Production, Management, and the Environment Symposium: Profitability and Sustainability

393  Colostrum management and calf nutrition for profitable and sustainable dairy farms. A. J. Heinrichs*1, P. S. Erickson2, H. Chester-Jones3, and C. M. Jones1. 1The Pennsylvania State University, University Park, PA, 2University of New Hampshire, Durham, NH, 3University of Minnesota Southern Research and Outreach Center, Waseca, MN.

Early life nutrition and management profoundly impact the health and productivity of dairy calves and by extension affect profitability and sustainability of dairy farms. Research into this topic is active, and members of the USDA Regional Research Project NC2042 have made many contributions specific to management and nutrition, including a colostrum emphasis. Field studies and USDA:NAHMS surveys consistently show that colostrum management has been deficient and contributes to increased calf morbidity and mortality. Heat treatment of colostrum can reduce bacteria loads and increase IgG absorption by the calf despite a small reduction in IgG level. While other collostral proteins are reduced by heat-treating, there have been no reports of long-term impacts on the calf. Investigation into IgG absorption has shown bacteria can directly interfere with IgG absorption, and there may be an upper limit on IgG uptake when feeding superior quality colostrum. Colostrum IgG may be increased by supplementing prepartum diets with nicotinic acid. Additional studies found mixed results on IgG uptake when sodium bicarbonate was added to colostrum replacers and colostrum. In relation to nutrition, a great deal of work has considered the level of feeding and its effect on calf growth and health. Calves can grow faster with increased milk intake; however, at some point, the volume of milk fed affects grain intake and compromises rumen development. This affects weaning age as well as growth and health after weaning. A meta-analysis and a large independent data set evaluated the effect of preweaning average daily gain on subsequent first lactation milk production. Both studies showed a small but significant improvement in milk production as calves grew faster, and both found grain intake was a factor in this improvement. Thus, research indicates that rumen development and the ability to efficiently digest concentrate and limited forage have a large effect on continued growth and calf health. Field studies further support the finding that grain intake at weaning affects growth, age at calving, and first lactation milk production.

Key Words: transition period, DMI, negative energy balance

394  Nutrition strategies for improved health, production, and fertility during the transition period. F. Cardoso1 and K. Kalscheur1. 1University of Illinois, Urbana, IL, 2Dairy Forage Center ARS-USDA, Madison, WI.

Dietary formulation and feeding management during the dry period, peripartum period, and early postpartum (fresh) period may facilitate or interrupt many of these steps before pregnancy is established and maintained. There is little evidence that milk yield per se contributes to greater disease occurrence. However, peak disease incidence (shortly after parturition) corresponds with the time of greatest negative energy balance (NEB), the peak in blood concentrations of NEFA, and the greatest acceleration of milk yield. Decreased fertility in the face of increasing milk production may be attributable to greater severity of postpartum NEB resulting from inadequate transition management or increased rates of disease. The depth and duration of NEB is highly related to DMI. Periparturient diseases can be a result from adverse ruminal conditions caused by excessive grain in the precalving or fresh cow diet, perhaps aggavated by overcrowding, heat stress, or other stressors. Others also have implicated inflammatory responses in alterations of metabolism, occurrence of health problems and impaired reproduction. A major area of concern in the fresh cow period is sudden increase in dietary energy density leading to subacute ruminal acidosis (SARA), which can decrease DMI and digestibility of nutrients. Adequate physical form of the diet, derived either from ingredients or mixing strategy, must be present to stimulate ruminal activity and chewing behavior. Dietary starch content and fermentability likely interact with forage characteristics and ration physical form. The comparison of 3 dietary starch contents (primarily from corn starch) in the fresh cow period for cows fed a controlled energy-type ration in the dry period. In conclusion, formulation and delivery of appropriate diets that limit total energy intake to requirements but also provide proper intakes of all other nutrients (including the most limiting amino acids methionine and lysine) before calving can help lessen the extent of NEB after calving. Effects of such diets on indicators of metabolic health are generally positive, suggesting the potential to lessen effects of periparturient disease on fertility.

