

292 Response of the somatotrophic axis and growth rate in mule deer (*Odocoileus hemionus*) fed three different diets from birth to 68 weeks of age. G. A. Comeau*¹, S. McCusker², J. P. Richmond¹, L. A. Shipley², E. A. Koutsos³, and S. A. Zinn¹, ¹University of Connecticut, Storrs, ²Washington State University, Pullman, ³Mazuri Exotic Animal Nutrition, St. Louis, MO.

To examine the somatotrophic axis in mule deer fed 3 distinct diets from birth (June) to 68 wk of age, mule deer (n=24) were randomly assigned to 1 of 3 dietary treatments [3 males (M); 5 females (F)/group]. Before weaning (15 wk), animals were fed milk replacer and their experimental diet. Diets differed in starch and fiber [A: high starch (22%), low fiber (13%); B: medium starch (16%), medium fiber (15%); and C: low starch (3%), high fiber (29%); DM basis]. Animals were exposed to natural photoperiods. Blood samples and BW were taken at 0, 5, 15, 24, 33, 47, 58, 68 wk. From 24 to 68 wk, leg length, and loin (LT) and rump fat (RFT) thickness were measured. Plasma GH and IGF-I were determined using RIA and IGFBP-2 and -3 were quantified using ligand blot. Except for IGFBP-2, diet did not influence any variables measured and data were combined. Average BW increased (P<0.01) from birth (7.3±1.2 kg) to 68 wk (66.4±1.1 kg) and was greater (P<0.01) in M than F (36.2±1.2 vs. 30.5 ±0.9 kg). Leg length (42.8 to 48.5±0.3 cm) and LT (2.8 to 3.7±0.07 cm) increased (P<0.01) from 24 to 68 wk and were greater (P<0.01) in M than F (47.1 vs. 44.5±0.3 cm, 3.4 vs. 3.0±0.1 cm, respectively). Measures of RFT decreased (P>0.01) from 24 to 47 wk (0.5±0.06 to 0.05 ±0.07 cm) and then increased (P<0.01) until 68 wk (1.5±0.1 cm). In addition, RFT tended to be greater (P<0.09) in M than F (0.53 vs. 0.38±0.05 cm). Concentrations of GH decreased (P=0.01) from birth (9.4±1.7 ng/mL) to 68 wk (1.7±1.4 ng/mL). Plasma IGFBP-2 paralleled changes in GH, except IGFBP-2 was greater (P = 0.05) in fawns fed Diet A. From birth to 33 wk IGF-I declined (112 to 63±9.4 ng/mL; P<0.01), and then gradually increased (P<0.01) until 68 wk (133±9.4 ng/mL). Overall IGF-I was greater in M than F (135±7.7 vs 98±4.3 ng/mL). Concentrations of IGFBP-3 paralleled IGF-I. Developmental patterns of GH and IGFBP-2 are similar to domestic cattle, but the decline in IGF-I and IGFBP-3 from birth to 33 wk may indicate that season influences these hormones in mule deer.

Key Words: mule deer, somatotrophic axis, insulin-like growth factor-I

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294 Behavior and dairy cattle nutrition: Not just what she eats but how she eats it. M. A. G. von Keyserlingk* and D. M. Weary, *University of British Columbia, Vancouver, BC, Canada.*

One of the most important challenges that any animal faces is ensuring its daily food supply. In intensive dairy cattle production, cows are completely reliant on our ability and knowledge to provide them with food that supports growth, productivity, health and welfare. There has been great progress in the field of dairy cattle nutrition over the past years – we are now better able to estimate the dietary needs of dairy cattle, and meet these needs through carefully formulated diets. Research on behavior is now broadening our understanding of dairy cattle nutrition; the question is no longer just what do they eat, but how do they eat it, and this improved understanding of behavior is helping to avoid practical problems such as competition for feed. One of the main challenges for lactating dairy cows is a sudden increase in nutrient requirements to support the onset of lactation at a time when dry matter intake lags behind. Cows are also susceptible to a suite of diseases in these weeks immediately after parturition. Thus, a more sensitive method of continuously monitoring animal health or risk for disease during the transition period is needed. Recent work in our laboratory indicates that changes in

293 Effects of zinc amino acid complex and iron amino acid complex on performance, health and pelt quality of weanling blue fox (*Alopex lagopus*). Y. Zhang¹, H. Wei¹, D. J. Tomlinson*², and T. L. Ward², ¹Institute of Special Wild Animal and Plant Science, Jilin, China, ²Zinpro Corporation, Eden Prairie, MN.

