ADSA-SAD (Student Affiliate Division) Undergraduate Competition: Dairy Production

124 WITHDRAWN.

125 Nutrigenomics: A new direction for the dairy industry. D. G. Wilson*, *Pennsylvania State University*, *University Park*.

Nutrigenomics, the study of how specific dietary nutrients influence gene expression, is a new and exciting science that shows promise of improving efficiency in many areas from milk production to reproduction. Extracting RNA for microarray analyses both before and after a ration change can indicate which genes are up-regulated, or "turned on," and which are down-regulated, or "turned off," when new nutrients are added to the diet. In this process, fluid RNA is placed on a computer chip, treated with a special dye, and exposed to a laser. The original microarray is then compared to the microarray completed after the dietary change. Those genes that are up-regulated by the dietary change will fluoresce, and those genes that are down-regulated will turn dark. Several research trials have demonstrated the linkage between nutrients and gene expression. In a Washington State study, cows with supplemented chromium propionate showed improved fat metabolism and increased milk production. When chromium was supplemented to 10 mg/d at measured intakes, milk pounds increased 2.6 kg/d between d 1 and d 90 of lactation, with a 4.6 kg/d increase between d 57 and d 90. McNamara et al determined that these changes were due to the up-regulating of five major genes. Another mineral that offers nutrigenomic promise is selenium. Research studies in mice, poultry, and pigs have shown reduced early embryonic loss and improved antioxidant function in reproductive tissues when diets were supplemented with this mineral. In future years, selection criteria may involve choosing animals who respond most efficiently to dietary changes. New trials involving minerals, fatty acids, and other targeted nutrients will refine our knowledge in this rapidly expanding field. Although this research is still in early phases, especially in dairy cattle, the ability to increase efficiency and profitability through the use of nutrigenomics shows great potential.

Key Words: Nutrigenomics, Chromium, Microarray

126 Genetics of feed conversion efficiency: using a dynamic metabolic model to investigate the patterns of nutrient flux in the most efficient dairy animals. C. Schachtschneider* and J. McNamara, *Washington State University*, *Pullman*.

Productive efficiency depends on processes such as feed intake and composition, synthetic ability of the mammary gland, and metabolic flux in visceral, muscle, and adipose tissues. These metabolic fluxes are functions of genotype, phenotype, and intake, including hormonal and neural responses. In order to identify patterns of metabolic flux in dairy cattle of varying genetic merit and intakes, an existing mechanistic metabolic model (Molly, UC Davis) was used. Data were collected from 2nd to 4th parity cows, including nutrient intake, milk component output and changes in adipose tissue and body protein (28 d prepartum to 90 DIM). Explicit inputs into the model included nutrient intake, initial body fat and protein, milk production, fat and protein output. Each cow (n = 42) was simulated separately from 0 to 120 DIM and fluxes in body and visceral energy and protein were output. Body fat, body protein (skeletal muscle) and visceral protein all varied ($P< 0.05$) in their daily flux and overall change from 0 to 120 DIM for the top 20% most efficient versus lowest 20%, based on energy efficiency (absorbed energy/feed energy) during that period. Means (ranges) for all cows were 112 (89 to 139) Mcal/d for intake energy, 32.3 (19.9, 41.9) for maintenance; -0.51 (-1.74, -0.015) for change in body energy; and 0.843 (0.826, 0.862) for Net E efficiency (milk energy/(energy absorbed maintenance E)). These data are consistent with variations in maintenance (body nutrient fluxes) affecting overall efficiency while mammary efficiency approaches the theoretical maxima. Nitrogen intake was 0.66 (0.52, 0.81) kg/d; milk N, 0.21 kg/d (.16, .27), change in body N, -0.016 (-0.06, -0.004), N in urea was 0.31 (.26, .37) and N balance was -0.018 (-0.032, -0.008). Animals varied in non-mammary E and N use, and the model identified ($P <0.05$) optimal differences in E and N in the 20 % top versus 20 % lowest efficient cows. We can use this approach to help identify the most efficient patterns of metabolism in non-mammary tissues, and eventually alter breeding strategies toward more efficient cows.

Key Words: Lactation, Efficiency, Model

127 The effects of inbreeding in Holstein dairy cattle. M. B. Rhoderick*, D. R. Winston, B. G. Cassell, and K. M. Olson, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Inbreeding in the Holstein breed has increased as a result of selection to improve an objective such as type or production for a long period of time. Inbreeding is the mating of related individuals and the concept is based on the probability of two genes being present at a locus that are identical by descent. Inbreeding is measured by the coefficient of relationship among cattle to determine a correlation between inbreeding level and performance traits. Analysis of data from Holstein Association USA, Inc. and the Animal Breeding Center at Cornell University from 1970 to 1998 indicated that the level of inbreeding increased over time. While the rate of inbreeding has declined, there are many negative effects associated with the level of inbreeding. Milk production losses per lactation were 35 kg per percentage of inbreeding greater than 1%. The amount of production lost increased to 55 kg per percentage of inbreeding within the range of 7 to 10%. Longevity of inbred cattle decreased as a result of decreased reproductive efficiency, decreased production and a slight increase in somatic cell score. Therefore, inbreeding has negative effects on management, profits, and cow health. Dairy managers should know the consequences of excessive inbreeding and should implement strategies including better record keeping and outcrossing to keep inbreeding at optimal levels.

