with approximately 2kb of 5′ sequence. For BCO2, an A>G mutation was discovered in exon three, 240bp from the translation initiation site. The A allele creates a premature stop codon resulting in a putative truncated protein of 79 amino acids (compared to the wild-type protein of 530 amino acids), in the three F1 sires heterozygous for this mutation. BCO2 cows homozygous for the stop mutation produced milk with 78% and 55% more β-carotene than homozygous (GG) and heterozygous (AG) wild type animals, respectively. In BCMO1, three polymorphisms were discovered (one in the 5′ region of the gene, one in exon 6 causing a G>R amino acid change, and one in exon 7 causing a N>D amino acid change. The most striking of these, N341D, resulted in a 32% increase in milk β-carotene. In SCARB1, one polymorphism was discovered, in the 5′ regulatory region (-321 bp relative to the +1 translation start site), which resulted in a 10% increase in milk β-carotene content. The results establish important physiological roles for BCO2, BCMO1 and SCARB1 in bovine β-carotene metabolism, and consequently the regulation of milk β-carotene content. Thus, milk fat color may be decreased or increased, using genetic selection, for specific industrial applications, including the production of bovine milk enriched for β-carotene to alleviate vitamin A deficiency in humans.

Key Words: β-carotene, β-carotene oxygenase, milk fat color

636 Analysis of quantitative trait loci affecting female fertility and twinning rate in Israeli Holsteins on chromosome 7. J. I. Weller*[1], G. Glick[1], M. Golik[1], E. Ezra[2], Y. Zeron[3], E. Seroussi[1], and M. Ron[1], [1]*ARO, The Volcani Center, Bet Dagan, Israel*, [2]*Israle Cattle Breeders Association, Caesaria, Israel*, [3]*Sion, Shikmim, Israel*.

Female fertility and twinning rate were analyzed by the multitrait animal model with parities 1 through 5 considered correlated traits. Fertility was scored as the inverse of the number of inseminations to conception at each parity. Negative genetic correlations between all combinations of parities 1 through 3 between twinning rate and fertility were found by multitrait REML analysis. We have previously reported the existence of QTL affecting these traits segregating on BTA7. The objective of this study was to test if the overall genetic relationship between these two traits was maintained at the level of individual genes on BTA7 affecting the traits. In the preliminary analysis, 288 Israeli Holstein bulls were genotyped by the BovineSNP50 BeadChip (Illumina, Inc.). After edits there were 1752 valid SNPs on chromosome 7. Three hundred to 600 bulls were genotyped for an additional 225 SNPs on the first half of the chromosome. Significance of SNP effects on both traits was tested by a linear model that included the effects of allele and the bulls' birth year on the bulls' genetic evaluations. There were a total of 27 SNPs that were significant for both traits ($p<0.05$). The effects were located in three major clusters, between physical positions 14 and 52 Mbp (Build 4.0). Assuming independent association among the 27 effects, 4.9 significant effects were expected by chance, giving a false discovery rate of 0.18. Of these 27 SNPs the effects associated with the two traits were in opposite directions in all but 4 SNPs ($p<0.001$). Thus it can be concluded that the observed negative genetic correlation is due to specific quantitative trait loci with effects in opposite directions on twinning rate and female fertility.

Key Words: female fertility, genomic selection, twinning rate

Contemporary and Emerging Issues: Joint with Extension Education: Science-Based Approaches to Address Consumer Concerns with the Processing and Marketing of Animal Products

637 Effects of cattle production practices on environmental quality. F. M. Mitloehner*, *University of California, Davis*.

