

## Horse Species

### **W135 Trends in equine farm management and conservation practices.** B. J. McIntosh\* and S. A. Hawkins, *The University of Tennessee, Knoxville.*

It is widely recognized that horse farms often have unthrifty, weed infested and overgrazed pastures due to poor grazing management practices, including continuous grazing and overstocking. Poorly managed pastures and lack of appropriate waste management practices on horse farms contribute to surface water pollutant loads of sediment, nutrients, and pathogens. A survey consisting of 48 questions was distributed to participants of the Tennessee Master Horse Owner Program from 2008 to 2011 to identify potential educational needs, demographics and management practices of horse farms. Data are summarized as percentages or mean  $\pm$  SE. The response rate was 89.0% and surveys (n = 121) were completed by respondents from 18 counties in TN and the states of MS, AR and AL. The respondents consisted of the following age ranges: less than 20 yr (6.6%); 20–29 yr (9.9%); 30–39 yr (6.6%); 40–49 yr (21.5%); 50–59 yr (43.8%); and 60–69 (12.4%). The majority of respondents were female (77.6%) compared with male (23.1%). Most of the respondents indicated involvement in the equine industry for more than 10 years (54.5%). The number of horses per farm was  $5.0 \pm 0.6$  head with a range of 1 to 51. The area designated for pasture was  $25.6 \pm 0.8$  acres. However, 48.8% of farms designated 10 or fewer acres for grazing. Continuous grazing was practiced by 51.5% of respondents. Pasture weeds were reported to be a problem by 78.1% of respondents. Soil testing for nutrient content was not practiced by the majority of respondents (58.4%). Respondents indicated equine were stabled with access to pasture for turnout (62.6%), housed on pasture continuously (36.6%) or stabled continuously (0.8%). The majority of respondents reported that stall waste was stored on bare ground in uncovered piles (89.8%). Mud was reported to be an issue in high animal traffic areas during periods of wet weather on the majority of farms (80.5%). The management practices indicated by the respondents in this study may lead to pollution due to erosion, surface water runoff, or leaching of N or P and volatilization of N from animal waste. This study indicates there is a need for educational programs that target best management and conservation practices for equine farms to reduce adverse environmental impact.

**Key Words:** equine, management, conservation

### **W136 The effects of feed-borne *Fusarium* mycotoxins on the presence and severity of equine gastric ulcer syndrome and the efficacy of a glucomannan mycotoxin adsorbent.** M. Mortson,\* G. Girgis, H. Staempfli, A. Gallastegui, and T. K. Smith, *University of Guelph, Guelph, Ontario, Canada.*

Standardbred racehorses have a high prevalence of ulcer development ranging from 40 to 80%. Consumption of mycotoxin-contaminated diets can have a negative effect on equine health. A study was conducted to determine the effect of feed naturally contaminated with *Fusarium* mycotoxins on the presence of equine gastric ulcer syndrome (EGUS). Feed intake, body weight (BW) gain and serum hematological and biochemical parameters were evaluated as well as the efficacy of a glucomannan mycotoxin adsorbent (GMA) (Integral, Alltech Inc., Nicholasville, KY). Nine standardbred mares at maintenance, of similar age, were assigned to one of 3 dietary treatments for 28 d with a 21 d recovery, in a replicated 3x3 Latin Square design. Each horse was housed in individual stalls and received limited turnout daily. Dietary treatments included a control, a contaminated diet and a contaminated diet + 0.2% GMA. The 2 contaminated diets ranged

from 8.1 to 10 ppm deoxynivalenol and 1.2 ppm zearalenone, along with minor quantities of aflatoxin and fumonisin. Gastrosopies were performed and biopsies collected every 2 weeks during the experimental period. Day 0 ulcer scores ranged from 0 to 1 on a scale of 4 across treatment groups. Histological evaluation of the tissue biopsies showed inflammation of the glandular mucosa across treatments with varying distribution in the contaminated and GMA diets. Data was analyzed using a 2-way ANOVA including horse, diet and day in the statistical model ( $P < 0.05$ ). A slight decrease in feed intake was observed in the contaminated groups compared with the control although the results were not statistically significant. BW gain was not affected by diet. Diet significantly altered serum anion gap ( $P = 0.033$ ) and thymidylate synthase activity ( $P = 0.046$ ) when comparing the control to the contaminated and GMA diets. It was concluded that horses tolerated this level of mycotoxin challenge with respect to BW and feed intake but histological changes in the gastric mucosa were evident.