Key Words: Inbreeding, Holsteins

128 Colostrum nutrition, immunization, and management when raising young dairy calves. A. Aguiar* and E. Jaster, *California Polytechnic State University*, *San Luis Obispo*.

Calves require proper nutrition, immunization and management in order to have proper growth and development. Calves need colostrum in order for passive transfer of immunoglobulins to assist the immune system in resisting pathogens and diseases. With proper colostrum quality and quantity, calves have the ability to fight calf hood diseases. A method to evaluate passive transfer of colostral immunoglobulins is to evaluate serum protein content of calf blood. Relatively high levels of serum protein indicate calves may have received the proper passive transfer of immunoglobulins. Vaccination of calves to provide immunity is necessary to assist the calf in disease prevention. Early intervention and use of vaccines to provide immunization is necessary for calf survival. Vaccines require evaluation by the calf ranch to determine the suitability and immunization efficacy. By providing proper colostrum management, vaccines that provide adequate immunization and proper management, the calf will have the opportunity to survive and grow to its genetic potential.

Key Words: Calves, Colostrum, Vaccine

129 Enhancing fertility with omega-3 fatty acids. J. A. Tekippe*, *Iowa State University*, *Ames*.

Meeting the energy demand of high producing dairy cattle in early lactation can be difficult and failure to do so affects several physiological functions especially reproduction. Current evidence suggests that dietary supplementation of certain essential fatty acids (FAs), specifically omega-3 FAs, may improve reproductive efficiency in dairy cattle. Feeding supplemental fat provides additional energy, enabling the cow to achieve positive energy balance quicker and return to a normal estrus sooner. Both linoleic (C18:2) and linolenic (C18:3) are essential FAs that must be provided in the diet. Approximately 55% if the FA in flaxseed is linolenic (an omega-3 FA), whereas both soybeans and cottonseed contain 54% and sunflower seeds 68% linoleic (an omega-6 FA). Cows fed diets supplemented with various fats developed larger follicles and subsequently 23% larger corpus luteums (CL) on average. In another study, conception rates following an initial timed AI protocol were greater in cows fed flaxseed (72.6%) than for cows fed sunflower seed (47.5%). Early embryonic loss occurring in the first 28 days post insemination was reduced from 27.3% in cows fed sunflower seed compared to a 9.8% loss in cows fed flaxseed. Cows fed a mixture of omega-3 (linolenic) and omega-9 (oleic) FAs produced 22% more high quality embryos compared to those fed an omega-6 (linoleic) FA. Production of series 2 and series 3 prostaglandins occurs from separate pathways, both utilizing and competing for the same enzymes. Omega-3 FAs are the precursor for series 3 PGs, while omega-6 FAs are the precursor for series 2 PGs. Increasing the amount of omega-3 FAs in a cow's diet should result in the production of more series 3 prostaglandins (PG-3) and proportionately less series-2 PG. Since PG-2 is more biologically active in regressing the CL and reducing progesterone production, a shift from PG-2 to PG-3 should benefit pregnancy. In conclusion, feeding a source of omega-3 FAs such as flaxseed may enhance reproductive efficiency of dairy cows.

Key Words: Fertility, Omega-3, Flaxseed

130 Grazing under irrigation: A novel approach to pasture-based dairying. E. Waggoner*, *Clemson University*, *Clemson, SC*.

The goal of the dairy industry has been and always will be to efficiently produce milk. This may sound simple, but dairymen will tell you that this task is not easily accomplished. With increasing feed costs and variable milk prices, it is a battle to make a living as a dairy farmer. At a time when dairies are either commercializing or leaving the industry, many are seeking other options. New methods of increasing efficiency and lowering costs are being explored to promote the survival of smaller farms. Pasture grazing is an appealing opportunity. The Southeastern United States is subject to high temperatures and humidity much of the year. These environmental factors have tremendous negative effects on cattle health and milk production, leaving cows seeking refuge in shade rather than consuming valuable forages. Many producers have made substantial investments in cooling systems; yet, have not addressed decreased forage consumption. A novel way to address both concerns is pasture grazing under irrigation. This form of pasture-based dairying maximizes forage utilization while also managing heat stress. With this plan, cattle are intensively grazed in fields managed by irrigation systems. As the irrigation equipment rotates around the pasture, cows follow the water, enjoying the cooling effects while consuming forages in a strip-grazing motif. Pasture grazing under irrigation provides advantages on a multi-discipline level to increase cattle comfort and milk production while lowering costs associated with confinement farming. Cropland irrigation and heat stress management are essential to farming in the Southeast. This plan integrates and improves upon both ideas. In addition to lower feed costs, improved cattle health, and maximized pasture based milk yield, irrigated grazing provides benefits of natural fertilization and improved field conditions as the cattle move throughout the pasture rather than congregating in one area. Consumers applaud efforts to produce milk in a natural, non-confined method with cow welfare in mind. Pasture grazing with irrigation is the alternative that is needed to make production possible and profitable on the small scale, pasture-based dairy.

