ADSA Multidisciplinary and International Leadership Keynote (MILK) Symposium: Colostrum Quality, Analytical Methods and Processing Challenges

405 The role of colostrum components on neonatal development and growth with emphasis on the calf. M. E. Van Amburgh*[1], H. M. Hammon[2], and F. Soberon[3], *[1]Cornell University, Ithaca, NY, [2]Leibniz Institute for Farm Animal Biology, Dummerstorf, Germany, [3]Shur-Gain USA, Nutreco Canada Inc., Guelph, ON, Canada.*

Colostrum, in comparison with milk, is known to be rich in immunoglobulins (60× cow), as well as hormones and growth factors such as relaxin (>19× pig), prolactin (18× cow), insulin (65× cow), IGF-1 (155× cow), IGF-2 (7× cow), and leptin (90× humans) (Odle et al., 1996; Blum and Hammon, 2000; Wolinski et al., 2005; Bartol et al., 2008) among many other factors that have biological activity in the neonate. This biological activity has been characterized in cattle, pigs and other mammalian species. In neonatal pigs, there are relaxin receptors present at birth in uterine and cervical tissues, and colostrum-derived relaxin induces estrogen receptor differentiation and proliferation of those tissues. Further, the development of the neonatal calf is influenced by colostrum intake when compared with non-colostrum diets. Maturation and function of the neonatal gastrointestinal tract in calves occurs through some of the hormones contained in colostrum. Nutritive and non-nutritive factors, such as the hormones and growth factors, affect intestinal growth and function, and enhance the absorptive capacity of the gastrointestinal tract. Glucose absorption increases and glycogen concentrations in liver rise significantly when colostrum instead of a milk-based diets are fed in the first meal. Growth, feed intake, feed efficiency and long-term productivity of calves receiving increased levels of colostrum, independent of the immunoglobulin status of the calf have been observed. In a recent study, calves were fed 4 L or 2 L of colostrum at birth and the 4 L group received an additional 2 L within 12 h. Calves fed greater amounts of colostrum consumed 8.5% more milk replacer, had an 18% increase in pre-weaning ADG, a 12% increase in postweaning feed intake, and a 25% increase in post-weaning ADG through 80 d of life indicating that colostrum potentially affects appetite regulation which enhances growth and possibly feed efficiency. Overall, colostrum is an important vehicle of communication between mother and offspring, through lactocrine signals that enhance developmental functions beyond the immune system.

Key Words: colostrum, calf, lactocrine

406 Colostrum: Bioactive components and its role in transmitting maternal signals that regulate neonatal health and development. T. B. McFadden*, *University of Missouri, Columbia.*

All mammals are completely reliant upon mammary secretions (colostrum and milk) for successful reproduction. In other words, mammalian neonates depend on those secretions to provide nutrients and bioactive factors necessary for survival and subsequent growth and development. Although humans have learned how to intervene in this fundamental process, the now universal acceptance that breast milk provides the ideal diet for human infants highlights the complexity and importance of milk components and illustrates that evolution is wiser than man in selecting the optimal match of components to requirements of the young. Milk and colostrum also provide a postpartal route for chemical communication from mother to young. Thus, it is logical that milk components include many bioactive factors that influence both immediate and long-term function and health. Colostrum is a unique mammary secretion and colostrum formation involves massive translocation of bioactive molecules from the mother's blood into mammary secretions and thereby delivery to the neonate. The most noteworthy of these molecules are the maternal immunoglobulins, primarily IgG1, which are transferred to the calf, providing passive transfer of immunity and thereby reducing risk of death or disease. In general, however, colostrum provides an avenue for chemical communication between the dam and the neonate that exists for as long as the young continue to nurse. For example, information as to the dam's nutritional, hormonal, immunological, microbial and even seasonal status can be conveyed via mammary secretions. In addition, recent recognition of the role of the gut microbiome as a key determinant of immunological and digestive system development opens new avenues by which colostral secretions can have long-term effects on future health and vitality of offspring. This paper will review the mechanisms involved in hormonal regulation and mammary secretion of these factors and their subsequent effects on neonatal growth and development of the calf, with emphasis on factors concentrated in colostrum.

Key Words: colostrum, bioactive molecule, mammary secretion

407 Colostrum and human health. D. Haines*[1,2], W. Duff[3], and P. Chilibeck[3], *[1]Department of Veterinary Microbiology, The Western College of Veterinary Medicine, The University of Saskatchewan, Saskatchewan, Canada, [2]The Saskatoon Colostrum Co. Ltd., Saskatoon, Canada, [3]College of Kinesiology, University of Saskatchewan, Saskatchewan, Canada.*