**Key Words:** *Fusarium* mycotoxins, horses, equine gastric ulcer syndrome

### **W137 Comparison of high fat, high fiber, and high starch diets on serum levels of insulin, IGF-1, and glucose in growing horses.**

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The objective of this study was to examine the effects of high fat, high fiber, and high starch diets on serum insulin, IGF-1, and glucose levels in growing horses. Yearling Quarter Horse fillies and geldings were randomly assigned into one of 3 treatment groups and individually fed 3 concentrates (each containing 4.0 Mcal/kg DE and 20% CP and fed at 2–3% of BW): 1) high fat (FT; 13% fat, 1% starch; as-fed basis: 90% alfalfa pellets (AF), 10% soybean oil; n = 6), 2) high fiber (FB; 3% fat, 1% starch; as-fed basis: 100% AF; n = 6) or 3) high starch (ST; 4% fat, 20% starch; as-fed basis: 50% AF, 20% ground shelled corn, 20% wheat middlings, 8% soybean meal, 2% minerals; n = 5). Each diet was formulated to contain approximately 20% CP to match the protein level of the FB diet. Diets were fed at 0700 h and 1800 h for 60 d. All horses were allowed 2 h of turnout exercise per day and weighed weekly. After 30 d (feed period 1) and 60 d (feed period 2) of treatment, blood samples were collected starting 15 min before (T-15) and 30 (T30), 60 (T60), and 180 (T180) min after the 0700 h feeding. Serum insulin, IGF-1, and glucose levels were analyzed using MIXED procedure of SAS in a split-split plot design. Main effects of diet, feed period, and time relative to feeding influenced ( $P < 0.05$ ) serum insulin and glucose levels. Within a treatment, glucose concentrations increased postprandially ( $P < 0.01$ ), peaking at T60. A subsequent decrease ( $P < 0.01$ ) in glucose levels was observed until T180. Insulin concentrations were greater ( $P < 0.05$ ) at T60 and T180 in horses fed ST diets compared with FB and FT diets (diet x time,  $P < 0.001$ ). Serum IGF-1 concentrations tended ( $P < 0.10$ ) to be influenced by diet x feed period. Serum IGF-1 levels in horses fed the ST diet tended to increase ( $P < 0.10$ ) from feed period 1 to 2, but did not change in horses fed FT and FB diets. Serum IGF-1 levels did not differ among groups in feed period 1. In feed period 2, horses fed the ST diet tended to have greater ( $P < 0.10$ ) IGF-1 levels ( $251 \pm 25$  ng/mL) than horses fed the FT ( $187 \pm 23$  ng/mL) or FB ( $187 \pm 23$  ng/mL) diets. Overall, the effects of ST diet on serum insulin and glucose were manifested acutely during feeding, whereas the effect of the ST diet on serum IGF-1 took 60 d to develop and was not acutely affected by feeding.

**Key Words:** equine, IGF-1, insulin

**W138 Horses decrease water intake when supplements are added to drinking water.** M. E. Gordon,\* B. L. Miller, and M. L. Jerina, *Land O'Lakes Purina Feed LLC, Gray Summit, MO.*