A recent United Nations report suggested that global livestock production is a significant threat to environmental quality, contributing to levels of greenhouse gas emissions that exceed those from all transportation sources. Furthermore, the report states that livestock is a major factor in degradation of air quality and surface and ground water resources. Indeed, livestock production in industrialized countries has consolidated, while at the same time production efficiencies per animal are at their near optimum. Over the last few decades, both beef and dairy production systems have dramatically improved efficiencies. For example, over the last 50 years, dairies have quadrupled milk output per lactation. This improvement in efficiencies per animal has considerably reduced the environmental impact per unit of production (milk or meat). However, in several regions of the industrialized world, cattle production has also spatially concentrated. A sustainable future in animal agriculture will require that the output of the cattle system will match the capacity of crops and soils to utilize these nutrients and that alternative uses of manure for fuel and energy production will be implemented. The ultimate goal must be to minimize unwanted nutrient losses to air and water while providing a growing human population with safe and nutritious food. Several recent papers have used a Life Cycle Assessment (LCA) to investigate the impacts of the entire milk- or meat chain on carbon footprint or energy use. To assess and compare production practices for their potential of releasing pollutants to air and water, a second, more comprehensive bio-geochemical modeling effort is required, often referred to as Process-based Modeling (PBM). Comparisons of cattle production systems like conventional versus organic or the use of production techniques with respect to effects on carbon footprint or pollutant contributions, will be feasible in the near future as numerous research teams are working on such assessment tools. These life cycle and emission prediction modeling tools will bring us closer to design and optimize sustainable production systems in animal agriculture.

Key Words: cattle, environmental impact, modelling

638 Effect of farm production practices on ruminant-derived foods: Fatty acid profile, product quality and human health outcomes. A. L. Lock*[1], J. Kraft[1], A. M. O'Donnell[2], and D. E. Bauman[2], [1]*University of Vermont, Burlington*, [2]*Cornell University, Ithaca, NY*.

There is increased consumer interest in the link between diet and health. A major focus of this has been the recognition that certain dietary fatty acids (FA) can impact human health. Related to this is the recent inter-

est in potential effects of different agricultural production practices on product quality, consumer perceptions and health outcomes. This presentation will utilize science-based approaches to address consumer concerns regarding these issues. First, we will address the impact of ruminant fats, particularly milk fat, on human health with a focus on saturated and *trans* FA which pose significant challenges because of their perceived negative effects on human health. The scientific evidence that some FA uniquely present in ruminant fat may have beneficial effects on human health and disease prevention (e.g., conjugated linoleic acids), and the recognition that not all saturated and *trans* FA have the same biological effects, may ultimately challenge the current public perception of ruminant fats. Second, we will discuss research which has investigated possible differences in nutritional value of ruminant products in conventional and emerging practices at the farm level. This discussion will also focus on FA. This has led to increased interest in the marketing of products from different production practices through the claim(s) of enhanced nutrient profile and/or benefits on human health. We will highlight physiological factors that have been examined for effects on the content of specific FA in ruminant fats. While some small differences in product composition have been reported between production practices, these must be taken within the context of the large impact of diet and the wide range among individual animals. Recent data from both meat and milk retail samples will be used to emphasize the similarity in nutrient composition of specific products regardless of production system, and importantly emphasize that all ruminant products are an excellent source of nutrients for the human population.

Key Words: production practices, ruminant fat, human health

639 Truth in labeling of dairy products: Legality, perception, and reality. J. S. Jonker*, *National Milk Producers Federation, Arlington, VA*.

As differentiation of dairy products accelerates in the marketplace, many dairy producers have become concerned about how this differentiation may lead to a perception of 'good' versus 'bad' milk. Label claims on dairy products can provide consumers useful information on nutrition of and production practices used in the manufacturing of those products. These label claims are governed by numerous Federal statutes and regulations overseen by the Food and Drug Administration, the Federal Trade Commission, and the U.S. Department of Agriculture. This presentation will explore the legal and regulatory basis for regulating labels on dairy products and examine how these shape marketing claims use in the marketplace.

640 Lactose intolerance and milk avoidance: An unnecessary risk for low calcium intake and poor bone health. D. A. Savaiano*, *Purdue University, West Lafayette*.