Key Words: transition period, DMI, negative energy balance


Demand for organic milk has grown steadily worldwide, thus creating a niche market opportunity for farmers to transition from conventional to organic certified production. However, surplus of organic milk in the last 2–3 years in the US drove prices down and shrank farmer profitability throughout the country. Currently, transition to organic dairy production has slowed down and the only growing segment of the industry is the “grass-fed” milk market. Farmers shipping “grass-fed” milk are not allowed to feed any source of grain or corn silage with molasses as the sole energy supplement permitted by certifiers and milk processors. While this production system brings challenges including losses in milk yield (MY) and the need for increased forage production, it pays additional premiums that may increase farm profitability. The objective of this paper is to provide data on feed efficiency (FE) using the University of New Hampshire Organic Dairy Research Farm as a case study. Surveys from commercial midwestern and northeastern US organic dairies were used for modeling the impact of “grass-fed” diets on greenhouse gas (GHG) output. Results from 14 experiments (7 published and 7 unpublished) using Jersey cows in confinement (n = 8 studies) or grazing management (n = 6 studies) showed (mean ± SD) DMI of 17.5 ± 2.05 kg/d, MY of 18.3 ± 3.7 kg/d, and ECM of 22.6 ± 4.57 kg/d. Feed efficiency expressed as MY/DMI or ECM/DMI averaged 1.05 ± 0.17 and 1.29 ± 0.20 kg/kg, respectively. Lowered production and FE compared with typical conventional dairies in the US may be related to the use of high forage rations, inclusion of pasture in the diets, increased energy expenditure for grazing, and the lack of digestible forage sources such as corn silage. In fact, our modeling work showed that GHG emissions decreased approximately 2-fold in traditional vs. “grass-fed” organic dairies in part due to the use of corn silage in the diets. In conclusion, MY and FE are lower in organic than conventional dairies. Organic dairy farmers, particularly those shipping “grass-fed”
milk should improve forage quality and grazing management and optimize the use of molasses.

**Key Words:** feed efficiency, organic, pasture

### 396 The top 5 technologies for the modern cow. A. E. Stone*, Mississippi State University, Starkville, MS.

Precision dairy monitoring (PDM) involves the use of technologies to measure physiological, behavioral, and production indicators on individual animals to detect events of interest. Heat, disease, and calving detection are common applications, although heat detection is the most tested and used. Many PDMs are commercially available and are being used in research and on farms. Precision dairy monitoring technologies can be placed on or in the cow, but many technologies are now available in the parlor, in robots, and in an exit or feed alley. Until recently, most PDMs worked with 3-axis accelerometers with different algorithms applied, but advanced imaging is now becoming more commonly used. A common question from researchers and producers alike is “what is the best technology available?” The top technologies are ones that improve 1) farm efficiency; 2) farm economics; 3) decision making; 4) animal welfare; and 5) producer happiness. Precision dairy monitoring technologies need to be a solution to a problem, not a solution searching for an application, which sometimes occurs particularly when non-agricultural companies start jumping into this market. They also cannot be another problem for a producer to add to their already-full plate. These technologies provide copious amounts of information, which can sometimes be overwhelming. The best PDMs process data and present information in an accurate and easy to understand manner. The producers gaining the most benefit from PDMs are the ones implementing them as part of their everyday standard operating practices and are using 3 of their most important sense to understand the data: common sense, cow sense, and business sense. Implementing PDMs onto a farm is an enormous and potentially expensive decision. As this part of the industry continues to progress, the potential for PDMs are endless. Sound university research and producer feedback are imperative to ensuring that PDMs continue to head in the right direction. This presentation will be aimed at helping weed through the currently available research, discuss current and potential future applications, and explain PDM adoption through the Theory of Diffusion.