The objective of this study was to test the hypothesis that horses decrease water intake when supplements are added to water. Six mature Quarter Horses ( $564.5 \pm 44.0$  kg, BW  $\pm$  SD) were acclimated to drinking water from buckets over a 7 d period, and then offered both plain water (PW) and water with one of 4 different supplements (SW) in a block design. Each treatment period lasted for 5 d, and horses had a 2 d period between treatments when only PW was offered. Supplements included 2 electrolyte preparations (Farnam Apple Dex and Land O'Lakes Calf electrolyte), a vitamin/mineral (Farnam Red Cell) and a joint additive (Finish Line Fluid Action). All supplements were offered at a rate of 28 g per 18.93 L of water. Water intake from buckets was recorded via weight and replenished at 0700 and 1800. Horses were fed 1% BW grass hay and 3.6 kg of commercial pelleted diet daily throughout the trial, split into 2 feedings. Horses had ad libitum access to plain white salt in block form and were housed individually in stalls with attached dry lot paddocks. An incomplete block design was used to test the effect of supplements in water on water intake, utilizing ANOVA with mixed models (SAS 9.2 2010). Least squares means were compared with Fisher's least significant difference ( $P < 0.05$ ). There was an effect of adding supplements to water ( $P < 0.0001$ ), as horses preferred PW with mean daily intake of  $11.92 \pm 0.893$  L versus  $4.86 \pm 1.785$  L for SW. There was no difference within the supplement treatments for water intake ( $P < 0.05$ ). There was a trend for water intake to be affected by time of day ( $P = 0.0583$ ), with the greatest volume consumed overnight. This trend may have been influenced by timing of water weighing and replenishment and/or housing management conditions. In this study, horses drank over twice the amount of PW versus SW. Therefore, adding supplements to water can decrease intake in horses and may cause horses to become dehydrated. This may lead to poor performance or other adverse health effects in horses.

**Key Words:** equine, water intake, supplements

**W139 The effects of coprophagy on the hindgut bacterial community of neonatal foals.** L. A. Strasinger\*<sup>1</sup>, L. M. Lawrence<sup>1</sup>, M. D. Flythe<sup>2,1</sup>, G. L. Gellin<sup>2</sup>, M. Brummer<sup>1</sup>, B. E. Davis<sup>1</sup>, and L. R. Good<sup>1</sup>, <sup>1</sup>University of Kentucky, Lexington, <sup>2</sup>United States Department of Agriculture, Agricultural Research Service, Forage-Animal Production Research Unit, Lexington, KY.

How and when foals establish their hindgut bacterial community has received little attention from researchers. The aim of this study was to determine if coprophagy of maternal feces is essential for bacterial colonization of the foal's digestive tract. Eight mare and foal pairs were randomly allocated into 2 treatment groups, allowed access to maternal feces (allowed,  $n = 4$ ) and restricted access to maternal feces (restricted,  $n = 4$ ). For at least the first 96 h after parturition, foals in the allowed group were monitored via video surveillance and the number of bouts of coprophagy was recorded. In the restricted group, each pair was constantly observed by an attendant for the 96 h following parturition, and mare feces was removed immediately following defecation. Starting with the passing of the foal's meconium, fecal samples were taken from the mare and foal during the first 4 d. Samples were immediately frozen then later subjected to PCR-denaturing gradient gel electrophoresis (PCR-DGGE). Comparisons of each mare and foal was made using Dice's index and cluster analysis, and reported as percent similarity. Foal body weights were measured every day a fecal sample was taken. Foals in the allowed group ate mare feces as early as 27 h after birth. When PCR-DGGE was performed on the meconium of newborn foals (d 0), no bands were observed and % similarity between mares and foals was

0 for both groups. By d 2 and 4 the number of bands had increased ( $P < 0.01$ ), but there was no effect of time  $\times$  treatment ( $P > 0.05$ ). The average foal to mare similarity increased over time ( $P < 0.05$ ) but there was no time  $\times$  treatment interaction ( $P > 0.05$ ). The % similarity between foals and their dams was  $47 \pm 16.8$  (mean  $\pm$  SD) for allowed group and  $48 \pm 6.3$  for restricted group by d 2. The similarity between mare and foals on d 4 was to  $62\% \pm 9.1$  for allowed and  $55\% \pm 10.3$  for restricted. On d 14 restricted foals had an average daily gain of 2.06kg/d, while the allowed foals gained 1.77 kg/d ( $P > 0.05$ ). Restricting access to maternal feces in the neonatal period did not appear to alter the diversity of the foal's hindgut bacterial community by d 4.

