

**260 Use of limpograss (*Hemarthria altissima*) in cow-calf grazing systems in southern Florida.** J. D. Arthington\*, *University of Florida-IFAS, Range Cattle Research and Education Center, Ona.*

Over 70% of Florida's 1 million beef cows reside in the state's peninsular region. Forages capable of providing adequate DM yield in the winter are a limitation to beef production systems in this region. Limpograss (*Hemarthria altissima*) possesses superior winter yield compared to other warm season perennial grasses. First extensively evaluated in 1974, 'Floralta' limpograss is the most widely utilized of the available limpograss varieties in southern Florida. This tropical grass originates from the Limpopo River in the Republic of South Africa. Floralta is a stoloniferous perennial tropical grass that was specifically selected for persistence under grazing conditions. In southern Florida, Floralta limpograss can be expected to produce as much as 40% of its annual growth in the winter months compared to only 10% for bahiagrass (*Paspalum notatum*), the predominate pasture forage specie in Florida. Another distinct characteristic of Floralta is the ability to maintain appreciable digestibility at later stages of maturity, suggesting potential as a stockpiled forage crop. In one 3-yr study, fall-calving cows assigned to a bahiagrass/limpograss rotational grazing system produced calves of equal weaning weight compared to cows grazing winter bahiagrass. In that study, 0.30 ha of stockpiled limpograss was equivalent to approximately 635 kg of supplemental winter. No differences in cow pregnancy rate were observed among grazing systems. Another distinct characteristic of limpograss is its relatively low crude protein content. Research investigating the performance of growing cattle grazing limpograss suggests that growth is not enhanced by protein supplementation until after the first frost of the season. After this time, protein-supplemented heifers realize a significant improvement in BW gain compared to heifers receiving no supplemental protein. Current research in southern Florida suggests that grazing strategies incorporating stockpiled limpograss could be an effective alternative to winter hay feeding. In addition, growing cattle grazing limpograss pastures may benefit from the provision of supplemental protein, especially after a killing frost.

**Key Words:** Limpograss, Grazing, Cow

**261 Managing tropical forages: production, environmental benefits and risks.** B. C. Pengelly\* and J. G. McIvor, *Agricultural Landscapes, CSIRO Sustainable Ecosystems, St Lucia, Qld, Australia.*

Tropical forages have been used in farming systems of the developed and developing world for several decades. Grasses such as *Panicum* spp. and *Pennisetum* spp. have been cultivated for over a century but in the past 50 years there has been a greater focus on legumes such as *Stylosanthes* and *Vigna* spp. In all, over 150 tropical grass and legume species have been identified as being of value in the wide range of tropical and subtropical farming systems. The aims of much of the tropical forage research and cultivar development has been to increase animal production by identifying higher yielding species with better forage quality. The benefits of these species have been improved nutrition of animals and subsequently greater production of meat, milk and wool as well as better reproduction. The production downsides of this pasture use have been high costs, low reliability and poor persistence in some situations. The last 20 years has seen more attention given to environmental aspects of the use of these species. Environmental benefits from such use include nitrogen fixation and raised availability of nitrogen to other species, improved soil carbon levels, greater water use, and biodiversity benefits when compared to cropping systems. However the use of tropical forages has also been associated with a range of environmental disadvantages such as loss of native biodiversity, weed potential, enhanced nitrogen causing changes in species composition, and soil acidification. Overall, there have been large production benefits and some environmental gains from the development and adoption of tropical forages but these have come at a cost. The continuing challenge is in balancing the benefits and costs of their use through the better selection of appropriate species and application of appropriate management. Science has a role in both aspects.

## Horse Species: Recent Advances in Understanding Metabolic Disorders in Horses

**262 The impact of variability in pasture forages on horse metabolism.** B. McIntosh<sup>1,2</sup>, D. Kronfeld<sup>1</sup>, R. Geor<sup>1</sup>, W. Staniar<sup>1</sup>, P. Harris<sup>3</sup>, and D. Ward<sup>4</sup>, <sup>1</sup>Virginia Polytechnic Institute and State University, Blacksburg, <sup>2</sup>Blue Seal Feeds Inc., Londonderry, NH, <sup>3</sup>WALTHAM Centre for Pet Nutrition, Melton Mowbray, United Kingdom, <sup>4</sup>Rutgers University, Bridgeton, NJ.