Healthy 65-day old arctic blue foxes (60 male and 60 female) with similar body weight and near kinship were assigned randomly to one of four treatments with 30 replicates. Treatment diets were: (1) Control: 80ppm supplemental Zn from ZnSO₄; (2) 40ppm Zn from ZnSO₄+40ppm Zn from Availa-Zn zinc amino acid complex (AvZn); (3) 80ppm Zn from AvZn; (4) diet 2 +40ppm Fe from Availa-Fe iron amino acid complex (AvFe). Diets were similar in ingredient composition except for trace mineral supplement. Diets were offered in two phases: growth (0 to 60d) and pelting (61 to 147d). Foxes were fed and managed in individual cages. Body weight and size were recorded every two wk. Ten kits were sacrificed at the beginning of the study to establish liver trace mineral status. Blood was collected from 24 foxes per treatment at the beginning and end of the study to measure superoxide dismutase and lactate dehydrogenase activity. At the end of the study, liver samples were collected from 24 fox per treatment to determine trace mineral status. Pelt quality was assessed for length, width and total area. Fur quality was assessed for texture, uniformity, color, clarity, length and density. Results show that compared to inorganic zinc, supplementing with AvZn at 40 or 80ppm Zn resulted in greater weight gain (P < 0.05) and feed intake (P < 0.05); longer body length at 80 ppm AvZn (P < 0.05); better fur quality (skin length, width and area with AvZn at 80 ppm; length and amount of guard hair and fluff, and fur density – all AvZn treatments; P < 0.05); and higher scores in sensory assessment – all AvZn treatments; significant increase in liver zinc concentration at 80 ppm AvZn (P < 0.01); greater maintenance of serum SOD and LDH activity which increased with level of AvZn in diet. These findings indicate supplementing arctic blue fox with AvailZn and AvailFe had positive effects on growth, fur quality and sensory effects.

Key Words: fox, zinc amino acid complex, iron amino acid complex

feeding behavior and dry matter intake in the weeks before calving are valuable indicators of illness in dairy cows. An understanding of social behavior in cattle can help improve feed access and changes in these behaviours also can be used as an early indicator of ill health.

Key Words: behavior, nutrition, dairy cattle

295 Interactions of nutrition and behavior in dairy calves. J. K. Drackley*, *University of Illinois, Urbana.*

Raising dairy calves has too often been viewed as a nuisance on dairy farms rather than as a critical investment for the future of the business. That calves have remarkable growth potential in early life has been well-documented for decades, yet has been forgotten amid the convention of restricted calf feeding. Recent research has confirmed this unexploited growth potential and also demonstrated that improved early nutrition increases subsequent milk yield. These findings have resulted in widespread interest in early-life nutrition in calves, and how to provide it in practical on-farm systems. While behavioral research in calves has frequently been relegated by nutritionists to the category of

animal welfare interests, a large body of research has accumulated on the importance of animal behavior in promoting efficient early growth. Researchers have investigated such aspects as teat versus bucket feeding, temperature and consistency of liquid feeds, availability and use of water, ad libitum versus restricted feeding, feeder design, computer feeding systems, single versus pair or group housing, number of feedings daily, systems for introduction of starter, and weaning methods. Management systems that capitalize on various natural feeding behaviors are becoming more clearly defined. These systems offer the possibility to capture greater biological efficiencies of nutrient utilization at little if any additional net costs for capital or labor. With animal agriculture worldwide challenged to improve utilization of nutrients and decrease nutrient loss to the environment, these systems are increasingly attractive for reasons beyond just improving animal well-being. However, widespread adoption of behaviorally enhanced feeding programs will require a major paradigm shift within the industry. Extensive education about their proper implementation and benefits will be essential. In particular, the concept that the calf is an investment for the future, and is complex with variable nutrient and behavioral requirements, must continue to be reinforced throughout the dairy industry.