**Key Words:** horse, neonates, microbiome

**W140 Influence of maternal plane of nutrition and arginine supplementation on mares and their foals: Foaling parameters.** K. N. Winsco\*<sup>1</sup>, J. A. Coverdale<sup>1</sup>, C. J. Hammer<sup>2,3</sup>, K. L. Gehl<sup>1</sup>, A. E. Hanson<sup>1</sup>, J. L. Lucia<sup>1</sup>, and A. N. Wolford<sup>1</sup>, <sup>1</sup>Department of Animal Science, Texas A&M University, College Station, <sup>2</sup>Department of Animal Sciences, North Dakota State University, Fargo, <sup>3</sup>Center for Nutrition and Pregnancy, North Dakota State University, Fargo.

To determine the effect of plane of nutrition and arginine supplementation on foaling parameters, 32 mares (468 to 668 kg BW; 3 to 19 yr) were blocked by expected foaling date and randomly assigned within block to treatments which were arranged as a  $2 \times 2$  factorial with 2 planes of nutrition, moderate (Mod; 0.5% BW AF grain/d) or high (High; 1% BW AF grain/d) and 2 levels of L-arginine supplementation, 0.21 g/kg/d (Arg) or no supplemental Arg (Con; L-alanine to maintain isonitrogenous diets). Treatments began 110 d before expected foaling date and terminated at parturition. Mares were housed by block and allowed ad libitum access to water and coastal bermudagrass (*C. dactylon*) hay, and fed commercial grain  $2 \times$  /d in individual stalls. Parturition was observed and the following foaling parameters were recorded: time of water break to birth, time to stand, and time of birth to placenta expulsion. Total length of gestation was calculated and placenta weight was recorded. Additionally, total colostrum volume (CV), specific gravity (SG), and Brix% of colostrum were measured. Physical measurements were also obtained which included mare BW, foal BW, foal wither and hip height, and foal body length. Data were analyzed using PROC GLM of SAS with main effects tested being plane of nutrition (Nutr), amino acid (AA), time, and their interactions. Significance was declared when  $P \leq 0.05$  and a trend toward significance declared when  $P \leq 0.10$ . There was no influence of Nutr or AA on gestation length, foaling parameters, physical measurements, ratio of placenta to mare BW, placenta to foal BW, and ratio of foal BW to mare BW ( $P \geq 0.15$ ). Maternal plane of nutrition tended to influence CV ( $P \leq 0.08$ ) with Mod mares having greater volume compared with High. There was an influence of Nutr ( $P \leq 0.03$ ) on colostrum quality indicated by greater SG in High mares compared with Mod. In summary, these data indicate that maternal plane of nutrition in late gestation affects colostrum volume and quality estimates, while arginine supplementation had no effect on foaling parameters, colostrum, or foal physical characteristics.

**Key Words:** pregnant mares, parturition, arginine

**W141 Mineral concentrations of cool season grasses as affected by specie and season.** A. L. Fowler,\* L. M. Lawrence, S. H. Hayes, and S. R. Smith Jr., *University of Kentucky, Lexington.*

In pasture-based horse production systems in Central Kentucky the concentrate is the primary source of many minerals imported onto

the farm, including phosphorus (P), potassium (K) and copper (Cu). By complementing the minerals in the concentrate with the minerals provided by the pasture, a reduction in mineral importation to the farm might be achieved. To develop a synchronized feeding program, factors affecting the concentration of minerals in the forage must be assessed. To this end, 2 studies were conducted. In experiment 1, replicated plots of 5 cool season grasses were sampled in early May to assess differences in the concentrations of calcium (Ca), P, Cu, K and the Ca:P ratio among species. Multiple samples of perennial ryegrass (n = 12), timothy (n = 12), tall fescue (n = 7), festulolium (n = 4), and orchardgrass (n = 4) were collected from experimental plots seeded the previous fall. Effect of grass specie on mineral content was determined using ANOVA. Ca concentrations ranged from a high of 0.73% in perennial ryegrass to a low of 0.49% in timothy ( $P < 0.0001$ ). Festulolium and perennial ryegrass had the highest concentrations of P (0.46% and 0.46%, respectively), while timothy had the lowest (0.33%;  $P < 0.0001$ ). There were no differences in the Ca:P ratio among species ( $P > 0.05$ ). Timothy had the highest concentration of Cu and perennial ryegrass, festulolium, and tall fescue had the lowest concentrations ( $P < 0.0001$ ). Perennial ryegrass, festulolium, and orchardgrass had higher concentrations of K than tall fescue and timothy ( $P < 0.0001$ ). In experiment 2, samples of 8 tall fescue cultivars were collected from experimental plots in early May and late September to evaluate seasonal differences in the concentrations of Ca, P, Cu, K and the Ca:P ratio. No differences were found in mineral concentrations between spring and fall ( $P > 0.05$ ). When synchronizing mineral content between pasture and concentrate, it might be beneficial to select pasture varieties that contain a higher concentration of necessary minerals to reduce the need for mineral supplementation of the diet and thus reduce the importation of nutrients to the farm.