The potential for lactose intolerance causes an estimated 30 to 50 million Americans to avoid milk (NIH website 2008). The NIH estimate is supported by a survey by Elbon et al. (1999) demonstrating that 17% of whites and 35% of blacks indicated a perceived milk intolerance. The National Dairy Council African American Lactose Intolerance Study (Wooten and Price 2004) reported that 24% of respondents considered themselves lactose intolerant, and 49% reported some physical discomfort at some time following dairy food consumption, of which 27% said they experience discomfort all the time. African American and other maldigesters most likely have a similar potential for intolerance (Byers and Savaiano 2005). If the conservative estimate of 24% of the African American population is used for extrapolation (i.e., 35% African American maldigesters are estimated to be intolerant) to the general U.S. population, at least 25 million (1/3 of 75 million) Americans are avoiding dairy foods due to lactose intolerance. If the 17% percent number from Elbon et al is used, 50 million Americans are avoiding dairy foods. Milk avoidance is a significant causative factor for low bone density (Corazza et al. 1995; Di Stefano et al. 2002) and thus a risk factor for osteoporosis. Individuals who avoid milk, due to intolerance or learned aversion, consume significantly less calcium and have poorer bone health and higher risk of osteoporosis. Lactose intolerance is easily managed by: 1) regular consumption of milk that adapts the colon bacteria and facilitate digestion of lactose 2) consumption of yogurts and cheeses and other dairy foods low in lactose 3) consumption of dairy foods with meals to slow transit and maximize digestion 4) use of lactose digestive aids. This presentation will review the available scientific data on milk avoidance and calcium consumption, and dietary management of lactose intolerance.

Key Words: lactose intolerance, milk avoidance

641 Dairy foods: Inherent and added nutrition for health benefits. N. Auestad*, *Dairy Management Inc./National Dairy Council, Rosemont, IL*.

Increased consumer interest in improving overall health has fueled the demand for foods and beverages that offer health benefits. Nutrient rich dairy foods and dairy products with added nutrition offer many health benefits for consumers. Milk and other dairy foods are the major source of calcium in the U.S. diet, providing more than 70% of the calcium available in the food supply. Dairy products also contribute substantial amounts of other essential nutrients including phosphorus, riboflavin, vitamin B12, protein, potassium, zinc, magnesium, and vitamins A and D. Many dairy foods are excellent to good sources of many of these nutrients, making certain nutrition and health-related claims available. Label claims provide an opportunity to showcase the nutritive benefits of dairy foods. The good news for certain dairy products is the link between calcium and vitamin D and reduced risk of osteoporosis, a bone disease that is a major cause of disability in the U.S. This health claim can be featured on several dairy products. Other health claims that certain dairy products may qualify for include those related to sodium and hypertension, potassium and blood pressure, and saturated fat and the risk of coronary heart disease. The Dietary Guidelines for Americans (2005) recommends three servings of low-fat or fat-free milk or milk products each day. On average, Americans consume 1.7 servings per day. A 2007 IFIC survey found that many participants said that they are currently consuming or would be interested in consuming foods or beverages with added health benefits. In their commitment to help consumers get the recommended servings of milk and milk products each day, dairy processors and manufacturers have developed new dairy products with added health benefits (e.g. probiotics for digestive and immune health; omega-3 DHA to support brain development). Both the inherent nutrition in dairy foods and the added nutrition that some dairy products deliver can help consumers improve the overall nutritional quality of their diets.

Key Words: dairy, nutrients, health

642 Meat product safety. E. W. Mills*, *Pennsylvania State University, University Park.*

With an abundant and inexpensive food supply in the US consumer concerns for quality and safety have become preeminent. Rather than concern themselves with obtaining enough food, US consumers focus on perceived quality, safety and food production practices such as animal husbandry practices. Animal management practices such as confinement, castration, dehorning, use of antibiotics and growth promotants all come under criticism in the market place. The popularity of production claims such as organic, natural, and grass fed among others derives from a growing consumer desire to know more about how foods are produced. Such knowledge may lead to an increased perception that foods are safe and environmentally friendly. When consumers hear that millions of pounds of beef are being recalled they reasonably presume that this effort involves unsafe products. But, the idea that unsafe products are being withdrawn from commerce does not give consumers confidence that other products are safe. In fact, the occurrence of a recall leads, at least temporarily, to decreased consumer confidence in similar products which remain on the store shelves. Recently, in the peanut industry, a salmonella outbreak and recall by a small Georgia peanut processor has lead to a dramatic decrease in demand for a variety of peanut-containing products across the industry. Similar outcomes occur when meat or dairy products are recalled. There could be benefit throughout the food chain when consumers are better informed and understand what is going on during a recall. However, by the time you issue the recall news release you are already in the "minimize damage" mode. There is not much opportunity for positive spin or consumer education. Even if you have valid points to be made, your credibility is at its lowest when you are on the defensive. During a recall it is best to stick to the business at hand – retrieving product as efficiently as possible. Informing consumers about safety and wholesomeness of meat products and putting meat recalls into perspective is an ongoing task that we must pursue constantly.