Key Words: calves, feeding systems, feeding behavior

296 Understanding the behavior of growing dairy heifers from a nutritional perspective. T. J. DeVries*, *University of Guelph, Kemptville Campus, Kemptville, Ontario, Canada.*

The primary goals of dairy replacement heifer rearing are to feed heifers for maximal production potential, while at a low economic and environmental cost, without compromising health or welfare. To meet these goals the feeding strategies utilized for dairy heifers are variable, including traditional high-fiber forage diets, higher energy diets to shorten the rearing period and reduce feed costs, and higher energy diets fed in a limited amount to control growth rate, while reducing feed costs and improving nutrient utilization. As with adult dairy cattle the feeding behavior of growing dairy heifers interacts with the feeding strategy utilized, as well as with the housing and management associated with those feeding strategies. For higher forage diets, with limited concentrate feeding, feeding method has a strong influence on feeding behavior. Component feeding results in the rapid consumption of concentrate after feed delivery, prior to forage consumption, and increases feed sorting across the day. Alternatively, provision of a TMR to growing heifers promotes feeding behavior patterns that result in a more balanced intake of nutrients across the day. Limit feeding dairy heifers caused changes in behavior, indicative of hunger and frustration. These behavioral changes include increased vocalization, increased standing while not eating, as well as aggressive 'reaching' to acquire feed. Given that feed is only available for a limited amount of time, adequate bunk space is required to reduce competition for feed and thus allow for equal bunk access. This in turn will reduce between-heifer nutrient intake variability, and thus reduce within-pen variability in growth and improve overall animal health. Alternatives to limit feeding include provision of low-nutritive feedstuffs in the ration. Such rations have been shown to target nutrient intake without negatively affecting feeding behavior or growth potential. Future research is needed to further refine the feeding strategies of growing dairy heifers to meet the goals of rearing these animals, while maintaining their behavioral needs, health and overall welfare.

Key Words: dairy heifer, behavior, feeding strategy

297 Application of feeding behavior as an indicator of pain and morbidity in feedlot cattle. K. Schwartzkopf-Genswein*, L. González, D. Gibb, and T. McAllister, *Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada.*

Studies exploring the utility of feeding and drinking behavior in the early detection of pain or sickness in feedlot cattle have shown great potential for identifying well-being and health issues before overt symptoms are displayed. Early detection of pain would allow for more targeted and effective pain mitigation, and improve welfare. Likewise, early detection of illness could improve an animals' response to drug therapy and help reduce the negative effects of disease. The magnitude and direction of change observed in specific feeding behavior measures with the onset of health problems or painful events appears to depend on the tissue or system being affected. For example, some health disorders (i.e. bovine respiratory disease) reduce appetite and feed intake leading to a reduction in daily feeding duration. In contrast, pain associated with castration results in calves making fewer daily visits to the feeder while daily feeding duration remains unchanged between castrated and uncastrated calves. Documenting changes in feeding behavior will allow a better understanding of the mechanisms affected, and the development of specific strategies to improve management and monitor their effectiveness. Automated approaches for the detection of pain and illness, such as radio frequency technology, will aid in facilitating such research.

Key Words: feeding behavior, feedlot cattle, morbidity

298 Grazing preferences in sheep and cattle: Implications for production, the environment and animal welfare. S. M. Rutter*, *Harper Adams University College, Newport, Shropshire, United Kingdom.*

Given a free choice of grazing on adjacent monocultures of perennial ryegrass and white clover, sheep and cattle show a partial preference of approximately 70% for clover. They also show a consistent diurnal pattern of preference, with the proportion of grass in their diet increasing over the course of the day. Studies with lactating dairy cattle show they produce significantly more milk when they graze adjacent grass/clover monocultures compared with mixed swards. This is attributed to reducing the costs of selection i.e. the spatial separation of the monocultures makes it easier for the cattle to select their own diet without having to search through the mixed sward. In-vitro studies have shown that the optimal level of microbial protein synthesis in an artificial rumen is achieved with approximately 70% clover i.e. the same proportion as the animals select. This suggests that the animals are selecting a diet that optimizes their own feed conversion efficiency, so optimizing the use of nutrients. Although requiring further research, this could help to reduce the environmental impact of ruminant production. In ongoing research, high-yielding dairy cows given a free choice between eating a total mixed ration indoors or grazing grass outdoors showed a partial preference of approximately 91% to be indoors. When outdoors, cattle spent a significantly higher proportion of their time eating compared with indoors, even though a TMR with a higher potential intake rate was freely available indoors. The fact that high-yielding dairy cattle make this trade-off suggests that the choice to graze outdoors is of some importance to them, and, therefore, is also of importance to their welfare. Further research is needed to establish whether it is being able to graze that is important, or whether the important factor is simply having a choice. In conclusion, offering cattle and sheep separated feeds enables them to easily choose what to eat and can offer clear production benefits. It could also offer environmental and animal welfare benefits. The development of livestock feeding regimes that facilitate diet choice warrants further research.

Key Words: grazing, preference, behavior