
0795 Linking from the farm to the table.

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Genomics promises tremendous opportunity to the beef industry; however, that opportunity is currently stymied by the structure of the industry and the limited use of long-standing traditional genetic evaluations. Industry segmentation and poor, or in some cases lack of, market signals can be seen in the industry response of the past decade to a demand for more highly marbled beef. From 2005 to 2015, the feeding sector simply overfed animals to achieve higher marbling at the very great expense of excess fat, poor carcass yield, and poor feed efficiency. Although a logical decision in itself at the finishing level, this approach ignored the potential of “supply-chain” genetics to meet an end goal. A further persistent need that the beef supply must address is inconsistency of tenderness of beef at the consumer level. Beef is a premium protein product and, as such, must meet a higher standard for consumer satisfaction. Considering the heritability of tenderness, it would seem obvious as a supply-chain breeding goal. And yet no selection has been attempted, due in part to the nature of the trait: difficult to measure on breeding animals. This is an area of particular interest to make use of genomics. A simple DNA test can give an estimate for tenderness, which, applied to three generations of sire selection, could have a dramatic impact on consumer satisfaction. A third trait that should be of interest to every beef producer is feed efficiency. Although a great deal of focus has been placed on residual feed intake and affordable panels have been developed, little selection pressure has been brought to bear. Again, this is due, in large part, to the segmentation of the beef industry. Genetic improvement in the beef industry will only reach its potential following a fundamental shift in outlook. Current segmentation by sector and “ranch-level” genetics must be replaced with a more holistic approach in which information and market signals flow up and down the supply chain. Only then will producers and, more importantly, consumers benefit from the promise of genomics.

Key Words: beef genomics, breeding goals, industry structure

HORSE SPECIES: MANAGEMENT

0796 Stress responses in horses tied with overchecks.

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Little information is available on the welfare of horses used for transportation. It is common to observe horses wearing a complete harness, hooked to horse-drawn vehicles, tied up for extended periods of time where horse-drawn transportation is popular. An observational survey of 305 horses at 7 locations

in northeast Ohio found 29.5, 51.5, and 13.8% of the horses were tied wearing harnesses with high, low, or no overchecks. Six Standardbred mares were used in a Latin square (treatment × period) designed experiment to evaluate the effects of tying horses wearing overchecks. All horses were acclimated to harness and tying before testing. Three 90-min test periods (May and June 2015) were used, and horses were randomly assigned to treatment groups: high overcheck (HC), low overcheck (LC), or no overcheck (NC). Each test period was followed by a 2-wk recovery period. Heart rate was measured before the test; during the test at 15 (T15), 45 (T45) and 90 (T90) min; and after the test at 45 (P45) and 90 (P90) min. Plasma cortisol (ELISA) was measured before the test and at T45, T90, P45, and P90. Muscle soreness and tightness at 20 sites—(right and left) rhomboideus, trapezius, deltoideus, latissimus dorsi, triceps, biceps femoris, longissimus, gluteus, hamstrings, and tensor fascia lata—were scored by a trained professional (Powel et al. 2008. *J. Equine Vet. Sci.*, 28(1):28–33) before testing and 24 h after testing. Heart rate tended to be higher (45 ± 2.5 bpm; $P = 0.098$) at T15 in all horses compared with pretesting values (40 ± 2.5 bpm), regardless of treatment. Plasma cortisol was higher ($P < 0.001$) in HC at T45 and T90 (159.7 and 166.3 ng/mL, respectively) compared with both LC (106.4 and 105.2 ng/mL) and NC (116.1 and 93.5 ng/mL) at T45 and T90, respectively. There was no treatment effect on muscle soreness and tightness. Overall, muscles were more sore ($P < 0.05$) and more tight ($P < 0.001$) following the test compared with pretest values in all horses. The rhomboideus ($P < 0.001$), latissimus dorsi ($P < 0.05$), and longissimus ($P < 0.05$) showed significant changes in both muscle soreness and tightness whereas the trapezius, deltoideus, and biceps femoris were only tighter ($P < 0.05$). We recommend loosening or removing overchecks while horses are tied and advocate additional studies on the common practice of tying up horses.

Key Words: horse, welfare, cortisol

0797 Effect of prerace behavior on performance in racing quarter horses.

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It is purported that prerace behavior of a race horse can diminish their performance, known as “washing out.” This study observed prerace behaviors of 1,040 Quarter Horse (QH) race horses that competed in 137 races over a 14-night duration at Delta Downs Racetrack (Vinton, LA). A total of 46 variables were recorded by experienced horsemen. The prerace period was divided into four different subsections: before saddling (BSAD), which was the time when the horse walked across the track’s infield to right before they entered the stall to be saddled; during saddling (SAD), which was the time while the horse was being saddled; after saddling (ASAD), which was the time from when the horse was finished being saddled to when the jockey mounted the horse; and after the parade (POSTP), which was the time from when the jockey mounted

to when they were finished with the postparade. During subsections, each horse assessed a behavior type of calm, ready, or nervous. Upon completion of each race the finish type (tired, pulled-up, or running) was recorded as well as finish position, which was checked the next day on the Equibase website. Categorical variables were statistically compared using a χ^2 test and quantitative variables were compared using general linear models in SAS. The average number of previous races at Delta Downs was statistically greater ($P < 0.05$) for calm horses (3.3 ± 0.2) than ready (2.2 ± 0.1) and nervous (0.9 ± 0.1) horses during all periods. The average finish position was not different for calm (5.1 ± 0.1) and ready (5.0 ± 0.1) horses but both were significantly better than nervous (5.9 ± 0.3) horses for all periods. However, horses (during POSTP period) that were ready (4%) were less likely ($P < 0.05$) to finish tired compared with calm (10%), which was also less likely ($P < 0.05$) to finish tired compared with nervous (19%). The results show that horses that appear nervous are more likely to finish behind horses that appear calm or ready to race and are three times more likely to finish the race tired compared with ready and twice as likely compared with calm. These data support that a nervous behavior can negatively impact their performance in races, even at short distances.