Key Words: Grazing, Irrigation, Dairy

131 The natural fertilizer. K. M. Bridges*, *Louisiana State University*, *Baton Rouge*.

Often manure is thought of as useless waste that should be removed as quickly as possible. It harbors pathogens, smells bad, and just gets in the way. However, manure can be a valuable asset to the farmer. Many of the nutrients in the diet are not all used by the cow, and therefore some are excreted in the manure. These nutrients can be utilized as fertilizer if managed properly. The major nutrients used by plants are nitrogen, phosphorus, and potassium. The average lactating dairy cow excretes approximately 0.8 pounds of N, 0.12 pounds of P, and 0.45 pounds of K. The plant available amounts of these nutrients are mainly affected by storage, distribution, and other handling techniques. Manure can also be composted and sold for landscaping and home gardening, and it can be burned to produce methane, a valuable fuel. There are other management practices that can reduce pathogens, odor, and prevent environmental contamination. These practices include aerobic and anaerobic digestion and wetland production. Without sound waste management practices, environmental contamination may take place. Excess nutrients on cropland may become runoff and contaminate waterways, which could lead to eutrophication. Improper irrigation may cause nutrient buildup in the soil surface or leaching into groundwater. Denitrification of ammonia will contribute to greenhouse gases. There are agencies and regulations in place to prevent this occurrence. Manure, properly managed, is a versatile asset that can be used in many ways to possibly save or even make money for the farmer. If it is improperly managed, its value

decreases and pollution can occur. Therefore, manure, although it is waste, should not be thrown away.

Key Words: Manure, Fertilizer, Nutrients

132 Effects of heat stress and milk replacer strategy on calf growth, starter intake, and fecal scores. L. J. Berger*, G. A. Holub, and J. E. Sawyer, *Texas A&M University*, *College Station*.

The objective of this study was to evaluate the effects of heat stress and milk replacer strategy on calf performance. Holstein bull calves < 7 d of age were housed in fiberglass hutches in either a moderate heat stress period (MS; May 5 to July 2; n=47) or a high heat stress period (HS; July 25 to Sep 22; n = 43). Within period, calves were fed either a low input (LI; 454 g/d, 20% CP, 20% fat) or a high input (HI; 908 g/d 28% CP, 15% fat) milk replacer program beginning on d 7 until d 56. Calves had ad libitum access to a commercial starter diet and water. Intake of starter diet and fecal scores (1 = firm, 4 = watery) were recorded daily. Body weight was recorded every 7 d through d 56 (pre-weaning) and from d 56 until d 104 (post-weaning) of each period. Rate of BW gain (ADG) was estimated from the regression of BW on time by calf pre- and post-weaning. Time required for calves to consistently consume starter diet and ADG were compared with heat stress period, replacer strategy, and their interaction as fixed effects. Fecal scores were evaluated as repeated measures with the above effects, time, and all interactions where calf was the subject. Calves fed HI had greater pre-weaning ADG ($P < 0.01$) than LI (0.73 vs. 0.48 ± 0.02 kg/d). Effect of replacer type on post-weaning ADG depended on heat level ($P = 0.03$). Calf ADG was similar for HI and LI during MS, but was greater ($P=0.05$) for HI in HS. More days were required to reach weaning (0.9 kg/d of starter diet for 3 consecutive days) during HS ($P < 0.01$, 39.3 vs. 48.6 ± 0.97). Heat stress, replacer strategy, and their interaction influenced fecal scores. Calves fed HI had higher ($P < 0.01$) fecal scores than those fed LI (2.18 vs. 1.82 ± 0.02). For calves fed HI, fecal scores increased as heat level increased from MS to HS ($P < 0.01$, 2.07 vs. 2.29 ± 0.02), while for calves fed LI fecal scores were similar under MS or HS ($P = 0.56$, 1.81 vs. 1.84 ± 0.03). High input milk replacer strategies resulted in higher calf ADG and appear to mitigate the effects of heat stress on post-weaning growth, despite reducing firmness of fecal matter.

Key Words: Calf, Growth, Nutrition