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## THE EFFECT OF OMEPRAZOLE ON THE MICROBIOTA OF HEALTHY ADULT HORSES

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**Background:** Equine gastric ulcer syndrome (EGUS) is a multifactorial disease of high prevalence in horses. The treatment of choice for EGUS is omeprazole, a proton pump inhibitor available as a proprietary oral formulation. Empirical administration of omeprazole without diagnostic evidence of gastric disease is commonplace in equine practice. In people, proton pump inhibitors have been associated with the development of infectious gastrointestinal complications and a shift in gastrointestinal microflora. An increase in the incidence of diarrhea has been reported in foals treated with proton pump inhibitors. Novel sequencing technologies have allowed in-depth analysis of broad microbial communities, including those present in the gastrointestinal tract.

**Objectives:** The objective of this study was to determine the effect of administration of omeprazole on the fecal microbiota of healthy adult horses.

**Methods:** Twelve horses were randomly assigned to either treatment (proprietary omeprazole paste) or placebo (water) groups. Administration of treatment or placebo occurred daily for twenty-eight days. Fecal samples were collected prior to initial treatment (day 0), and on days 7, 28, 35, and 56. 16S rRNA gene sequences were amplified and sequenced from DNA extracted from each fecal sample to characterize diversity and structure of the fecal microbiota.

**Results:** Composition and diversity of the fecal microbiota were not significantly different between the treatment and placebo groups or over time.

**Conclusions:** Omeprazole administration does not have a measurable effect on the fecal microbiota diversity in healthy adult horses.

**Ethical animal research:** Approved by the University of Georgia Institutional Animal Care and Use Committee (IACUC). **Source of funding:** Funding obtained from UGA's For the Love of the Horse and medication donated by Merial®. **Competing interests:** None.

## Physiology/Pathophysiology Session

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## EFFECT OF A PROBIOTIC SUPPLEMENT ON THE EQUINE METABOLOME FOLLOWING EXPOSURE TO ANTIMICROBIALS

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**Background:** Probiotic use is widespread in the equine industry, yet there is little data assessing the impact of probiotics on the gastrointestinal microbiome and metabolome. This study attempts to investigate the influence of probiotics on the equine gastrointestinal metabolome using an antibiotic challenge model.

**Objectives:** The objective of this study was to evaluate the role of an equine prebiotic/probiotic supplement (Platinum Balance®) on *Lactobacillus* spp. quantification and the metabolome following antibiotic challenge.

**Methods:** A randomized crossover design was applied to 5 horses undergoing 4 treatment periods consisting of: no treatment, antibiotics alone (Excede®), probiotics alone (Platinum Balance®), and both antibiotics and probiotics. Each treatment period was 14 days and included fecal samples acquired per rectum on days 0, 3, 10, and 14 to undergo microbial and metabolomics analysis. Statistical analysis included principle component analysis (PCA), analysis of variance (ANOVA), mixed model ANOVA, and supervised metabolic profiling using OPLS discriminant analysis.

**Results:** No significant differences were detected in *Lactobacillus* spp. quantitation between or within horses in response to treatment. Metabolomics data demonstrated statistically significant changes in multiple compounds in which the response to treatment is time dependent. OPLS-DA revealed some distinct separations between fecal metabolic features between treatment groups at day 14 suggesting that probiotic administration has a significant impact on fecal metabolites and these metabolites more closely resemble those of control samples compared with antibiotic treatment alone.

**Conclusion:** Antibiotics alter the fecal metabolome. Administration of probiotics in conjunction with antibiotics may help to normalize the fecal metabolome.

**Ethical animal research:** Ethical approval obtained by the Colorado State University Institutional Animal Care and Use Committee. **Source of funding:** Funding obtained from Platinum Performance. **Competing interests:** Dr. Hassel is a research advisor for Platinum Performance.

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## PREVALENCE OF FECAL SHEDDING OF EQUINE CORONAVIRUS IN HOSPITALIZED HORSES

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**Background:** Coronavirus infection has been identified in foals and adult horses with pyrogenic and enteric disease; however its significance as a pathogen remains undefined. Recently, Equine Coronavirus (ECoV) has been identified in feces of healthy horses suggesting that inapparent carriers may shed the virus.

**Objective:** The objective of this current, ongoing study was to investigate the presence of ECoV in feces of horses hospitalized for enteric disease (n = 70) or orthopedic conditions (n = 70).

**Methods:** Fecal samples were collected at admission and 48-72 h thereafter. Presence of ECoV was evaluated using electron microscopy (EM) and RT-PCR. Categorical analyses will be performed using Kruskal-Wallis test to determine the association between observations (age, breed, sex, clinical signs, clinicopathological data, EM and RT-PCR results).

**Results:** Our preliminary data showed that 17% (3/18) of horses with enteric disease were positive for ECoV. These horses had fever (2/3), elevated liver values (1/3), hepatic lipidosis (1/3), and sand enteropathy (1/3). So far, ECoV has not been detected in the orthopedic group (n = 16). Interestingly, a discrepancy between EM and RT-PCR results was noted and is currently being further investigated.