Key Words: quarter horse, horse racing, stress, behavior, performance

0798 Evaluating the effectiveness of varying doses of supplemental tryptophan as a calmativ in horses.

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The objective of this study was to examine how various doses of tryptophan supplementation impacted reactive behavior and physiological stress measurements in the horse. Eleven horses (9 geldings and 2 mares) were given four treatments—a control dose, consisting of 0 mg Trp/kg BW (CON); 20 mg Trp/kg BW (LOW); 40 mg Trp/kg BW (MED); and 60 mg Trp/kg BW (HIGH)—in a randomized crossover design. Each treatment lasted 3 d. On Days 1 and 3 of each treatment, horses underwent a behavior test to measure startle response. Heart rate measurements and the speed at which the horses fled from startling stimuli were recorded. In addition, serum glucose, lactate, and cortisol levels were analyzed both immediately before the startle test and again 15 min after the test. Significant sedative effects were seen at LOW Day 1 on heart rate increase during the startle test ($P = 0.05$) and on change in serum lactate levels ($P = 0.03$). At MED Day 1, sedative effects were seen on change in serum cortisol levels ($P = 0.01$). Some excitatory effects were seen at MED Day 3 on the time for heart rate to return to baseline after the startle test ($P = 0.03$). A subset of blood samples was analyzed for serum free Trp and the ratio of Trp to other large neutral AA, which verified treatment effect.

Key Words: behavior, horse, tryptophan

0799 Effects of barefoot trimming and shoeing on the lower forelimb: Hoof morphology.

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Limited information is available pertaining to potential benefits of barefoot trimming techniques under standard management conditions. Therefore, 12 mature Quarter horses (8–14 yr and 450–572 kg) were used in a switch back design for a 140-d trial to determine effects of barefoot trimming and shoeing on joints of the forelimb and digital cushion thickness. Before the start of the trial, all horses were adapted to a standardized exercise protocol and lameness examinations were performed by a veterinarian; hooves were allowed to grow naturally with minimal farrier interventions. This study was divided into 3 phases: d 0 to 42, horses were barefoot trimmed (BF1); d 49 to 91, horses were shod (SD) on the forehand with standard St. Croix plain lite shoes; and d 98 to 140, horses received another barefoot trim (BF2). Between phases, a 7-d transition period was given to allow for farrier practices. Horses were group exercised 3 times/wk on a 132 by 3.7 m linear dirt track to a mean HR of 80.00 ± 1.90 bpm. Measurements were obtained every 21 d immediately following exercise. Digital cushion thickness was ultrasonically measured through the superficial frog using a 5.0-MHz convex probe and stand-off pad following previously described methods. Stride lengths were also recorded following exercise at a walk and trot (EquineTec, Monroe, GA). Data were analyzed using the PROC MIXED procedure of SAS. There was no influence of day ($P = 0.25$) on mean HR; however, there was an influence of treatment. Mean HR was lower ($P < 0.01$) during the BF1 phase (75.50 ± 1.90 bpm) compared with the SD (82.08 ± 1.90 bpm) and BF2 (82.42 ± 1.90 bpm) phases. Mean stride lengths at the walk ($P < 0.05$) and trot ($P < 0.01$) were greater in SD horses compared with BF1 and BF2 horses. There was no main effect ($P \geq 0.47$) of day or treatment on digital cushion thickness. However, on d 42 of each of the 3 phases, mean digital cushion thickness was greater ($P \leq 0.01$) during the BF1 (1.41 ± 0.03 cm) and BF2 (1.43 ± 0.03 cm) phases compared with the SD phase (1.26 ± 0.03 cm). These data indicate that a shod fore digit may cause changes in hoof morphology due to alterations in lower limb movement and hoof load dispersion and, therefore, may cause an increase in the incidence of lameness over time.

Key Words: shoeing, digital cushion, stride length

0800 Effects of barefoot trimming and shoeing on the lower forelimb: Joint inflammation. D. K. Proske¹, J. L. Leatherwood*¹, K. J. Stutts¹, M. J. Anderson¹, C. J. Hammer², and J. Coverdale³, ¹*Sam Houston State University, Huntsville, TX*, ²*North Dakota State University, Fargo*, ³*Texas A&M University, College Station*.

Limited information is available pertaining to potential benefits of barefoot trimming techniques under standard management conditions. Therefore, 12 mature Quarter horses (8–14 yr and 450–572 kg) were used in a switch back design for a 140-d trial to determine effects of barefoot trimming and shoeing on the hoof and joints of the forelimb. Before the start of the trial, horses were adapted to a standardized exercise protocol and lameness examinations were performed by a veterinarian. This study was divided into 3 phases: d 0 to 42, horses were barefoot trimmed (BF1); d 49 to 91, horses were shod (SD) on the forehand with standard St. Croix plain lite shoes; and d 98 to 140, horses received a second barefoot trim (BF2). Between phases, a 7-d transition period was given to allow for farrier practices. Horses were group exercised 3 times/wk on a 132 by 3.7 m linear dirt track to a mean HR of 80.00 ± 1.90 bpm. Measurements were obtained every 21 d immediately following exercise protocol and included thermography images (FLIR Systems, Boston, MA) of carpal and metacarpal joints, superficial horn of the frog, and medial and lateral sole of the front digits. Joint circumferences were obtained using a soft tape measure at the accessory carpal and proximal sesamoid bones, respectively. Additionally, blood samples were collected to evaluate PGE₂ concentrations after exercise. Data were analyzed using the PROC MIXED procedure of SAS. An influence of treatment ($P < 0.01$) was detected in all areas measured, with mean surface temperatures being greatest during the BF1 phase. Although no difference was detected ($P = 0.38$) in the joint circumference of the metacarpal joint, there was an influence of treatment ($P < 0.01$) at the carpal joint with the BF1 phase having the lowest mean joint circumference compared with all other phases. PGE₂ concentration decreased throughout each phase of the trial ($P < 0.01$) independent of the treatment applied. This is likely due to an increased cardiovascular stamina of the horses from repetitive exercise as the study progressed. In the BF1 phase, the lower joint circumferences and the increased surface temperatures illustrate the presence of greater blood flow and lack of joint inflammation and swelling. These data indicate that a shod fore digit may cause inflammation on the joints of the lower forelimb accompanied by a reduction in blood flow and, therefore, may cause an increase in the incidence of lameness over time.

Key Words: shoeing, thermography, joint

0801 Characterizing the physiological response of a novel vaccine in mature horses. J. L. Leatherwood*, D. L. Parker, M. J. Anderson, K. J. Stutts, M. M. Beverly, and S. F. Kelley, *Sam Houston State University, Huntsville, TX*.

