618 Temporal variables of the flat walking Tennessee Walking Horse foal.

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Temporal variables of non-gaited horses are established as early as 4 months of age allowing for early performance prediction. However, Tennessee Walking Horse (TWH) gaits are often described as learned. TWH research noted temporal differences between flat walking weanlings. Therefore, the temporal variables of the flat walking TWH foal were measured within 24 hours of birth. Mares were lead at a consistent flat walk with foals matching the gait. 5 strides were selected from 4 TWH foals on the basis of consistency, speed, and gait correctness. 60 Hz frame-by-frame analysis determined stride duration and the following temporal variables, which were calculated as percent of stride: stance duration, bipedal support, tripedal support, advanced placement, and advanced lift-off. Means (SD) were determined and paired t-tests ($P<0.05$) were performed between the following temporal variables: fore and hind stance, lateral and diagonal stride variables, and tripedal support with 2 hind limbs and with 2 forelimbs (Table 1). Similar to the weanlings, the foal flat walk was a symmetrical, 4-beat stepping gait alternating between bipedal and tripedal support with the majority of the stride spent in stance. Tripedal support was longer than weanlings while the stride duration was shorter, which suggests foals move at a slower velocity with a faster stride rate. All foals had an irregular rhythm with lateral couplets, which was only present in half of the weanlings studied. The variations between the temporal variables of weanlings were not evident in the foals indicating foals start out with similar gaits; but with growth, environmental factors influence the continued gait development.

	Means (SD)
Stride Duration (ms)	958 (109)
Fore Stance (%)	68 (2)
Hind Stance (%)	69 (3)
Lateral Advanced Placement (%)	18 (4)[a]
Diagonal Advanced Placement (%)	29 (6)[b]
Lateral Advanced Lift-Off (%)	23 (4)
Diagonal Advanced Lift-Off (%)	27 (4)
Lateral Bipedal Support (%)	23 (5)[c]
Diagonal Bipedal Support (%)	9 (2)[d]
Tripedal Support-2 Hind (%)	33 (2)
Tripedal Support-2 Fore (%)	35 (3)

Table 1: Means (SD) for the temporal variables of the foal group. Different superscripts between variables denote significant differences.

Key Words: Temporal variables, Tennessee Walking Horses, Foals

619 The effect of *Kluyveromyces marxianus* and *Saccharomyces cerevisiae* on lactose concentration of equine milk.

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Yeasts are living organisms that benefit intestinal microflora, which in turn promotes good health for the animal. The milk sugar, lactose, is a vital energy source for the newborn foal and milk from the mare is the only natural source. Because there is a link between nutrient digestibility and milk composition, 2 different yeast species were used to determine differences in lactose concentrations within the milk. Twelve mares were randomly assigned to 1 of 3 groups. The composition of the herd was consistent with common breeds and ages of horses in North Carolina. Mares were allowed access to grass pastures and water ad lib. A commercial pelleted feed was administered at 1% body weight divided into 3 feedings per day along with coastal bermuda grass hay as needed to maintain a body condition score of 5-6. Yeast treatments to mares began 14 days before expected foaling date to allow for maximum treatment effect before sampling. Yeast treatments were standardized to colony forming units (CFU). Group 1 served as the control group. Group 2 was given 20g of Turval® 12 fodder, which included live *Kluyveromyces marxianus* yeast, for 5 days on and 2 days off. Group 3 was given 8g of BIOSAF®, a concentrate of live *Saccharomyces cerevisiae* yeast cells, for 5 days on and 2 days off. Treatments ceased on day 42 post-partum. Twenty-five mls were hand milked from each mare on day 0 (parturition) and days 14, 28, 42, and 56 after parturition. Milk samples were refrigerated until analyzed. Lactose concentrations were determined using a YSI model 2700 select biochemistry analyzer. The highest concentration of lactose (4.77%) was noted in the control group at day 56. Statistical differences ($p< .05$) were noted over time. This study shows dietary yeast supplementation may affect lactose concentration in equine milk. Despite low lactose concentration in milk when supplemented with yeast, other benefits of yeast supplementation should be considered.