**Key Words:** horse, calcium, phosphorus

**W142 Effects of late gestation on conformation and movement in mares.** H. Roberts,\* J. M. Reddish, and K. Cole, *Department of Animal Sciences, The Ohio State University, Columbus.*

Studies have shown that conformation, soundness and external weight distribution can affect a horse's movement. These factors can also influence the viability of the mare as a breeding animal. The effects of internal weight as opposed to external weight distribution have not yet been evaluated. During pregnancy, mares typically gain approximately 10% of their body weight (BW), with the majority of the weight gain occurring during the last 3 mo of gestation. The objective of this study was to evaluate the effects of increased BW during late gestation on conformation and movement in Quarter Horse mares. Each mare (n = 5) was videotaped in hand at the walk and trot tracking to the left and right on a flat surface on d 270, 285, 300, 315 and 330 of gestation, within 12 h of foaling, and d 15 and 30 postpartum. The camera was positioned at a height of 3.0 m and 8.6 m away from and perpendicular to the line of travel. Each horse was photographed from the left and right lateral view along with a plantar view of the left front and rear hoof. Videos and photographs were analyzed using OnTrack Equine software for hoof width, shoulder and hip angle, maximum knee and hock angle at the walk and trot, and stride length at the walk and trot. Data were analyzed using the PROC MIXED procedure of SAS. A P value of  $\leq 0.05$  was considered statistically significant. Average gestation length was  $341.8 \pm 8.9$  d. BW increased by an average of 4.5% in the mares between d 270 of gestation and foaling then decreased after the birth of the foal and passage of the placenta ( $P = 0.059$ ). Conformation of the shoulder and hip were not influenced by increased BW during late gestation ( $P > 0.05$ ). Similarly, BW did not influence conformation of the hoof, as measured by hoof width ( $P > 0.05$ ). Stride length at the

walk and trot were not influenced by BW ( $P > 0.05$ ). Knee and hock angles recorded at the walk and trot also were not influenced by BW ( $P > 0.05$ ); however, there was a tendency for these measurements to decrease between d 330 of gestation and 15 d postpartum. In summary, increased BW during late gestation did not influence the conformation or movement of mares in this study.

**Key Words:** horse, movement, gestation

**W143 Exercise response in unfit horses of different selenium status.** M. Brummer,\* S. Hayes, B. E. Davis, L. A. Strasinger, S. M. McCown, and L. M. Lawrence, *University of Kentucky, Lexington.*