The vaccination of animals has been implemented to prevent the spread of infectious diseases through the use of inactivated or modified live organisms. Vaccination serves to induce an immune response that is effective at limiting the exposure to a natural born pathogen. Criteria for successful vaccination programs is to ensure that the vaccine does not cause the disease or produce negative side effects that may overwhelm the ability of the immune system to provide a means of protection. Therefore, the objective of this study was to characterize the physiological response of mature horses to a novel vaccine through the use of thermography and assessment of vital parameters as well as to determine differences in surface temperatures at the injection sites of the vaccine and saline to better understand the localized inflammatory response to injection. Thirty horses (5–10 yr and 413–551 kg) were vaccinated against bovine respiratory syncytial virus, bovine viral diarrhea virus, and infectious bovine rhinotracheitis as a one-time vaccination with a saline contralateral injection that was completed on the opposite side of the neck. Horses were assumed to be naïve to bovine diseases. Vitals including heart rate (HR), respiration rate (RR), and rectal temperature along with thermal images (FLIR Systems, Boston, MA) of the ocular globe (OG), rectum (RM), and injection sites were recorded at 0 and 6, 12, 24, and 48 h following vaccine administration. Data were analyzed using the GLM procedure to evaluate differences over time and a paired *t* test to evaluate differences between injection sites. Vitals including HR and RR decreased ($P < 0.01$) following initial handling at 0 h and remained consistent up to 48 h following vaccine administration. Rectal temperature increased ($P < 0.01$) and peaked at 12 h ($P < 0.01$) compared with other time points measured. Similarly, thermography data of OG and RM followed a similar pattern and peaked at 12 h ($P < 0.01$). Comparison between the vaccine and saline injection sites revealed that the vaccine site had an elevated temperature ($P < 0.01$) compared with the injection site of the saline control. This illustrates the localized inflammation detected is a result of a response to the vaccine rather than the injection alone. Similarly, changes in rectal temperature along with thermography of the OG and RM are valid indicators of a response to vaccination whereas HR and RR were not altered and may not be reliable predictors.

Key Words: equine, thermography, vaccine

0802 Application of either a single or multiple doses of an intravaginal gonadotropin-releasing hormone agonist to induce ovulation in mares.

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Triptorelin acetate (TA) is a GnRH agonist that is used in the swine industry to induce ovulation. In a previous study, we investigated the efficacy of an intravaginal TA gel to induce ovulation in mares. Treatment with TA gel tended ($P = 0.08$) to elicit an increase in LH concentrations by 12 h after treatment but failed to shorten the interval from treatment to ovulation or cause a greater percentage of mares to ovulate within 48 h of treatment compared with placebo-treated controls. Because peak LH concentrations were observed at 12 h after treatment and declined to nearly baseline concentrations by 24 h, we postulated that LH concentrations may not have remained elevated sufficiently to induce ovulation. Therefore, the objective of this study was to investigate whether 2 doses of TA gel would result in elevated LH concentrations sustained for a sufficient period to reduce the interval from treatment to ovulation and cause ovulation to occur within 48 h of treatment. Twenty-three cyclic mares were stratified by parity and age and randomly assigned to 3 treatments: 500 μg TA (TA5); two 500- μg doses of TA, given 24 h apart (TA5x2); or 5 mL vehicle gel only (control). Ultrasonography occurred once daily until detection of a follicle ≥ 25 mm in diameter was detected, at which point ultrasonography and blood collection occurred every 12 h. Once a follicle ≥ 35 mm was detected, treatment was administered intravaginally and ultrasonography and blood collection then occurred every 6 h until 48 h after ovulation. At 6 and 12 h after treatment, LH was increased ($P < 0.05$) in both TA5 and TA5x2. In TA5x2, the second dose of TA failed ($P > 0.05$) to elicit more LH release compared with both TA5 and control. With regard to LH concentrations, the overall treatment effect was not significant ($P > 0.05$); however, a treatment \times time interaction was identified ($P < 0.05$). A greater ($P < 0.05$) percentage of mares ovulated by 48 h after treatment in TA5 but not TA5x2 compared with control. Interval from treatment to ovulation was shorter ($P < 0.01$) in both TA5 and TA5x2 compared with control. We concluded that both 1 and 2 doses of 500 μg TA hastened ovulation in cyclic mares; however, 2 doses failed to cause sustained release of LH or cause a greater percentage of mares to ovulate within 48 h of treatment.

Key Words: mare, ovulation, gonadotropin-releasing hormone

Table 0802.

Table 1 – Effects of TA gel on the interval from treatment to ovulation and the percentage of mares ovulating by 48 h post-treatment

	<i>n</i>	Hours from TRT to ovulation Mean \pm SEM	% ovulating by 48 h
Control	7	123.1 \pm 21.7 ^a	0.0% ^a
TA5	8	61.5 \pm 8.8 ^b	75.0% ^b
TA5x2	8	61.5 \pm 9.6 ^b	50.0% ^a

^{a,b} $P < 0.05$; TRT = Treatment.

0803 Incidence of exercise induced pulmonary hemorrhage in race horses in Puerto Rico.

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Exercise-induced pulmonary hemorrhage (EIPH) is a very common disease in race horses characterized by an alteration of the respiratory system. Depending on the magnitude, the EIPH causes bleeding in lung passages making breathing difficult. Exercise-induced pulmonary hemorrhage is evaluated by endoscopies on a scale from 0 to 5, with 0 corresponding to no hemorrhage and 5 to a severe condition. In Puerto Rico, the only preventive measure used is the administration of a diuretic 4 h before the race. A data set was analyzed to determine factors associated with the incidence of EIPH and the preventive effect of the diuretic. The data were supplied by Equus PR and the factors considered were month of the year, sex (male or mare), distance of the race in meters (C1, 400 to 1,200; C2, 1,300–1,400; and C3, >1,600), and the use or not of the diuretic. The randomly selected data of 2,632 endoscopies of race horses running or not represented 20% of the total endoscopies recorded in 2014. Of this number, 1,377 were from horses within 1 h after the race, representing 52% of the total. A χ^2 test analysis was performed to determine the frequency of EIPH regarding the factors, month, sex, distance of the race, and use of the diuretic. Of the 1,377 animals, 488 presented some degree of EIPH, equivalent to 35% of the total sample. The percentage of horses suffering EIPH condition from 1 to 5 was 52.8, 23.6, 13.5, 7.3, and 2.8, respectively. The frequency and severity of EIPH was similar ($P = 0.435$) during the 12 mo of the year. Males and mares also had similar ($P = 0.587$) incidence. Horses running shorter races (C1 and C2) had a higher ($P < 0.02$) incidence of EIPH than those running longer races (C3). The number of healthy horses or those suffering the condition was similar ($P = 0.375$) regardless of diuretic use. In summary, 35% of the race horses competing presented some level of EIPH; month of the year and sex did not alter the incidence. Horses running shorter distance showed more incidence of the condition and the use of the diuretic was not effective as a preventive method for EIPH.