The selection of dairy animals to produce large quantities of milk has resulted in the production of excess volumes of colostrum. There are several companies in North America and elsewhere that collect, heat treat and spray dry manufacture colostrum for supplementation of calves and increasingly for use as natural health products in pets and human beings. In addition to immunoglobulin there is a diverse array of relatively high levels (compared with milk) of factors including non-specific antimicrobial compounds and factors that affect growth, differentiation and metabolism in the newborn and which presumably may be of benefit to adults. Bovine colostrum ingestion by people has been shown to have a variety of benefits including improved immune function, decreased incidence and severity of infectious disease, improved gastrointestinal health and improved athletic conditioning. The latter effect has been speculated to be either through improved health, through anti-inflammatory effects that benefit muscle strength building and/or from the anabolic effects of the high levels of insulin-like growth factor (IGF1) present in colostrum. Most studies have looked at the "athletic conditioning" effects of colostrum in young people. Older individuals have decreased muscle strength compared with younger people and it is postulated that many of these and other adverse effects of aging are linked to the age-associated decline in levels of IGF-1 which logically may improve with supplementation. Older people (n = 40, ≥50 years) were given either 60 g/day whey protein powder or bovine colostrum for 8 weeks and subjected to 3-times weekly resistance training and tested for changes in strength, muscle size, body composition and cognitive function. Both whey and colostrum supplemented groups significantly increased upper body strength, muscle thickness, lean tissue mass, decreased body fat percentage and improved cognitive function. In addition the colostrum-

supplemented group increased leg press strength (baseline 122 ± 40 kg and post 145 ± 53 kg) compared with the whey-supplemented controls (baseline 143 ± 51 kg and post 151 ± 58 kg). These data show there were substantial benefits of 8 weeks of weight training along with either whey protein powder or bovine colostrum in older adult volunteers and that colostrum supplementation had additional benefits to leg muscle strength not demonstrated with whey protein powder.

Key Words: colostrum, human health, whey protein

408 Improving the value of colostrum through application of novel processing technology. H. Patel*[1] and T. Carroll[2], *[1]Dairy Science Department, South Dakota State University, Brookings, [2]Fonterra Research Center, Palmerston North, New Zealand.*

Milk and milk products contains numerous essential nutrients, that may provide health benefits to consumer. Colostrum is the early milk produced by cows during the first several days after the calf's birth. Bovine colostrum contains many beneficial substances including bioactive components such as immunoglobulins (Ig), lactoferrin (LF) and other health promoting components such as oligosaccharides, growth factors (GF) such as IGF1, TGFβ1 and TGFβ2, antimicrobial compounds and immune-regulating constituents. However, many studies in the literature suggested that Ig, LF and GF are very sensitive to heat treatment. We compared the effects of different heat treatments with high pressure processing (HPP) on colostrum and pure Ig in the range of 150 to 800 MPa and in the pH range of 3.0 to 7.0. The results of our study demonstrated that Ig, LF and GF are very sensitive to heat, but they are pressure-resistant. More than 60 to 70% of Ig and GF were retained at all pH in the range of 5.0–7.0, whereas more than 90% of IG and growth factors were retained in the samples pressure-treated in the pH range of 3.0–4.0. The study clearly demonstrated that HPP is an ideal non-thermal technology for processing of formulations containing heat sensitive bioactive components present in milk and colostrum. HPP can be applied to improve the value of colostrum by designing ambient stable long shelf-life colostrum products and beverages containing high level of active Ig, LF and GF.

Key Words: colostrum, high pressure processing (HPP), immunoglobulin and growth factors

409 Bovine colostrum as a source of milk growth factors: technological aspects. Y. Pouliot* and S. F. Gauthier, *STELA Dairy research Center, Institute of Nutrition and Functional Foods (INAF), Université Laval, Québec, QC, Canada.*

Bovine colostrum contains several highly attractive molecules among which milk growth factors have been already been exploited to develop health ingredients. The most abundant growth factors in bovine milk and colostrum are insulin-like growth factor-I (IGF-I), transforming growth factor-β 2 (TGF-β2), epidermal growth factor (EGF), and basic fibroblast growth factor, respectively. However, even in colostrum, their concentration is very low (≤1,000 ng/mL). Designing cost-effective methods to extract growth factors from colostrum and substantiating the extracts with relevant scientific data on their bioactivity represent the 2 main challenges in the development of growth factor-rich protein ingredients. Our work has encompassed the many technological aspects involved in the development of protein-based health ingredients from bovine colostrum, including milking, processing/ fractionation and characterization of the extracts. Identifying the optimal period for collecting colostrum after parturition represents a critical step. It was found that TGF-β2, TGF-β1 and IGF-1 concentrations in liquid colostrum decreased rapidly (<12 h). However when reported on protein content, the values remained interesting within the first 48 h after parturition. Removing caseins from colostrum was found to have a major effect on the growth factor content of the extracts. Approaches using polysaccharides such as λ-carrageenan (λ-CG) or pectin were developed and enabled a partition of major growth factors between casein fractions and serocolostrum. Those studies highlighted potential interactions between some growth factors and casein micelles. Protein-based growth factors extracts were characterized for their protein composition, in vitro digestibility, and also, for several bioactive properties. Altogether, the experimental data evidence that protein-based milk growth factor extracts can modulate inflammatory processes in different models such as neutrophils from healthy humans, intestinal mucosae and skin lesions. However, understanding the mechanisms and ascribing specific activities to individual growth factors or compounds has yet to be achieved.

Key Words: growth factor, colostrum