Key Words: Lactose, *Saccharomyces cerevisiae*, *Kluyveromyces marxianus*

620 An ideal protein for the lactating mare.

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Empirical estimates on amino acid (AA) requirements for the lactating mare are not available. The objective of this study was to estimate the AA requirement of the lactating mare based on a factorial approach using milk and muscle amino acid profiles. Five mature multiparous Arabian mares with a body condition score ranging from 4.5-7 post foaling were used to determine milk AA concentration. Mares were initially fed high quality alfalfa hay at 2% of their body weight (BW) and concentrate at 1-2% of their BW. Mares were given access to mixed alfalfa-grass pasture during the third and fourth week post foaling, and milk was collected manually on day 30 of lactation. Coefficient of variation (CV, %) among mares for milk AA concentrations were Arg, 12.19; His, 11.65; Ile, 11.35; Leu, 11.69; Lys, 11.32; Met, 14.48; Phe, 12.61; Thr, 13.31; Val, 13.33. Three mature horses (two 4-year-old geldings and one 15-year-old mare) were used to determine AA concentration in muscle (gluteus and gastrocnemius). The CV for muscle AA concentrations were Arg, 0.58; His, 6.23; Ile, 2.64; Leu, 3.59; Lys, 3.91; Met, 2.65; Phe, 3.71; Thr, 3.38; Val, 3.72. The AA profiles in both muscle and milk were obtained by expressing each AA concentration as a ratio to lysine concentration. Maintenance (maint) requirement (reqt) for each individual AA were estimated as the product of their respective ratio in muscle relative to lysine and the digestible lysine requirement of 25.30 mg lysine/kg BW. Digestible (Dig) AA requirements for milk production (prod) were estimated as the product of their respective ratio in milk relative to lysine and lysine concentration in milk (1.7 g/kg milk) adjusted for an efficiency of utilization of 0.65 (1.7 g/0.65 = 2.62 g digestible lysine/kg milk). In conclusion, these results provide a basis on which total AA requirement for lactation can be derived.

Amino acid	Muscle AA:Lys	Milk AA:Lys	Reqt for maint (mg Dig AA/ kg BW)	Reqt for milk prod (g Dig AA/ kg milk)
Arginine	.75	.69	18.98	1.81
Histidine	.75	.33	18.98	0.86
Isoleucine	.58	.78	14.68	2.04
Leucine	.95	1.47	24.04	3.85
Lysine	1.00	1.00	25.30	2.62
Methionine	.32	.32	8.09	0.84
Phenylalanine	.47	.53	11.89	1.39
Threonine	.51	.72	12.93	1.88
Valine	.59	.97	14.91	2.54

Key Words: horse, lactation, amino acids

621 Influence of short duration, high intensity exercise on bone mineral content in stalled weanlings.

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Confinement housing has been shown to decrease skeletal strength due to the lack of loading placed on the bone. Stalling young horses results in decreased bone density compared to those allowed free exercise. However, only a few loading cycles may be needed to stimulate an osteogenic response. In order to investigate the hypothesis that short duration exercise may ameliorate the reduction in bone mass witnessed with confinement, 18 Quarter Horses were weaned at 4 mo of age and placed into box stalls. After 5 wk, individuals were grouped by age and weight, and then divided randomly into three treatment groups - group housed (GR), confined with no exercise (CF), and confined with exercise (EX). The CF and EX groups were housed in a 3.7 m x 3.7 m box stalls for the 56 d duration of the trial. The EX group was sprinted

82 m/d, 5 d/wk. The sprint was performed in a fenced grass alleyway. The GR horses were housed together in 992 m^2 drylot with free access to exercise. On d 0, 28 and 56, dorsopalmar and lateromedial radiographs of the left third metacarpal bone were taken in order to estimate changes in bone mineral content. An aluminum penetrometer was attached to the radiographic cassettes to allow the calculation of radiographic bone aluminum equivalence (RBAE). Mean values of medial, lateral, and total RBAE increased over time (P<0.05), while dorsal and palmar RBAE did not change significantly. There was a trend (P<0.1) for a treatment*day interaction in the dorsal, medial and total RBAE, with values increasing over time in the EX group. When values were normalized to account for differences in horses at the start of the trial, there was again a trend for a trt*day interaction in the dorsal cortex, with the gain in RBAE of EX being greater than CF on d 56. Normalized medial and total RBAE tended to differ (P<0.1) with treatment, with EX greater than CF. As differences between treatments approached significance, this inicates such short term exercise may be beneficial to the stalled animal.