Key Words: diuretic, race horses, exercise induced pulmonary hemorrhage

0804 Application of gait analysis to determine if the Galiceno horse breed is a gaited horse breed.

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The Galiceno horse breed is classified as critically endangered by The Livestock Conservancy (LC) with less than 200 pure Galicenos in the United States. The Galiceno is one of several breeds classified as a Spanish Colonial horse breed. The breed has been noted for its ground-covering movement and its capacity for performing a running walk. Although other Spanish Colonial horse breeds have been classified using gait analysis as gaited, research documenting the gait mechanics of the Galiceno breed is unavailable. The objective of the study was to evaluate symmetrical gaits at various velocities performed by the Galiceno documenting gait mechanics that would be classified as gaited. Horses ($n = 12$) were selected by the LC and Galiceno Horse Registry (121.9–137.2 cm height) to represent the breed. Horses were asked to move freely along an arena railing while being filmed. Frame-by-frame analysis was performed documenting hoof contact and lift-off. A full stride cycle was determined from the time the right hind hoof made ground contact to the time it returned back to the ground. Only gaits demonstrating gait symmetry were used for this study. Student's paired t tests were performed to determine gait symmetry ($P < 0.05$). Stance durations between left and right variables that were not significantly different indicated gait symmetry. A total of 30 symmetrical strides were selected for each horse. From the strides evaluated, 32% demonstrated a 4-beat rhythm with a lateral footfall sequence and no period of suspension similar to the walk. The velocity for these strides ($1.36 + 0.19$ m/s) fell within the range of a typical walk for the height of the horse, thus falling under the velocity of that of a running walk performed by a gaited breed. Stride duration ($1,220 + 89$ ms) was comparable to a slow walk. The remaining strides demonstrated a diagonal footfall sequence with 8 to 23% of the stride duration spent in a period of suspension. Only 4% of those strides had a 4-beat rhythm demonstrating diagonal couplets as the rest demonstrated a true 2-beat rhythm. The velocity for the diagonal leaping gait was $3.78 + 0.63$ m/s with disassociation of diagonal pairs occurring at the upper range of the velocity. Stride duration was $690 + 72$ ms. Both stride duration and velocity were comparable to the trot seen in other nongaited Spanish Colonial horse breeds. In conclusion, those strides evaluated did not suggest the Galiceno should be classified as a gaited horse breed.

Key Words: Galiceno, kinematics, gaited

0805 Effect of body condition score on fatty acid composition of equine subcutaneous adipose tissue.

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Body condition score serves as a proxy indicator of the health and metabolic disposition of horses; however, this subjective assessment does not take into account the fatty acid composition of adipose tissue (AT) depots. The objective of this study was to investigate the relationship between BCS and fatty acid composition of subcutaneous AT. Fourteen horses with BCS of 4 ($n = 4$), 5 ($n = 6$), and 6 ($n = 4$) were euthanized, and the subcutaneous fat was collected at the junction of the last rib and the vertebral column. Samples were frozen in liquid nitrogen, pulverized, and stored at -80°C . Fat samples were directly derivatized for fatty acid identification and quantification on a gas chromatography system (Agilent Technologies, Santa Clara, CA) using an internal standard for calibration. Fatty acid methyl ester concentrations were used to calculate fatty acid percentages. Statistical analysis was performed by the GLIMMIX procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC), and statistical significance was determined at $P \leq 0.05$. Overall, there was no effect of BCS on fatty acid percentages composition ($P \geq 0.129$), except that capric acid was greater in horses with BCS of 4 than in those with BCS of 6 ($P = 0.008$). In terms of overall composition, equine subcutaneous AT was composed of approximately 35.36 to 37.77% SFA, 35.80 to 36.90% MUFA, and 25.33 to 28.84% PUFA, which were markedly distinguishable from the relative percentages reported in ruminants and other monogastric species. Palmitic, oleic, and linolenic acids were the predominant SFA, MUFA, and PUFA with respective relative percentages of approximately 24.68, 28.96, and 16.41%, respectively. Linoleic acid, the predominant PUFA found in most ruminant and monogastric species, was the second most predominant PUFA in equine, at 6.78%. Vaccenic acid, a typical *trans* fatty acid found in ruminants, was not detected in horse subcutaneous adipose tissues. These data indicate that BCS did not have a marked impact on the fatty acid composition of the subcutaneous AT depot in the equine animal for the range of BCS investigated in the current study.

Key Words: equine, adipose, body condition

0806 Feeding a small amount of hay before concentrate neutralizes the effects of high starch diets on inflammation in horses. J. K. Suagee-Bedore^{*1}, K. Wimbush¹, D. R. Linden¹, and R. K. Splan², ¹The Ohio State University, Wooster, ²Virginia Tech, Middleburg.