Nonstructural carbohydrates (NSC), which includes sugars, starches and fructans in pasture forages undergo circadian and seasonal variation which have direct effects on metabolism in grazing horses. Increased intake of NSC is implicated in the development of digestive and metabolic disorders, such as laminitis. A series of 36 h studies in Virginia examined circadian and seasonal variability in forage NSC content and circulating plasma glucose and insulin in grazing horses (n=10) compared to control horses fed timothy/alfalfa hay (n=4). The unequal group size was accounted for in the statistical analyses which included two-way repeated measures ANOVA with post tests, linear regression, and correlations. We found that circadian and seasonal patterns in forage NSC content in a 5-ha mixed grass/legume pasture

were associated with environmental conditions, and NSC was in turn associated with plasma insulin and glucose in the grazing horses. Forage NSC content was highest in April (20.3±0.4 %DM) (P < 0.001) and was attributed mostly to sugars (18.9±0.4 %DM), including glucose, sucrose and fructose. Circadian patterns in forage NSC were evident in April, May, and August, with the most distinct pattern found in April with peaks in the afternoon (22.2±0.3 %DM) and nadirs in the morning (17.1±0.3 %DM). Plasma insulin was higher in grazing horses than control horses in April (54.6±9.9µIU/mL) and May (20.8±3.4µIU/mL) (P < 0.05). In grazing horses, plasma insulin was significantly correlated with forage NSC and sugar in April, May, and January. In grazing horses, plasma glucose was higher in April than all months except for May, and plasma glucose was higher in grazing horses compared to controls in April. These studies identified a potential link between forage NSC content and alterations in glucose and insulin characteristics that may increase risk of laminitis via exacerbation of insulin resistance. Management strategies to decrease intakes of pasture NSC by horses at risk of developing metabolic disorders are needed.

**Key Words:** Horse, Forage, Metabolism

**263 Advances in diagnosis and management of equine polysaccharide storage myopathy (PSSM).** M. E. McCue\*, S. J. Valberg, and J. R. Mickelson, *University of Minnesota, St. Paul.*

PSSM is a debilitating muscle disease in diverse breeds of horses. Clinical signs range from exertional rhabdomyolysis in Quarter Horses, muscle atrophy and progressive weakness in Draft breeds to muscle soreness and gait abnormalities in Warmbloods. PSSM affects 10% of Quarter Horses and 36% of Belgian Draft horses and an unknown number of Warmbloods in both Europe and North America. The gold standard for diagnosis of PSSM is the presence of periodic acid Schiff<sup>TM</sup> (PAS) positive inclusions in type 2A and type 2B muscle fibers which are resistant to amylase digestion. In addition, PSSM is characterized by 1.5-4 X normal glycogen concentrations in skeletal muscle. No defect in glycogenolysis or glycolysis have been identified in PSSM horses. Rather glycogen accumulation appears to be related to enhanced glycogen synthesis. In Quarter Horses enhanced insulin sensitivity is also reported. Through a limited breeding trial and a genetic association analysis of an extensive number of clinical cases, we recently identified an autosomal dominant genetic mutation that is highly associated with PSSM in both Quarter Horses and Belgian Draft horses. This mutation accounts for 80 and 89% of PSSM cases in each breed respectively. We anticipate a genetic test will be available for PSSM within the next year.

Dietary management of PSSM involves decreasing dietary starch and provision of a fat supplement as an alternative energy substrate. This stabilizes blood glucose, increases serum free fatty acids and lowers insulin concentrations. Fat supplementation should be used judiciously in overweight horses. Muscle stiffness and exertional rhabdomyolysis can be eliminated in most horses if this diet is combined with daily exercise. Quarter Horses have a low skeletal muscle oxidative capacity and low intramuscular lipid stores. Gradual training is essential to improve muscle function likely through increased glycogen metabolism, increased oxidative capacity to utilize fat and improved substrate flux.