Key Words: Bone development, Confinement, Exercise

622 Feeding-fasting cycle in meal fed yearling horses. W. B. Staniar*[1], D. S. Kronfeld[1], R. M. Akers[1], J. R. Burk[1], and P. A. Harris[2], [1]*Virginia Polytechnic Institute and State University, Blacksburg, VA*, [2]*Equine Studies Group, WALTHAM Centre for Pet Nutrition, Melton Mowbray, UK*.

A meal that results in high glycemic and insulinemic responses may also affect the secretion of growth hormone (GH) and insulin-like growth factor I (IGF-I), key hormones in the somatotropic axis that regulates skeletal development. Our objective was to characterize the feeding-fasting cycle of plasma concentrations of glucose, insulin, GH and IGF-I, and to compare two feeds differing in DE sources. Twelve Thoroughbred yearlings were randomly assigned to two dietary groups. Isocaloric feeds (SS and FF) contained 53 and 17% hydrolyzable carbohydrates (CHO-H), 57 and 19% non-structural carbohydrates (NSC), 11 and 23% ADF, 19 and 37% NDF, and 3 and 17% ether extract, respectively. Meals, 1.6 kg, were fed at 0 and 6.5 h in a 24 h period, and animals had *ad libitum* access to hay. Blood samples were taken every 30 min for assay of insulin, GH, and IGF-I by RIA and glucose by enzyme assay. Glycemic response was higher (P = 0.048) in the FF group than SS. The effect of meals was revealed by changes in plasma glucose and insulin with time (P < 0.0001). Plasma glucose peaked 1.3 h, plasma insulin 2 h, after meals. Plasma GH exhibited 6.6 0.6 GH secretory episodes averaging 15 1.9 ng/ml per day. Four distinct secretory episodes (3.2 0.17, 8.6 0.17, 16 0.32, and 22 0.22 h) suggested a synchronizing effect of the feeding-fasting cycle. Plasma IGF-I concentration was 239 3.8 ng/ml with no feed or meal effect. This study demonstrates a feeding-fasting cycle in plasma glucose and insulin concentrations. Failure of 17% CHO-H to reduce glucose and insulin responses contrasts with effectiveness of 14% in a similar experiment over 6 hr in our laboratory. Also, pre-meal plasma IGF-I was lower in horses fed a 16% CHO-H feed in a 12 mo study. These comparisons indicate that the degree of starch restriction is critical to minimize the feeding-fasting cycle and putative perturbations of skeletal development.

Key Words: Feeding-fasting cycle, Somatotropic axis

623 Pyrimethamine and sulfadiazine administration lowers plasma folate and increases plasma homocysteine in horses. A. L. Ordakowski*[1], D. S. Kronfeld[2], C. A. Williams[2], J. L. Holland[2], and L. S. Gay[2], [1]*University of Maryland, College Park, MD 20742*, [2]*Virginia Polytechnic Institute and State University, Blacksburg, VA 24061*.