When fed to horses, high starch diets elevate plasma concentrations of IL-1 β as soon as 1 h post eating. This increase in IL-1 β is possibly due to changes in intestinal pH that result from rapid bacterial fermentation of starches and sugars in the digestive tract. This altered pH may disrupt the gut microbial environment and ultimately lead to inflammation. The purpose of this research was to investigate the effect of feeding 0.9 kg of grass hay 30 min before feeding a concentrate meal (HF) on the postprandial rise in IL-1 β , as compared to control horses receiving the same concentrate without hay first (HS). Six mature light-breed geldings of moderate body condition (5–6 on a scale of 1–9) were used in a switchback design. Horses were fasted overnight before being offered a concentrate feed at 0800 h that provided 1.2 g/kg bodyweight of non-structural carbohydrates. Plasma from blood was harvested at –30 min (sample obtained before hay feeding), 1, 2, 4, 6, and 8 h post feeding. Horses were offered ad libitum grass hay following completion of their concentrate meal. Concentrations of IL-1 β , D-lactate, glucose, and insulin were analyzed by repeated measures ANOVA (SAS v. 9.3). Where necessary, values were log transformed and are presented as geometric means. The HF treatment reduced ($P < 0.01$) postprandial geometric mean concentrations of IL-1 β compared to the HS treated horses at post-feeding hours 2 (296 [263–330] vs. 449 [402–500] pg/mL), 4 (272 [244–303] vs. 474 [425–530] pg/mL), and 6 (257 [230–287] vs. 439 [394–490] pg/mL). The HF treatment also decreased ($P < 0.05$) mean D-lactate concentrations at post-feeding hours 2 (1188 ± 110 vs. 1509 ± 110 μ mol/L) and 4 (1186 ± 110 vs. 1581 ± 110 μ mol/L), as compared to HS treated horses. Plasma glucose and insulin increased postprandially for both treatments ($P < 0.001$) with no effect of HF treatment ($P > 0.5$). Given these findings, we believe that feeding a small amount of hay before feeding a meal of moderate starch and sugar content reduced the negative effects of rapid starch and sugar fermentation in the equine digestive tract, as seen through reduced postprandial D-lactate and IL-1 β concentrations.

Key Words: high-starch diet, IL-1 β , inflammation

0807 Feeding DigestaWell Buffer to horses neutralizes the effects of high starch diets on blood pH and inflammation. J. K. Suagee-Bedore^{*1}, A. L. Wagner², and I. D. Girard², ¹The Ohio State University, Wooster, ²Probiotech International Inc., St-Hyacinthe, QC, Canada.

When fed to horses, high starch diets elevate plasma concentrations of lipopolysaccharide (LPS) at 2 h post eating and IL-1 β at 1 h post eating. These changes are possibly due to rapid bacterial fermentation of starches and sugars in the digestive tract, which may alter the pH in the digestive tract and lead to inflammation. The purpose of this research was to investigate the efficacy of a dietary supplement containing bicarbonate, DigestaWell Buffer (DB), to mitigate these postprandial changes, as compared to control horses receiving the same concentrate but without the supplement (HS). Six mature light-breed geldings were used in a switchback design. Horses were fasted overnight before being offered a concentrate feed at 0800 h that provided 1.2 g/kg bodyweight of nonstructural carbohydrates. The DB treatment supplied 150 g of top dressed DB supplement. Plasma from blood was harvested at –30 min, 1, 2, 4, 6, and 8 h post feeding. Whole blood was analyzed for pH and TCO₂. Horses were offered ad libitum grass hay following completion of their concentrate meal. Concentrations of IL-1 β , LPS, D-lactate, glucose, and insulin, and pH and TCO₂ values were analyzed by repeated measures ANOVA (SAS v. 9.3). Where necessary, values were log transformed and are presented as geometric means. Supplementation with DB reduced ($P < 0.01$) postprandial geometric mean concentrations of IL-1 β at post-feeding hours 4 (284 [253–321] vs. 474 [421–534] pg/mL), and 6 (261 [232–294] vs. 439 [390–494] pg/mL), tended to decrease geometric mean D-lactate ($P = 0.060$) concentrations at 8 h post feeding (1215 [1120–1318] vs. 1457 [1344–1581] μ mol/L), and decreased mean LPS concentrations across all time points ($P < 0.001$). Meal consumption reduced blood pH in both treatments; however, pH was higher in DB than HS (7.414 ± 0.003 vs. 7.398 ± 0.003) treated horses ($P < 0.05$). Plasma glucose and insulin increased postprandially for both treatments ($P < 0.001$) with no effect of DB treatment ($P > 0.1$). Blood TCO₂ levels were below the upper limit of 37mmol/L but tended to be higher in DB treated horses (31.4 ± 0.3 vs. 30.6 ± 0.3 mmol/L, $P = 0.068$). Given these findings, we believe that DB mitigates the negative effects of rapid starch and sugar fermentation in the equine digestive tract, as seen through reduced postprandial inflammation.

Key Words: DigestaWell, IL-1 β , lipopolysaccharide

0808 Efficacy of a brewer's yeast supplement with or without fat added to an energy restricted diet for performance horses. L. B. Hodge¹, A. Boyer², and B. J. Rude¹, ¹Mississippi State University, Mississippi State, ²FL Emmert, Cincinnati, OH.

Objectives of the current trial were to evaluate effects of additional fat to a brewer's yeast supplement on hoof, coat, mane, and body condition of performance horses fed an energy deficient diet. Twelve performance geldings were randomly allotted to one of 3 dietary treatments: 1) a commercially available horse feed (10% CP, 4.5% fat) at 0.35% BW/d; 2) diet 1 plus a brewer's yeast supplement at 226 g/d; 3) diet 2 plus corn oil at 10% of the diet. Diet 1 was fed to be deficient in energy to evaluate additional energy supplied by fat. Geldings were fed half of their diet treatment twice per d for 84 d. Geldings had ad libitum access to bermudagrass pasture, hay, and water. Body weight (BW) measurements and body evaluations were collected at initiation of the trial and every 28 d until 84 d. Body evaluations included coat and mane condition, body condition score (BCS), and hoof condition. Coat, mane and hoof condition were evaluated on a scale from 1 to 5 (1 reflecting poor or damaged and 5 reflecting glossy and smooth) accounting for condition, texture and appearance. Body condition was based on the standard BCS scale of 1 to 9 (Henneke et al., 1983). Data were analyzed through ANOVA using the GLM procedures of SAS. No effect of diet was found for hoof (3.5, 3.3, and 3.6; $P = 0.7973$), coat (3.2, 3.6, and 3.7; $P = 0.2724$), mane (3.5, 3.5, 3.4; $P = 0.9885$) or BCS (5.1, 5.5, and 5.2; $P = 0.9982$) for diets 1, 2, and 3, respectively. Body weights were not different (505.6, 516.7, and 505.5 kg; $P = 1.000$) among diets 1, 2, and 3, respectively. Addition of fat to brewer's yeast supplement did not enhance body scores or body weight. In a previous trial (Seidle et al., 2014), concentrate was fed at 0.9% BW/d and fat was supplemented at 5% of diet. It was concluded that feeding concentrate at this amount may have masked the effects of increased energy from fat. In the current trial, diet 1 (basal diet fed to all treatments) was fed to be energy deficient in an attempt to evaluate if additional fat (10% of diet) added to brewer's yeast supplement had an effect on body weights and condition. Results may have been influenced by forage quality, which was not measured. Research should be conducted to evaluate brewer's yeast supplement and fat while feeding a larger amount of Brewer's yeast.

