

Effects of a dietary supplement on gastric ulcer number and severity in exercising horses¹

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ABSTRACT: This study evaluated the effect of a dietary supplement on the treatment of equine gastric ulcer syndrome (EGUS). Gastroscopy was performed on university riding horses of mixed breeds at two locations and only horses exhibiting gastric ulcers were selected to participate in this study (location A, $n = 13$; location B, $n = 15$). Gastric ulcer severity was assessed using two different methods depending on location before treatment (Pre). After gastroscopy, horses were fed the supplement in addition to their regular diet for 44 d (14-d adaptation period followed by 30-d feeding period). All horses were subjected to gastroscopy again at the end of the feeding period (Post) to evaluate changes in gastric lesions. Statistical analysis was performed using SAS. Individual horses were the experimental unit with dependent variables including severity and number of gastric ulcers. At location A, dependent variable included severity of gastric lesions with fixed effects of time

(Pre and Post) and location (stall or pasture). For location B, dependent variables included severity and number of gastric lesions with fixed effects of time. Severity of gastric ulcers decreased at both locations in horses following the feeding period. Gastric lesion scores decreased from 2.2990 to 1.3760 ($P = 0.0015$) at location A and gastric lesion severity from 3.8000 to 2.5667 ($P = 0.0322$) at location B. No differences were found in gastric lesion scores at location A between horses housed in stalls or pastures (1.8750 and 1.8000; $P = 0.7783$). The number of gastric ulcers observed at location B were similar Pre and Post treatment (3.4667 and 3.5333; $P = 0.8363$). There were no changes in body condition score ($P \geq 0.2607$), BW ($P \geq 0.4551$), or behavior at either location. Results suggest that oral supplementation may decrease severity of gastric ulcers in horses participating in university riding programs.

Key words: EGUS, equine, gastric ulcers, oral supplementation

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INTRODUCTION

Equine gastric ulcer syndrome (EGUS) affects a large number of horses in the equine industry, from recreational animals to those who are intensely competitive, and has been reviewed

at length (Orsini, 2000; Andrews et al., 2005; Martinez and Silveira, 2014). Among the variety of causes, exercise (Begg and O'Sullivan, 2003; McClure et al., 2005), diet (Nadeau et al., 2000), and confinement (Husted et al., 2008) have been shown to promote gastric ulcers in horses. Negative impacts on equine health and performance, costs for diagnostic testing, and medications for treatment make gastric ulcers an expensive economic and clinical problem that affects many horses in recreational and professional aspects of the

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equine industry. Common treatment of EGUS includes use of medications such as omeprazole paste (Johnson et al., 2001; Lester et al., 2005) and ranitidine (Lester et al., 2005), both of which can be costly in terms of money and time. Other studies have evaluated effects of diet or daily management changes in horses with EGUS (Nadeau et al., 2000; Husted et al., 2008), with varied results. An oral supplement was developed with the purpose of preventing or reducing the incidence of EGUS. It was hypothesized that horses with ulcers fed the supplement would show a reduction in number and severity of ulcers after treatment. Horses in university equine programs experience many of the causes of EGUS which may affect behavior, health, their utilization in classes, and research programs. Therefore, the objective of this study was to assess the impact of an oral supplement on gastric ulcer lesion numbers and severity after a 30-d feeding trial in horses utilized in university riding programs.

MATERIALS AND METHODS

The experimental design and procedures of this study for each location were reviewed and approved by the Institutional Animal Care and Use Committees at Murray State University (MSU) as per the Public Health Service Office of Laboratory Animal Welfare, and at Virginia Intermont College (VIC). This study was conducted as two projects at two separate locations. The MSU Equine Center in Murray, KY, was labeled location A. The VIC Riding Center in Bristol, VA, was labeled location B.

Location A

Gastric ulcer evaluation. Horses over 4 yr of age ($n = 44$) that were involved in the riding program at MSU were initially examined. All horses were restricted from forage and grain for 12 h before gastroscopy was performed by a licensed veterinarian. Horses were restrained in standing stocks and by use of a nose twitch. Nineteen horses were also sedated via jugular intravenous injection of 0.4 mL

Dormosedan (detomidine hydrochloride, 10 mg/mL; Zoetis, Parsippany, NJ, USA) and 0.3 mL Torbugesic (butorphanol tartrate, 10 mg/mL; Zoetis). A camera on a 3-m endoscope was inserted through one nostril and advanced to the horse's stomach. Based on the veterinarian's observation, horses were scored using the Equine Gastric Ulcer Council lesion grading system (Table 1). Horses that scored ≥ 2 were automatically included in the study ($n = 13$). After supplementation, horses were again evaluated for gastric ulcers using the same procedure.