**Conclusions:** The results of our ongoing study shows that, for our study population, ECoV is detected in a small percentage of horses admitted for enteric disease and is not a common finding in horses admitted for orthopedic conditions. Also, the disagreement between tests for ECoV highlights the need for further research. The data from this study will contribute to our understanding of the role of ECoV in the horse.

**Ethical animal research:** This project was approved by the IACUC office at WSU (#04793). Samples were collected after client consent was obtained. **Source of funding:** The study was fully funded by the Advancement in Equine Research Award, Boehringer Ingelheim Vetmedica. **Competing interests:** None.

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### EVALUATION OF MICROCIRCULATORY PERFUSION USING SIDESTREAM DARK FIELD MICROSCOPY (MICROSCAN<sup>®</sup>) IN HEALTHY HORSES WITH ISOFLURANE-INDUCED HYPOTENSION TREATED BY DOBUTAMINE

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**Background:** Inadequate peripheral perfusion may lead to tissue hypoxia and dysfunction. Microcirculatory dysfunction may be present despite normal macrocirculatory measurements; particularly during colic surgery. Thus, direct assessment of tissue perfusion may be advantageous. Microcirculatory evaluation has been performed with dark field microscopy (Microscan<sup>®</sup>), providing microvascular perfusion indices (MPI).

**Objective(s):** 1) To compare the MPI of distinct vascular beds of anesthetized healthy horses under normotensive, hypotensive, and dobutamine corrected normotensive conditions 2.) To compare MPI to macrovascular indices.

**Methods:** Six adult horses were anesthetized. Macrovascular monitoring included arterial blood pressure (MAP) and cardiac output (CO). Microcirculation was assessed by videos obtained from the oral mucosa, rectal mucosa, and colonic serosa. The colon was accessed following a ventral laparotomy. Measurements were taken at normotension (70-80 mmHg), followed by isoflurane induced hypotension (<60 mmHg), and then dobutamine corrected normotension.

**Results:** Significant differences in MAP were present between the normotensive and hypotensive time points, dobutamine and hypotensive time points, but not between the normotensive and dobutamine time points. No significant difference was present between CO of the normotensive and hypotensive time points, both of which were significantly different from the CO of the dobutamine time point. Significant associations of MPI were not present in the colon or rectum between time points. No significant association was present between time points for the oral MPI, except for PPV between the hypotensive and dobutamine time points (P = .045).

**Conclusion:** Microscan<sup>®</sup> can be used to assess changes in peripheral perfusion subsequent to induced hypotension and pharmacological intervention.

**Ethical animal research:** The study was approved by the University of Georgia Institutional Animal Care and Use Committee. **Source of funding:** This study was funded by the

University of Georgia's For The Love of the Horse Foundation. **Competing interests:** None.

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### DIFFERENTIAL EFFECTS OF SELECTIVE AND NON-SELECTIVE CYCLOOXYGENASE INHIBITORS ON GASTRIC ULCERATION SCORES, INTESTINAL INFLAMMATION, AND FECAL MICROBIOTA COMPOSITION AND DIVERSITY IN ADULT HORSES

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**Background:** Non-steroidal anti-inflammatory drugs (NSAIDs) are among the most frequently administered pharmaceuticals in equine medicine. Gastro-intestinal (GI) injury is a frequent adverse event associated with NSAID use. Moreover, evidence exists that NSAIDs induce GI microbial imbalance (dysbiosis). A common strategy to limit NSAID-induced GI injury is administration of cyclooxygenase (COX)-2-selective NSAIDs. It is unknown, however, to what extent COX-2-selective NSAIDs and non-selective NSAIDs differ in causing equine GI injury, and to what extent these classes alter the microbiota in horses.

**Objectives:** The objective of this study was to determine whether there are differential effects of between a COX-2-selective and a non-selective NSAID on GI injury and on the fecal microbiota of adult horses.

**Methods:** Twenty-five adult horses were randomly assigned to receive placebo (n = 5), phenylbutazone (n = 10), or firocoxib (n = 10). Treatments were administered on days 1-10. Gastroscopy was performed on days 0 and 10 and fecal samples were collected on days 0, 10, and 25. Fecal albumin was quantified as an indicator of GI damage and fecal DNA was extracted for 16S rRNA amplification and sequencing.

**Results:** Both NSAIDs induced glandular ulcers, but ulcer severity was greater for phenylbutazone-treated horses. Fecal albumin concentration was significantly associated with glandular ulcer scores irrespective of treatment. Horses treated with phenylbutazone and firocoxib had decreased diversity and alteration of their fecal microbiota profiles at day 10.

**Conclusions:** These findings suggest that while COX-2-selective NSAIDs may result in less gastric ulceration, both classes of NSAIDs are associated with similar degrees of lower GI injury and dysbiosis in horses.

**Ethical animal research:** Ethical approval obtained from Texas A&M Institutional Animal Control and Use Committee. **Source of funding:** Department of Large Animal Clinical Sciences, College of Veterinary Medicine & Biomedical Sciences, Texas A&M University. **Competing interests:** None.