Key Words: equine, brewer's yeast, fat supplementation

0809 Modeling ammonia emission rate from horses fed different concentrations of dietary crude protein. J. Weir¹, H. Li², L. K. Warren¹, E. Macon³, and C. Wickens¹, ¹University of Florida, Gainesville, ²University of Delaware, Newark, ³Middle Tennessee State University, Murfreesboro.

Evaluating the impact of animal agriculture on air quality has been the focus of recent research. Ammonia (NH₃) volatilization occurs when excess crude protein is fed and excreted as urinary nitrogen. Information regarding NH₃ emission from equine facilities is limited, and the effects of dietary CP intake on NH₃ emission have not been investigated. Nine mature (mean \pm SE, 562 \pm 13.1 kg) geldings were used in a 3 \times 3 replicated Latin square design study to determine the effects of dietary CP concentration on potential NH₃ losses from urine of horses fed an all forage diet. We hypothesized that increasing dietary CP concentration would increase NH₃ emission rate. Three diets were formulated using bahiagrass and bermudagrass hays fed at 3 different crude protein concentrations: LOW-CP, MED-CP, and HIGH-CP (10.6, 11.5, and 12%, respectively). Horses consumed a commercial ration balancer to meet micronutrient requirements. Each study period consisted of an 11-d diet adaptation phase, followed by a 3-d total collection of urine. Samples were pooled within a period by diet ($n = 3$) and mixed with either wheat straw or wood shavings. Ammonia emission of these samples were measured using a 12-vessel emission system with a constant airflow rate (2.5 L/min) at 20°C over a 7-d period. Concentration of NH₃ in each vessel was measured using a photoacoustic multi-gas analyzer. Temperature, airflow rate and NH₃ concentration in each vessel were used to calculate NH₃ emission rate (ER). Data were analyzed as a Latin square using the Mixed Model procedure with repeated measures (JMP Pro v. 11). Concentration and ER data were log transformed. Crude protein intake differed ($P < 0.05$) from LOW-CP to MED-CP and HIGH-CP, as designed. Vessel NH₃ concentrations were different across diets ($P < 0.05$), ranging from 51.8 ppm (LOW-CP) to 87 ppm (HIGH-CP), and bedding types ($P < 0.01$) with straw being higher than shavings (97 vs. 73.5 ppm, respectively). Cumulative urinary NH₃ ER also differed across diets ($P < 0.01$) ranging from 4.9 g/m² to 8.2 g/m² and bedding types ($P < 0.01$), with straw being higher than shavings (11.1 vs. 6.9 g/m², respectively). This study confirms that high crude protein intake and wheat straw bedding increases NH₃ ER from equine urine.

Key Words: ammonia emission, equine, dietary protein

0810 Dietary supplementation of DigestaWell NRG to unconditioned Warmblood mares may reduce lactate rise following exercise. A. L. Wagner¹, R. K. Splan², J. K. Suagee-Bedore³, and I. D. Girard¹, ¹Probiotech International Inc., St-Hyacinthe, QC, Canada, ²Virginia Tech, Middleburg, ³The Ohio State University, Wooster.

Lactate rise during strenuous exercise and prolonged recovery to pre-exercise levels may partially contribute to elevated muscle soreness in humans and horses. Many equine disciplines require consecutive days of competition, and thus, horses may be challenged with soreness during successive days of work or competition. Additionally, during training, muscle soreness may affect or impair progress while trying to increase fitness in horses. There are a number of commercially available dietary supplements containing spices that are marketed to improve performance or exercise recovery; however, research on their efficacy is limited. Therefore, the objective of this research was a preliminary evaluation of a novel proprietary blend of spices in the supplement, DigestaWell NRG (NRG) on lactate rise and post-exercise lactate recovery in unconditioned horses. Nine mature warmblood mares were used in a crossover design with a 7-d washout period. Mares were fed twice daily with 1 kg concentrate supplemented with or without 100 g of NRG for 7 d. On Day 7 horses performed a standardized exercise test during which venipuncture blood samples were collected pre- and 10 and 30 min post-exercise. Plasma lactate was determined using a YSI 2300 STAT Plus glucose and lactate analyzer, and changes in lactate concentration were determined using repeated measures analysis of variance in the PROC MIXED procedure of SAS 9.3. The rise in lactate concentration (change from pre-exercise to 10 min post-exercise) as a result of exercise tended to be lower ($P = 0.10$) in NRG ($52 \pm 15\%$) compared to control horses ($101 \pm 15\%$). Additionally, the return post-exercise determined by the change in lactate concentration from 10 to 30 min post-exercise tended to be higher ($P = 0.10$) in NRG ($28 \pm 3\%$) compared to control horses ($20 \pm 3\%$). The results of this preliminary trial show the promise of NRG to reduce lactate rise and improve lactate recovery in unconditioned horses in response to exercise after consuming NRG after 7 d. This may indicate the potential for NRG to reduce muscle soreness following exercise; however, additional research is warranted with a longer supplementation period to determine the effects of NRG on lactate, inflammation, and muscle soreness following exercise.