Horse management. No changes in equine management were made during study, other than addition of the supplement to the diet. Nine horses were maintained in 3.6×3.6 m stalls and received limited access to turnout in small grass paddocks or dry lots, while seven horses were maintained on pasture. All horses were exercised regularly in equitation classes and for riding team practices. Pastured horses were fed a pelleted concentrate (Southern States, Reliance 12–6, Park City, KY) at 0700 and 1500 each day. Stalled horses received a textured concentration (Southern States, Triple 10, Park City, KY) and received Bermudagrass hay (*Cynodon dactylon*) at 0700 and 1500 each day. All horses were fed to maintain a moderate body condition score (BCS; Henneke et al., 1983). Thoroughbreds and Quarter Horses represented the breeds of horses included in the study.

BW and BCS were evaluated for each horse at the beginning and the end of the feeding period. Trained faculty and staff members evaluated BCS, and BW was measured using a weight tape. Behavioral characteristics were evaluated subjectively by faculty instructors and the barn manager, and any changes in appetite, attitude, or performance were noted.

Feeding trial. The supplement was a proprietary blend of buffering agents and ingredients formulated to support healthy gastric function in performance horses (Table 2). Horses were fed the supplement for a 14-d acclimation period before the 30-d trial. Each horse was given 0.45 kg of

Table 1. Equine gastric ulcer council lesion grading system^a

Lesion score	Description
Grade 0	Epithelium intact; no appearance of hyperemia (reddening) or hyperkeratosis (yellow appearance to the squamous mucosa)
Grade 1	Mucosa intact; areas of reddening or hyperkeratosis (squamous) are apparent
Grade 2	Small, single, or multifocal lesions
Grade 3	Large, single, or multifocal lesions or extensive superficial lesions
Grade 4	Extensive lesions with areas of apparent deep ulceration.

^aAdapted from Andrew et al., 1999.

Table 2. Proximate analysis of proprietary supplement designed to support equine gastrointestinal health^a

Nutrient	Value (%)
Crude protein	14.00
Crude fat	4.50
ADF	11.90
NDF	29.80
Calcium	2.10
Phosphorus	0.60
Sodium	0.11
Potassium	0.97
Magnesium	1.73

^aIngredients included wheat middlings, dehydrated alfalfa meal, natural and artificial flavors, distillers dried grains, magnesium oxide, sodium bicarbonate, calcium oxide, cane molasses, soybean oil, yeast culture, lignin sulfonate, and vitamin E.

supplement in addition to their regular diet with their morning feeding. All refusals were weighed and recorded before the afternoon feeding. Molasses and a textured concentrate (Southern States, Triple 10) were added to some diets to increase palatability of the supplement. After the 14-d acclimation period and with the addition of additives, supplement refusals decreased.

After the 30-d trial, all horses again underwent gastroscopy. Lesions were scored as previously noted and changes in scores evaluated.

Statistical analysis. Data were analyzed using the mixed procedure of SAS (SAS Inst. Inc., Cary, NC). Only horses identified as having gastric lesions were included in this study. Gastric lesions were scored for severity prior to starting the feeding period (Pre), and served as baseline measurements. Experimental unit was horse with lesion grade as the dependent variable of interest and time and location as fixed effects. The time by location interaction was not significant and was therefore removed from the model and the model refit. Data are presented as least squares means.

Location B

Gastric ulcer evaluation. Horses over 4 yr of age ($n = 19$) that were involved in the riding program at Virginia Intermont were initially examined via endoscopy by a licensed veterinarian. All horses were restrained in stocks and sedated via jugular intravenous injection of 0.5 mL/45 kg BW Rompun (xylazine, 100 mg/mL; Bayer HealthCare LLC, Shawnee Mission, KS, USA). A camera on a 3-m endoscope was inserted through one nostril and advanced to the horse's stomach. Based on

Table 3. Gastric lesion scoring system for horses with (EGUS)^a

Lesion number score	Description
0	No lesions
1	1–2 Localized lesions
2	3–5 Localized lesions
3	6–10 Lesions
4	> 10 Lesions or diffuse (or very large) lesions
Lesion severity score	Description
0	No Lesion
1	Appears superficial (only mucosa missing)
2	Deeper structures involved (greater depth than No. 1)
3	Multiple lesions and variable severity (1, 2, and/or 4)
4	Same as two and has active appearance (active = hyperemic and/or darkened lesion crater)
5	Same as four plus active hemorrhage or adherent blood clot

^aAdapted from MacAllister et al., 1997.

the veterinarian's observations, horses were scored using the alternative gastric ulcer scoring system (Table 3). Horses scoring ≥ 1 were automatically included in the study ($n = 15$). After supplementation (as stated above for location A), horses were again evaluated for gastric ulcers using the same procedure.

Horse management. No changes in equine management were made during study, other than addition of the supplement to the diet. All horses were maintained in 3.6 × 3.6 m stalls and received limited access (less than 5 hr/d) to drylot turnout. Horses had access to mixed grass hay in stalls and drylots. Horses were also fed concentrate (Purina, Strategy) in stalls twice per day at 0700 and 1600 at an amount to maintain a moderate BCS and BW, which were monitored as described above. All horses were exercised regularly in equitation classes and for riding team practices. Thoroughbreds and warmbloods represented the breeds evaluated at location B.