**Key Words:** dairy, precision, technology

### 397 Decomposing efficiency of milk production and maximizing profit. A. Bach*, ICREA (Institució Catalana de Recerca i Estudis Avançats), Barcelona, Spain, 2Department of Ruminant Production, IRTA (Institut de Recerca i Tecnologia Agroalimentàries), Caldes de Montbui, Spain.

Maximizing milk yield has been the main focus of the dairy industry as it is believed that it maximizes profit mainly through dilution of maintenance costs. Efficiency of milk production has received, until recently, considerably less attention. The most common methods to determine efficiency of milk production are feed efficiency (FE), which is defined as the amount of milk produced relative to the amount of nutrients consumed, and residual feed intake (RFI), which is the difference between observed and predicted DMI, and assumes that animals with a high RFI have a low efficiency. Feed efficiency is affected by 1) ration quality and management (e.g., nutrient balance, mixing order, mixing accuracy, changes in nutrient composition across days, feed availability in the feedbunk), 2) digestive function (e.g., passage rate, rumen fermentation, rumen and hindgut microbiome), 3) feeding behavior (e.g., eating rate, sorting), 4) physical activity of the cow, 5) metabolic function (e.g., homeorhesis, insulin sensitivity, hormonal profile), 6) immune system activity and health, 7) age (e.g., body size,udder vascularization), 8) environmental conditions (e.g., heat stress), and 9) genetics (controlling ultimately most of the previous aspects). Over the years, energy requirements for maintenance have progressively increased, but interestingly, efficiency of nutrient use for milk production has also increased. Empirical evidence from the literature suggests that marginal increases in milk require progressively greater marginal increases in nutrient supply (despite the supposed dilution of maintenance), in other words, the marginal amount of milk produced for every additional Mcal of NE1 or every additional gram of metabolizable protein consumed follows the law of diminishing returns. Thus, the dilution of maintenance requirements associated with increases in production is partially overcome by a progressive diminishing biological response to incremental energy and protein supply, and thus FE also follows the law of diminishing returns. Hence, profits associated with improving milk production might, on some occasions, be considerably lower than expected.

**Key Words:** economics, feed efficiency, residual feed intake

### 398 Strategies to improve efficiency and profitability of heifer raising. J. L. Anderson*, P. S. Erickson, K. F. Kalscheur, and G. J. Lascano, South Dakota State University, Brookings, SD, 3University of New Hampshire, Durham, NH, 4USDA-ARS Dairy Forage Research Center, Madison, WI, 5Clemson University, Clemson, SC.

Raising replacement heifers represents a significant investment for producers in time and resources. It is not until the start of lactation that any return on investment is received. Thus, it is critical to the success of the dairy industry that advancements continued to be made to optimize heifer management. The objective of this presentation will be to discuss key research on different aspects of heifer raising strategies that have been conducted by members of the NC-2042 USDA Multistate Project: Management Systems to Improve the Economic and Environmental Sustainability of Dairy Enterprises. A few key areas that will be highlighted specifically in their relationship to improved heifer performance and profitability are: evaluations of different feeding strategies, utilization of alternative forages, and utilization of alternative protein and concentrate feedstuffs. Within our group a variety of feeding strategies such as limit-feeding or precision-feeding versus more moderate limited diets or traditional total mixed rations have been evaluated leading to increased understanding of advantages and disadvantages of each strategy. Research will be reviewed on evaluation of feeding high and low forage diets containing new and developing forage sources such as sorghum silage, sudan grass, and fibrous by-products. Additionally, research has been conducted on effects of feeding co-products such as distillers grains, brewer’s grains, oilseed meals, and soy products to heifers in comparison to more traditional concentrate ingredients. In conducting research related to these different feeding strategies and feedstuffs we have gained increased understanding of the relationships of nutrient and energy source utilization and metabolic profile to the development and growth of heifers which can have widespread impacts. In recent years, it has also become apparent the genotype and genetic management will have many implications on heifer performance and influence on nutritional management.

**Key Words:** dairy heifer, management, efficiency