Key Words: horse, exercise, lactate

0811 Maturity of bermudagrass hay affects digestibility by horses. T. L. Hansen*, E. C. Lee, O. K. Zugay, and L. K. Warren, *University of Florida, Gainesville.*

Bermudagrass (*Cynodon dactylon*) hay is one of the most common preserved forages fed to horses in the southeastern United States. Bermudagrass, a C4 plant, typically has greater fiber concentrations than C3 plants. The objective of this study was to evaluate equine digestibility of Coastal bermudagrass hays differing in maturity. We hypothesized DM digestibility (DMD) would be reduced in bermudagrass diets, but NDF and ADF digestibility (NDFD and ADFD) would be greater in the bermudagrass diets compared to C3 legume and grass hays due to greater fiber intake. Five dietary treatments (alfalfa hay, *Medicago sativa*, ALF; orchardgrass hay, *Dactylis glomerata* L., ORCH; early maturity bermudagrass hay 4 wk regrowth, EARLY-BG; mid-maturity bermudagrass hay 5–6 wk regrowth, MID-BG; late maturity bermudagrass hay 8 wk regrowth, LATE-BG) were evaluated in this 5×5 Latin square design experiment with 5 mature geldings ($n = 5$, BW = 552 ± 14 kg, mean \pm SEM). Hay was fed at $1.62 \pm 0.02\%$ BW (DM basis), and horses were fed a commercial ration balancer to meet micronutrient requirements. A 7-d dietary adaptation was imposed followed by a 3-d total fecal collection. A 2% subsample of daily fecal excretion was saved for DM, NDF, and ADF analyses. Fiber concentrations were determined using an ANKOM 200 Fiber Analyzer. Digestibility was calculated by difference between intake and excretion. Data were analyzed as Latin square design using a generalized linear model (SAS, v. 9.3). Statistically different means were separated by Sheffe's method. Diets differed in DMD (Table 1, $P < 0.001$). Dry matter digestibility was greatest for ALF and least for MID-BG and LATE-BG diets ($P < 0.05$). Fiber digestibility differed by diet ($P < 0.001$) with NDFD and ADFD greater ($P < 0.05$) for ALF, ORCH, and EARLY-BG diets compared to MID-BG and LATE-BG diets. Despite similar fiber concentrations among the bermudagrass hays, digestibility of EARLY-BG was comparable to other forage types with lower fiber concentrations. These findings indicate fiber structure in bermudagrass changes with maturity, reducing forage digestibility.

Key Words: equine, fiber, warm-season grass

Table 0811.

Table 1.

	ALF	ORCH	EARLY-BG	MID-BG	LATE-BG	SEM	$P <$
DMD, %	61.2 ^a	50.6 ^b	46.3 ^b	35.0 ^c	33.6 ^c	1.3	0.001
NDFD, %	48.0 ^a	48.9 ^a	51.9 ^a	38.9 ^b	38.8 ^b	1.4	0.001
ADFD, %	44.4 ^a	49.6 ^a	45.1 ^a	30.7 ^b	31.1 ^b	2.6	0.001

^{abc} $P < 0.05$

0812 Investigation of equine hindgut microbiota development in young horses. B. St-Pierre*, M. E. Graf, B. M. Schlaikjer, and R. C. Bott, *South Dakota State University, Brooking.*

The gastrointestinal microbiota is an important contributor to the health and nutrition of mammals. Since the gut of young mammals is devoid of microorganisms at birth, its colonization by symbiotic microbes and their arrangement into complex communities is a critical aspect of a young host's post-natal development. Compared to most other experimental animal models or livestock, the gut microbiome of the horse remains largely unexplored, particularly in young foals. To gain further insight on development of the equine hindgut bacterial microbiota, fresh fecal samples were collected from 2 foals over their first 4 mo of life. Fecal samples from their respective dams were also collected as representative of mature hindgut microbial communities. Microbial DNA was extracted from the samples and used as template to generate PCR amplicons of the bacterial 16S rRNA gene (V1-V3 region), which were sequenced using the Illumina MiSeq 2×300 platform. A combined total of 333,300 high quality sequence reads corresponding to the expected full length PCR amplicons were used to determine the hindgut bacterial composition of the sampled animals. The number of sequence reads per sample ranged between 17,613 and 59,964. At the youngest age sampled (3.7 wks), the bacterial profile consisted predominantly of Verrucomicrobia (50.9%) and Bacteroidetes (22.9%) related sequences, with the most abundant species-level OTU (operational taxonomic unit) for each phylum found at 44.9% (OTU SDEc-1) and 10.7% (OTU SDEc-2), respectively. At later time points (5.86–18.57 wks), Verrucomicrobia representation was reduced dramatically (0.7– 2.1%), while Bacteroidetes appeared to be maintained within a similar range (20.3– 37.7%). However, population shifts were detected within Bacteroidetes. For instance, OTU SDEc-2 abundance was greatly reduced during this period (< 0.05%), and OTU SDEc-3 was transitionally higher (range of 5.1–7.2%) between 5.6 wks to 9.57 wks. We also observed an overall increase from 13.1% to 65.0% in Firmicutes representation among foal samples during the sample period. In comparison with the fecal bacterial composition of their dams (2.2–15.5% Bacteroidetes; 71.6–83.3% Firmicutes), our results suggest that hindgut bacterial populations in horses younger than 4 mo have not yet developed a mature microbiota.

Key Words: gut microbiota, microbial ecology, 16S rRNA, bacteria

0813 Evaluation of chromic oxide and titanium dioxide as external markers for estimating digestibility in horses. A. Fowler¹, M. B. Pyles¹, B. Harlow^{1,2}, S. H. Hayes¹, A. Crum¹, and L. M. Lawrence¹, ¹University of Kentucky, Lexington, ²USDA-ARS Forage Animal Production Research Unit, Lexington, KY.

Total fecal collections are frequently used when performing digestibility studies in horses, however collection of all fecal output (FO) is labor intensive. The use of indigestible markers to determine digestibility indirectly will simplify digestibility studies. The objective of this study was to evaluate the accuracy of chromic oxide (Cr₂O₃) and titanium dioxide (TiO₂) in predicting daily FO. Eight Thoroughbred mares were used in this study: four mares were fed Cr₂O₃ and four mares were fed TiO₂. The daily ration was split into two equal feedings per day and consisted of timothy hay cubes, a pelleted concentrate, and soybean oil. External markers were top-dressed on the timothy cubes and complete consumption was ensured. Diets and markers were fed for 10 d before and during the 4-d total fecal collections. Fecal samples (250 g) were obtained every 4 h for external marker analysis; the remaining feces were composited by horse per day. Actual total FO was measured using daily composites and compared to FO calculated from marker concentrations in the 4-h fecal samples using a paired *t* test. For horses fed Cr₂O₃, mean actual FO was 2.62 ± 0.16 kg DM/d and mean calculated FO was 2.64 ± 0.07 kg DM/d (*P* > 0.1). For horses fed TiO₂, mean actual FO was 2.57 ± 0.12 kg DM/d and mean calculated FO was 2.79 ± 0.12 kg DM/d (*P* > 0.1). The absolute difference between actual FO and calculated FO was determined for each horse. The absolute difference was different from 0 for all horses consuming either TiO₂ or Cr₂O₃ (*P* < 0.001) probably because some horses did not achieve constant marker excretion during the collection period. Constant marker excretion is necessary if fecal grab samples are to be used to calculate digestibility. Increasing the frequency of marker dosing may result in a more stable marker excretion. With more validation, Cr₂O₃ and TiO₂ as external markers may be useful for estimating mean daily FO.