**Key Words:** Genetic, Glycogen, Muscle

**264 Management of obesity and insulin resistance in horses.** R. J. Geor\*, R. A. Carter, and K. H. Treiber, *Virginia Polytechnic Institute and State University, Middleburg, VA.*

Although epidemiological data are scant, it has been suggested that the prevalence of obesity in horse (and pony) populations is on the rise. There is no universal definition of obesity in equids but according to the body condition scoring system (BCS) developed by Henneke, horses or ponies with a BCS of 8 (fat) or 9 (extremely fat) can be defined as obese, while animals with a BCS of 7 might be considered overweight. Insulin resistance (IR) is associated with obesity in horses and this disturbance to metabolic regulation may underlie susceptibility to laminitis, particularly the pasture-associated form of this disease. In support of this hypothesis, Treiber et al. (2006) recently described a "pre-laminitic metabolic syndrome" (PLMS) in otherwise healthy ponies with high (>70%) sensitivity and specificity for identification of animals at increased risk for pasture-associated laminitis. The central features of the PLMS were hyperinsulinemia, IR and generalized and/or regional (e.g. a cresty neck) adiposity. A similar clustering of clinical conditions, referred to as the equine metabolic syndrome (EMS), likely occurs in mature horses. In susceptible horses and ponies, consumption of forage or feed rich in nonstructural carbohydrates (NSC; sugars, fructans, and/or starch) may exacerbate IR and risk of laminitis. The mechanisms linking IR and laminitis are unknown, but might involve impaired glucose delivery to hoof keratinocytes or vascular endothelial dysfunction associated with oxidative stress and/or inflammation. Specific quantitative characterization of IR can be used to identify horses and ponies in need of special measures to avoid laminitis, particularly interventions that target decreased body fat mass and improved insulin sensitivity, including a reduction in dietary energy (calories) and NSC, restricted access to pasture during high-risk periods, and increased physical activity. The administration of levothyroxine sodium may be justified for animals that do not respond to diet and exercise programs alone.

*Treiber KH, Kronfeld DS, Hess TM et al. 2006. J Am Vet Med Assoc 228:1538-1545.*

**Key Words:** Horse, Obesity, Insulin resistance

## Lactation Biology: Metabolism and Gene Expression in Support of Lactation

**265 Characterization of the utilization of trans octadecenoic acids in lactating dairy cows.** C. Tyburczy\*<sup>1</sup>, A. L. Lock<sup>1</sup>, D. A. Dwyer<sup>1</sup>, F. Destailants<sup>2</sup>, Z. Mouloungui<sup>3</sup>, L. Candy<sup>3</sup>, and D. E. Bauman<sup>1</sup>, <sup>1</sup>Cornell University, Ithaca, NY, <sup>2</sup>Nestle Research Center, Lausanne, Switzerland, <sup>3</sup>Laboratoire de Chimie Agro-Industrielle, Toulouse, France.

The biological activity of individual octadecenoic acids may be dependent on the location and orientation of the double bond. Therefore, our objective was to examine the affect of elaidic acid (trans-9 18:1; EA) and vaccenic acid (trans-11 18:1; VA) in relation to oleic acid (cis-9 18:1; OA) during lactation. Three mid-lactation Holstein cows were used in a 3x3 Latin square design, and treatments (>82% purity) involved abomasal infusion of 1) EA (41.7 g/d), 2) VA (41.4 g/d) and 3) OA (45.5 g/d). Treatment periods were 4 d, separated by a 7 d wash-out interval. Milk yield (24.2 ± 2.2 kg/d; mean ± SD) and yield of milk components were not affected by treatment. Incorporation

of infused isomers into milk fat triglycerides (TG) plateaued by d 3 and transfer efficiency averaged 59.1 ± 0.1%, 54.2 ± 0.1% and 54.6 ± 0.3% for EA, VA and OA, respectively. For the VA treatment, milk fat content of cis-9, trans-11 conjugated linoleic acid (CLA) more than doubled and the ratio of VA to CLA did not change, consistent with mammary conversion of VA to CLA by delta-9 desaturase. Total lipid concentration of plasma lipid classes averaged 209.9 ± 10.5 mg/dl, 161.4 ± 15.4 mg/dl, 14.5 ± 2.0 mg/dl and 2.4 ± 0.5 mg/dl for phospholipids (PL), cholesterol esters (CE), TG and free fatty acids (FFA), respectively. Similar values for the proportion of fatty acids provided by each plasma lipid class were 60.3 ± 2.2%, 32.1 ± 1.8%, 6.4 ± 0.8% and 1.2 ± 0.3%. Infusion of EA, VA and OA increased their specific content in plasma PL, TG and FFA, but for VA the relative increase was much greater for plasma TG and FFA. Overall, data demonstrate that biological differences exist among individual octadecenoic acids in lactating dairy cows.

**Key Words:** Milk Fat, Trans Fatty Acids, Lactation