Glutathione peroxidase (GPx) plays an important role in the neutralization of hydrogen peroxide which can generate hydroxyl radicals known as reactive oxygen species (ROS). Exercise has been shown to increase ROS as well as alter GPx activity post exercise. This study aimed to evaluate the effect of Se status on the response of unfit horses to mild exercise. Twenty 5 mature horses that had received one of 4 dietary Se treatments for 29 wk were used. The 4 dietary treatments were low Se (LS, n = 6), adequate Se (AS, sodium selenite, n = 6), high organic Se (SP; Sel-Plex, Alltech, Nicholasville, KY, n = 7) and high inorganic Se (SS, sodium selenite, n = 6). Total dietary Se for LS, AS, SP and SS was 0.07, 0.14, 0.3 and 0.3 ppm respectively. The basal diet consisted of low Se pasture, hay, cracked corn and a balancer pellet either low (LS, SP, SS) or adequate (AS) in Se. The SP and SS supplements were top dressed on the balancer pellet. Prior to the exercise test blood Se was higher ( $P < 0.01$ ) for SP and SS (255 and 240 ng/mL) than AS and LS (195 and 125 ng/mL). Vitamin E status was adequate and similar between groups ( $P > 0.05$ ). The exercise test, conducted in a 6 horse exerciser (Stratton Equine Enterprise Inc., Lexington, KY), consisted of walking and trotting, covering 4.41 km in 36 min. Blood samples were taken pre-, 0, 4 and 24 h post exercise to evaluate blood GPx activity, serum malondialdehyde (MDA) as indicator of oxidative stress, serum creatine kinase (CK) and aspartate aminotransferase (AST). Data were analyzed as ANOVA with repeated measures (SAS 9.2). There was an effect of treatment ( $P < 0.05$ ) and treatment x time ( $P < 0.05$ ) for GPx. Post exercise GPx decreased in LS and did not recover by 24 h, while remaining unchanged in AS. Post exercise GPx increased in SP and decreased in SS, but both returned to pre values at 24 h. At 24 h MDA was elevated in all groups (time  $P < 0.05$ ). MDA was lower at 4 h in SP compared with AS (treatment x time  $P < 0.05$ ). CK and AST were unaffected by Se status ( $P > 0.05$ ). Overall Se status did not have a substantial effect on response to exercise in unfit horses, but the differences in post exercise GPx response may warrant further investigation.

**Key Words:** equine, GPx, MDA

**W144 The effect of antibiotic administration on fermentative characteristics of equine feces.** B. E. Davis\*<sup>1</sup>, L. M. Lawrence<sup>1</sup>, M. D. Flythe<sup>2,1</sup>, S. H. Hayes<sup>1</sup>, C. Wilson<sup>1</sup>, A. L. Fowler<sup>1</sup>, M. Brummer<sup>1</sup>, and L. A. Strasinger<sup>1</sup>, <sup>1</sup>University of Kentucky, Lexington, <sup>2</sup>United States Department of Agriculture, Agricultural Research Service, Forage-Animal Production Research Unit, Lexington, KY.

Horses are often treated with antibiotics in response to wounds or respiratory disease. Antibiotic use is occasionally associated with diarrhea, suggesting a disruption of the normal hindgut microflora. Not all horses receiving antibiotics develop diarrhea, but it is not known whether antibiotic treatment alters fermentation in the hindgut. Therefore, this study was designed to look at the effect of 2 commonly used antibiotics on the functional capacity of the microbial community of

the equine hindgut. Horses ranging from 2 to 14 y, were blocked by age and gender into 6 blocks of 3 horses each. Within block horses were randomly assigned to 1 of 3 treatments: CO (no antibiotic; n = 6), ST (trimethoprim-sulfadiazine, oral, 30 mg/kg; n = 6) and CF (ceftiofur sodium, IM, 2.2 mg/kg; n = 6). Each block consisted of a 21 d adaptation, a 7 d treatment, and a 7 d withdrawal period. Feed refusals were weighed back and recorded on the last week of adaptation and during the treatment and withdrawal periods. Fecal samples were collected during each block and were analyzed for pH and DM. In vitro dry matter disappearances (IVDMD) of tall fescue, orchard grass and alfalfa hay were measured using fresh feces from each horse as the inoculum. In vitro gas production (IVGP; mL/g of substrate) from alfalfa hay was also measured using fresh feces as the inoculum. Data were analyzed using repeated measures ANOVA in the mixed procedure of SAS version 9.2. No horses exhibited diarrhea during the study. No differences in feed refusals were found between treatments ( $P > 0.05$ ). There were no treatment or time x treatment effects on fecal DM ( $P = 0.51$ ), fecal pH ( $P = 0.78$ ) or IVGP ( $P = 0.30$ ). Furthermore, treatment did not affect IVDMD of tall fescue, orchard grass, or alfalfa hay respectively ( $P = 0.20$ ;  $P = 0.21$ ;  $P = 0.28$ ). Treatment with CF and ST did not induce changes in the in vitro fermentation associated measurements made in this study, without onset of diarrhea.