Key Words: digestibility, equine, external marker

0814 Effect of starch source in pelleted concentrates on fecal bacterial communities in thoroughbred mares. M. B. Pyles¹, A. L. Fowler¹, V. Bill¹, B. E. Harlow^{1,2}, A. Crum¹, S. H. Hayes¹, M. D. Flythe^{1,2}, and L. M. Lawrence¹, ¹University of Kentucky, Lexington, KY, ²United States Department of Agriculture, Agricultural Research Service, Forage-Animal Production Research Unit, Lexington.

Dietary starch source has been shown to affect fecal bacterial communities of horses fed cereal grains with little to no processing. Others suggest that grain processing, such as

pelleting, increases foregut starch digestibility, possibly mitigating effects of starch source on bacterial communities. The aims were to (i) determine the effect of starch source in pelleted concentrates on *Lactobacillus* spp., total starch utilizing bacteria (TSU), and cellulolytic bacteria in mares, and (ii) evaluate pre- and postpartum changes in fecal bacterial communities from 324 d of gestation to 28 d postpartum. Nineteen Thoroughbred mares were paired by last breeding date then randomly assigned to either an oat-based (OB) or a corn and wheat middlings-based (CWB) pelleted concentrate in addition to forage. Beginning at 310 d of gestation, mares were fed 3.2 kg/d (DM) of assigned concentrate (OB or CWB). After parturition, concentrate intake gradually increased to 4.8 kg/d (DM). The concentrates contained 38.0%, 36.2% starch, 6.6%, 8.8% WSC, and 5.4%, 7.5% ESC for OB and CWB, respectively. Fecal samples were collected at 324 d of gestation, before parturition, 24 h, 14 d, and 28 d postpartum. Fecal samples were collected immediately after defecation by catch or from the center of the pile into single use plastic bags and transported to the lab in an insulated cooler (37°C) under CO₂. Samples were serially diluted 10-fold with phosphate buffered saline and the dilutions were used to inoculate selective media. Selective media were used for enumeration of *Lactobacillus* spp., TSU, and cellulolytic bacteria. Data were log transformed then analyzed with PROC MIXED (SAS 9.3) to test the main effects of treatment (OB or CWB), time of sample, and treatment by time interaction. Results were considered significant when $P < 0.05$. There was no effect of starch source on enumerated bacterial communities ($P > 0.05$), in contrast to previous work. These results suggest that pelleting concentrates may alter some of the effects of starch sources. There was no effect of time on TSU ($P > 0.05$), however *Lactobacillus* spp. and cellulolytic bacteria decreased 24 h postpartum ($P < 0.05$). Therefore, major physiological events, such as parturition, appear to alter the hindgut microbiota.

Key Words: bacteria, concentrate, horse

HORSE SPECIES SYMPOSIUM: NUTRITION AND IMMUNOLOGY

0815 Nutritional immunology for the geriatric horse.

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Over the past century, improvements in health care and advancements in science and medicine have extended the average lifespan of humans and companion animals, including horses. We are now facing new challenges with the paradox of an older horse population with increased longevity and the potential of increased age-associated diseases. One of the most recognized consequences of aging is a decline in function of the immune system. Two main terms that characterize

a declining immune system of the old horse are immunosenescence and inflamm-aging. Immunosenescence in the aged individual is characterized by changes in various aspects of cellular and humoral immunity, in particular a decline in lymphoid cell numbers and function. It has been well documented that the aged, including horses, have increased susceptibility to and prolonged recovery from infectious disease, poor vaccine responses, and increased incidence of cancers. Somewhat paradoxically, advanced age is also associated with increased production of pro-inflammatory cytokines and other inflammatory mediators, a phenomenon termed inflamm-aging. Inflamm-aging predicts both increased morbidity and mortality for a variety of chronic diseases. Together, immunosenescence and inflamm-aging may increase susceptibility to infection and contribute to aged-related health conditions such as arthritis, equine Cushing's disease, and laminitis. Nutritional immunology is a new field of study, in which nutrition is used as a modifiable factor in impacting immune function in particular to delay/reverse immunosenescence and to improve the aged resistance to infection. Further, nutritional interventions are practical, cost-effective approaches to mitigating this age-related breakdown in immune function. Natural dietary compounds found in a variety of plants, roots, fruits, vegetables, nuts, and seeds are promising candidates in helping to combat the effects of an aging immune system. Several natural dietary compounds (carotenoids, flavonoids, isothiocyanates, terpenoids, proanthocyanidins, omega fatty acids, and polyphenolic compounds) have been shown to possess broad biological activities of anti-oxidation, anti-inflammation, detoxification, regulation of signaling pathways, modulation of enzyme activities, and improvement of immune responses to vaccination. Unfortunately, few studies have been conducted to better understand what effect nutrition may have on modulating or improving immune responses of the aged horse. Previous and current nutritional studies to improve immune function in old horses by supplementation with vitamin E, n-3 polyunsaturated fatty acids (DHA), prebiotics, and polyphenols will be reviewed here. More research is needed to identify effective and optimal conditions for various nutritional intervention regimens to improve the function of the aged immune system of the horse.

Key Words: horse, aging, immune

0816 Nutrition and immunity: General principles.

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The development, maintenance, and response of the immune system are influenced by nutrition. For most nutrients the most important nutritional strategy for optimizing immunity is meeting the established requirements for maximizing growth, reproduction, and feed efficiency and avoidance of traditional signs of deficiency. Severe deficiencies of required nutrients typically impair host immunity and resistance to disease, but such deficiencies should be rare in modern animal production.