Key Words: meat safety, product recall, consumer perceptions

CSAS Symposium: Functional Foods, Probiotics and Animal Health

643 Postnatal development of the mucosal immune system in domestic animals and consequences on health in adulthood. M. Bailey*, *University of Bristol, Bristol, U.K.*

In many mammalian species the immune system is poorly developed at birth. In the pig, the mucosal immune system is almost absent and develops over the first few weeks in conventional husbandry conditions. Sequentially, the intestine is populated by dendritic cells, CD4+ T-cells and CD8+ T-cells, while B-cell compartments firstly expand (Peyers patches) and then class-switch (to IgA). Much of this development is dependent on, or driven by, the presence of microbial flora in the intestine. Our observational studies have demonstrated that the complexity and type of microbial flora seems to depend on the genetics of the sows and piglets and on the environment (indoor, outdoor farms), and can be further manipulated by environmental modification (high-hygiene isolators). Similarly, there are marked differences in the rate of acquisition of memory T-cells between pigs on different farms, indicating environmental effects on immunological development. Consistent with these observational studies, direct manipulation of microbial flora in neonates using highly controlled conditions (caesarean-derived germ-free piglets reared in full gnotobiotic conditions and colonised with a defined, three-component flora) or conventional conditions (piglets fed a probiotic micro-organism from weaning) have also clearly demonstrated an impact of microbial flora on measures of immunological development and function. However, an important issue is the value, or otherwise, of such manipulations for subsequent 'enteric health' of the individual. The mucosal immune system is a complex, self-regulating system, capable of expression of active immune responses or tolerance directed at pathogens, commensals or food antigens. Manipulations directed at enhancing certain components may be advantageous under some circumstances but deleterious under others. Rational manipulation of early life flora will require considerably greater mechanistic understanding of the complexity of interactions between micro-organisms and the intestinal immune system.

Key Words: mucosal immunology, probiotics, neonate

644 Use of probiotics and prebiotics to modulate intestinal health in monogastric farm animals. M. Lessard*[1], X. Zhao[2], and F. Guay[3], [1]*Dairy and Swine Research and Development Centre, Agriculture and Agri-Food Canada, Sherbrooke, QC, Canada*, [2]*McGill University, Department of Animal Science, Montreal, QC, Canada*, [3]*Université Laval, Département des sciences animales, Quebec, QC, Canada.*

There is increasing evidence that probiotics and prebiotics have beneficial effects on animal health through their potential to modulate intestinal microbiota and interaction between bacterial populations and host intestinal defenses. Probiotics are well-defined bacteria or yeasts and their functional properties are strain specific. Among proposed mechanisms, probiotics have the potential to increase resistance to enteric infections by inhibiting growth of pathogenic bacteria. However, the most common purported benefits of the consumption of probiotics are associated with their potential to modulate barrier properties of the intestinal wall and host immunity. Prebiotics are non-digestible food ingredients such as inulin, fructo-oligosaccharides and mannan-oligosaccharides. They are fermentable and can stimulate the growth and/or the activity of commensal intestinal bacteria such as bifidobacteria or bind to pathogenic bacteria that contribute to health. To modulate intestinal barrier functions and immunity, probiotics and commensal bacteria must interact with epithelial cells and immune cells. Recent data suggest that production of intestinal antimicrobial peptides and inflammatory cytokines are modulated by probiotics and commensal bacteria. This review will summarize mechanisms by which probiotics and prebiotics can affect health by modulating bacterial populations in the gut and mucosal immunity. The current understanding of the cross-talk between beneficial and commensal bacteria and the host remains limited and further research is still necessary to characterize complex interactions among probiotics/prebiotics, microbiota and gut health.

Key Words: probiotics, prebiotics, intestine