**Key Words:** diarrhea, IVDMD, fermentation

**W145 Effects of probiotic supplementation on stress and immune responses in horses.** J. Saul, J. M. Reddish,\* K. Barnhart, C. Dyer, and K. Cole, *The Ohio State University, Columbus.*

Today's horse management practices often include restricted access to forage and feeding large quantities of grain in a limited number of meals throughout the day. These practices may create physiological and psychological stress in the horse, leading to increased cortisol production which may alter gastrointestinal microflora and immune responses. In this study, 12 Quarter Horses ( $1.6 \pm 0.6$  yr) were used to evaluate the effects of probiotic supplementation on stress and immune response to tetanus toxoid vaccination. Horses were randomly assigned to one of 2 treatment groups: Probiotic or Control. All horses received 0.5% BW of a 14% CP pelleted concentrate, with water and mixed grass hay ad libitum. Horses in the probiotic treatment group were fed a target dose of  $10^7$  cfu/(45 kg of BW x d) of a mixed culture containing *L. acidophilus*, *L. casei*, *L. plantarum*, and *E. faecium* throughout the study. After 45 d, horses were vaccinated against tetanus toxoid and blood samples were taken on d 0, 7, 14, 21 and 28 d post-vaccination to determine tetanus antibody titers. On d 28 post-vaccination, horses were transported for 15 min and blood samples to determine cortisol concentrations were taken by jugular venipuncture immediately before and after transport. Tetanus antibody titers and cortisol concentrations were analyzed using the PROC MIXED procedure of SAS. A P value of  $\leq 0.05$  was considered statistically significant. By d 7 post-vaccination, all of the horses in the study were fully protected against tetanus, regardless of treatment. Although no differences in cortisol production were found across treatment groups, cortisol concentrations increased significantly after transport for 15 min within the control group ( $P < 0.05$ ). Denaturing gradient gel electrophoresis (DGGE) analysis of fecal samples revealed no differences in the microbial profiles of the horses due to probiotic supplementation. However, the microbial profiles of horses of comparable age showed similarities in banding patterns. Overall, probiotic supplementation did not influence gastrointestinal microflora, cortisol response to transport stress, or antibody response in this study.

**Key Words:** horse, probiotic, antibody response

**W146 Biochemical markers of bone metabolism in growing Quarter Horses fed a higher starch versus a higher fat diet.** K. R. Vineyard,\* M. E. Gordon, and M. L. Jerina, *Land O'Lakes Purina Feed, Gray Summit, MO.*

The objective of this study was to determine if diet affects serum concentrations of osteocalcin (OC, marker of bone formation) and carboxy-terminal pyridinoline cross-linked telopeptide region of type I collagen (ICTP, marker of bone resorption) in growing Quarter Horses (QH) during the first 2 years of life. Eleven QH foals (5 fillies, 6 colts) housed in dry lot paddocks and individual stalls were fed either Omolene 300 (n = 5) (16% CP, 5% fat, 6.5% fiber, 29.4% starch, 10.6% WSC, 3.4 Mcal/kg) or Ultium Growth (n = 6) (15.5% CP, 9.5% fat, 13% fiber, 16.6% starch, 10% WSC, 3.7 Mcal/kg; analyses by Dairy One, Ithaca, NY). Foals were creep fed beginning at d28, starting with 0.23 kg/d and increased by 0.23 kg every 2 d until intake reached 3.6 kg/h/d, not exceeding 0.45 kg/mo of age before weaning at wk20. Foals consumed grass hay along with their dams and received 1% BW in grass hay post-weaning. Blood serum was collected at birth (d0) and at 6 wk intervals thereafter through wk102 (2 yr) and analyzed for OC (Metra Osteocalcin, Quidel Corporation, CA) and ICTP (ICTP RIA, Orion Diagnostics, Oulunsalo, Finland). A completely randomized factorial split-plot design was used to test the effect of diet, sex, and weaning. Analysis of variance was done with mixed models (SAS 9.2 2010) and least squares means compared with Fishers LSD ( $P < 0.05$ ). There were no differences due to diet or sex for OC ( $P = 0.60$ ,  $P = 0.16$ ) and ICTP ( $P = 0.48$ , 0.10), but OC was higher in fillies than in colts before weaning ( $P = 0.03$ ). In all horses, both OC and ICTP rose after birth, peaking at wk6 for OC ( $132.74 \pm 11.2$  ng/ml) and ICTP ( $24.26 \pm 0.6$   $\mu$ g/L), and were higher before weaning compared with post-weaning levels ( $P < 0.0001$ ). OC returned to d0 levels ( $86.03 \pm 9.4$  ng/mL) by wk18 ( $P < 0.05$ ) and fell and remained below d0 levels by wk42 ( $P < 0.05$ ). ICTP returned to d0 levels ( $21.82 \pm 0.6$   $\mu$ g/L) by wk18 ( $P < 0.05$ ) and fell and remained below d0 levels by wk24 ( $P < 0.05$ ). Although feeds higher in starch and sugar have sometimes been implicated in metabolic bone problems in growing horses, these results suggest that bone formation and resorption are not affected by dietary starch and sugar levels in the current study.

