types. Some ongoing industry needs are greater efficiency and consis-
tency of production, better control of flavor, development of targeted
flavors, cheesemaking processes that provide highest quality whey, and
cheese with improved health/wellness characteristics. Unfortunately,
industry is often unaware of the latest research developments and many
feel that most current research efforts cannot be directly applied to meet
their individual company needs. Researchers often appear uninterested
in addressing industry needs (or they do not have the time to visit plants
or have open discussions with them). To bridge this gap we need more
opportunities, or structures, that allow industry to engage with research-
ers, and we need incentives (like funding) for researchers to tackle real
industry needs. At our center, we include staff with industry experience
in all our research teams, to help bring an applied perspective to proj-

ects. Industry problems like quality defects are a useful example where
discussions can lead to very challenging research projects that can allow
researchers to apply modern techniques to solve an issue, while still
generating new scientific understanding. Benefits to industry of greater
engagement in the research area include more focused/relevant projects
as well as better access to highly trained technical research staff. We live
in a time where there is an amazing array of analytical capabilities that
are available to answer important scientific questions related to cheese
science. How best to exploit this opportunity is a strategic challenge to
both researchers and the dairy industry.

Key Words: cheese science, industry needs