A depletion-repletion study of folate status was conducted on 8 healthy mature Thoroughbred geldings (583.3 20.1 kg initial BW). Oral administration of pyrimethamine (PYR) and sulfadiazine (SDZ) for 9 wk (Period 1) was followed by coadministration of these anti-folate drugs with either peptidoglycan (PG) or folic acid (FA) for 6 wk (Period 2). Geldings were maintained on a 0.5-acre dry lot with an adjacent shed, and were fed orchardgrass/alfalfa hay. During Period 1, each horse was orally administered 1 mg/kg BW of PYR and 20 mg/kg BW SKZ once daily. During Period 2, were paired by age and BW and randomly assigned to either once daily oral administration of 20 mg FA or 35 g of PG as a source of formylated folate derivatives. Body wt, rectal temperature, and jugular blood samples were obtained weekly. Hematological indexes assessed were variable, but were within normal limits for horses during both periods. After 1 wk of PYR/SDZ administration, plasma folate concentrations decreased 59 % compared to baseline levels ($P < 0.05$). Folate status was impaired during 9 wk of PYR/SDZ administration as determined by a decreased plasma folate concentration ($P < 0.05$) and an increased plasma homocysteine concentration ($P <$ 0.05). During Period 2, coadministration of either PG or FA was not effective in preventing further decline of plasma folate and increases in plasma homocysteine. Despite a lowered folate status in the horses, no abnormal hematological indexes were found indicating clinical anemia did not occur. A moderate case of hyperhomocysteinemia occurred as a result from an impaired folate status, but not from lowered B_{12} status in our horses during the experimental period. The stable concentrations of plasma B_{12} indicated that administration of PYR and SDZ did not impair microbial synthesis of that B-vitamin. These results demonstrate that an impaired folate status can be induced by commonly used anti-folate drugs in the horse, and that this impaired folate status is refractory to the coadministration of natural and synthetic folates.

Key Words: Folate, Homocysteine, Anti-folate drugs

624 Age and exercise training alter plasma beta-endorphin, cortisol, and immune parameters in horses. K. Malinowski*[1], E. Shock[1], V. Roegner[1], P. Rochelle[1], C.F. Kearns[1], P.D. Guirnalda[2], and K.H. McKeever[1], [1]*Rutgers University, New Brunswick, NJ, USA*, [2]*Sloan Kettering, New York, New York, USA*.

Objective was to determine if training and age [Y 7 yr; n=6), middle-aged (MA 15 yr; n=6), and old (O 27 yr; n=5)] affect plasma β-endorphin (BE), cortisol (F), and immune responses to acute exercise in unfit mares. A graded exercise test (GXT) was performed before and after 12 wk training at 60 % HR_{max}. Leukocyte number, CD4+ and CD8+ cell subsets, lymphoproliferative response (LPR), and BE and F were measured in jugular blood. BE and F were measured at rest and at 5, 10, 20, 40, 60 and 120 min post-GXT. F rose by 5 min post-GXT in Y and MA mares (P<0.05) and remained elevated until 40 min and 60 min post-GXT, respectively, during both pre-and post-training GXT. There was no rise in F in O mares post-GXT after either GXT (P>0.05). Pre-training BE rose (P<0.05) by 5 min post-GXT in all mares. After training, BE was higher in Y and O vs. MA (P<0.05) at 5 min post-GXT. Post-training BE was higher at 5 min post-GXT in Y and O vs. pre-training (P<0.05). BE was higher at 10 min post-GXT in O post-training vs. pre-training. Monocyte number was lower (P<0.05) post-GXT in O vs. Y after training. After GXT, lymphocyte number rose in all mares (P<0.05); however lower numbers (P<0.05) were seen in MA vs. Y and O vs. MA(P<0.05). CD4+ lymphocytes were higher at rest in O and MA vs. Y (P<0.05). A reduction (P<0.05) in CD4+ lymphocytes was seen in O and MA during the pre-training GXT and in all mares during post-training GXT. Age had no effect on resting CD8+ lymphocytes (P>0.05). CD8+ lymphocytes rose (P<0.05) after GXT in all ages. The O had reduced LPR to Con A stimulation (P<0.05) compared to Y and MA after GXT during both tests. The O displayed reduced (P<0.05) LPR to PHA only after post-training GXT. GXT and training had no effect (P>0.05) on Con A or PHA induced LPR> LPR to PWM was lower (P<0.05) in O vs. Y and MA after pre-training GXT only. Training caused an increase in resting LPR to PWM in MA only (P<0.05). Age and training affected post-GXT F and BE. Age affected immune function.

Key Words: Age, Exercise, Horse