**Key Words:** equine, osteocalcin, ICTP

**W147 Anthelmintic resistance testing and training on horse farms in the Southeast.** N. C. Whitley\*<sup>1</sup>, R. M. Kaplan<sup>2</sup>, R. K. Spann<sup>3</sup>, A. M. Zajac<sup>4</sup>, K. Moulton<sup>1</sup>, R. A. Franco<sup>1</sup>, C. Swanson<sup>5</sup>, A. E. Cooper<sup>1</sup>, and V. R. Jackson<sup>1</sup>, <sup>1</sup>North Carolina A&T State University, Greensboro, <sup>2</sup>University of Georgia, Athens, <sup>3</sup>Virginia Tech MARE Center, Middleburg, <sup>4</sup>VA-MD Regional College of Veterinary Medicine, Blacksburg, VA, <sup>5</sup>Virginia Cooperative Extension, Albemarle County, Charlottesville, VA.

A total of 487 horses on 11 NC farms, 5 SC farms, and 9 VA farms were used for training agricultural professionals in and conducting fecal egg count (FEC) reduction testing for gastrointestinal nematode (GIN) parasite anthelmintic resistance. Horses (249 females, 238 males) of various breeds averaging  $519 \pm 6$  kg BW and  $11.3 \pm 0.4$  yr of age (range 1 to 34 yr) were used. Animals were assigned to treatment to account for preliminary fecal egg count (FEC), sex, breed type and age as possible. Ivermectin (Zimecterin; IVM; n = 246) and pyrantel (Strongid; PYR; n = 241) were used as labeled for BW (measured by equine weigh tape) plus 15% with doses rounded up to the nearest 22.7 kg (50 lb). Ninety horses on 12 farms were used in a switchback design but analyzed as independent data points. At treatment (d 0) and at d 14, fecal samples were collected after defecation for FEC using the Modified McMasters technique with a sensitivity of 8 eggs per gram (epg). Reduction in FEC

(RED) were calculated as  $((\text{FEC before trt} - \text{FEC after trt}) / \text{FEC before trt}) \times 100\%$  for animals with d0 FEC of at least 40 epg ( $n = 472$ ). Treatment was considered effective with RED of  $>80\%$  for PYR and  $>90\%$  for IVM. On 14 farms, for horses for which treatment was considered effective, fecal samples were collected every 14 d until FEC increased to below effective RED level (egg recovery period; ERP). Using SAS, Chi Square analysis and Wilcoxon Rank Sum testing was conducted. For random samples from 7 farms, individual McMaster chamber FEC was recorded; the CV for those samples averaged 22.1% for all farms. Overall, d0 FEC averaged  $639 \pm 30$  epg. The average RED was greater

( $P < 0.01$ ) for IVM (99.5%) than PYR (63.8%). For individual horses, IVM was effective in 99.2% of the horses tested while PYR was only effective in 57%. The average ERP was  $53.4 \pm 2.4$  d for IVM and  $46.0 \pm 3.1$  d for PYR. As previously reported in other states and livestock species, this study confirms GIN resistance to PYR on NC, VA, and SC horse farms. At least 10 agricultural professionals were trained in equine GIN anthelmintic resistance testing, resulting in overall decreased anthelmintic use on horse farms.

**Key Words:** anthelmintic resistance, horse, ivermectin