Feeding trial. Horses were fed the supplement for a 14-d acclimation period before the 30-d trial. Each horse was given 0.45 kg of supplement in addition to their regular diet with their morning feeding. All refusals were weighed and recorded before the afternoon feeding. After the 30-d trial, all horses again underwent gastroscopy. Lesions were scored as previously noted and changes in scores evaluated.

Statistical analysis. Statistical analysis was performed in a manner similar to location A. Again, horses served as their own control with each horse

diagnosed with ulcers receiving the supplement. Dependent variables included the number of gastric ulcers identified and severity of the gastric lesions with time as the fixed effect.

RESULTS

Location A

There were no observed changes in behavior, BCS (Pre = 5.4 and Post = 5.5; $P = 0.6809$), or BW (Pre = 1041.46 and Post = 1064.92; $P = 0.4551$). Horses continued to perform as expected in university classes and during team practices. Horses at location A evidenced palatability issues throughout the acclimation period and portions of the study. Molasses and then textured feed were added to improve palatability. The rate of refusals decreased but was still documented throughout the study. Most horses that continued to refuse to consume the entire supplement were Thoroughbreds. Thoroughbreds have been shown to have a high incidence of gastric ulcers (Hammond et al., 1986; Murray et al., 1996). Although the supplement did affect ulcer scores, suggesting the horses consumed enough to have an effect, the product cannot work if it is not consumed. An increase in supplement refusal toward the end of the study may have been influenced by the addition of fall grazing.

Lesion scores were determined for location A using the EGUS council lesion grading system (Table 1). Lesion score Pre treatment differed from Post treatment lesion scores. Lesion scores were highest at the start of the study and declined after the supplemental feeding period (2.2990 and 1.3760; $P = 0.0015$; SE = 0.2562). No differences were found between Pre and Post lesion scores for horses according to location, barn vs. pasture (1.8750 and 1.8000; $P = 0.7783$).

Location B

There were no observed changes in behavior, BCS (Pre = 7.4 and Post = 7.1; $P = 0.2607$), or BW (Pre = 1310.53 and Post = 1288.93; $P = 0.7268$). Horses continued to perform as expected in university classes and during team practices. There were no documented feed refusals by horses at location B. Lesion scores were determined for location B used the gastric lesion scoring system (Table 3). Although the number of gastric lesions were similar Pre and Post treatment (3.4667 and 3.5333; $P = 0.8363$), the severity of gastric lesions differed according to time. Gastric lesion severity ratings were highest Pre

treatment and declined after the supplemental feeding period (3.8000 vs. 2.5667; $P = 0.0322$) which is in agreement with results observed at location A.

DISCUSSION

There are two grading systems that are predominantly used for grading lesions. The Equine Gastric Ulcer Council created the lesion grading system to be used by veterinarians (Andrews et al., 1999). This system was designed to provide a simple and straightforward method of evaluating gastric lesions in a manner similar to other grading systems used to characterize clinical severity, such as with lameness diagnosis. An alternate gastric ulcer scoring system was created by researchers for use in research studies (MacAllister et al., 1997; Andrews et al., 2002). This system evaluates two variables: the number of lesions present and the severity of those lesions. Location A used the Equine Gastric Ulcer Council lesion grading system (Table 1) while location B used the alternative gastric ulcer scoring system (Table 3). It should be noted that study design precluded the inclusion of horses without ulcers to serve as controls or evaluate the effect of the supplement on horses without ulcers. Whether or not the supplement could serve as an ulcer preventative would require further research.

Several factors may influence the results of this study when considering data from both locations. First is the difference in scoring systems used. Based on descriptions, lesion scores from location A most closely relate to lesion severity as graded at location B. In both cases, scores improved after supplementation. It is not known if the number of lesions remained the same at Location A, as this data was not recorded. However, the results suggest the supplement had similar effects on horses at both locations.

Horses were housed differently at each location. At location A, 8 horses were housed on pasture. Horses kept in stalls ($n = 5$) were allowed turnout on grass lots an estimated 2 to 3 d/wk for approximately 5 hr each day. All horses at location B were kept in stalls with similar turnout, but on dry lots with access to hay. Access to continuous forage has been shown to provide a buffer against acids that can cause ulcers (Collier, 1999), and horses at both locations had ready access to forage, either hay or pasture, the majority of the time. However, horses still began the study with moderately serious gastric lesions, suggesting that forage access alone may not be enough to prevent ulcer formation in all horses.

As a result of feeding the supplement, lesion scores, and presumably equine health, were improved.

Horses at both locations were used in a riding program and for team practices. Exercise in horses can also lead to an increased prevalence of ulcers, which is often noted by poor performance (Nieto et al., 2009). During this study equine behavior was evaluated subjectively by faculty instructors and the barn manager. Although ulcers were confirmed via gastroscopy and there were improvements in either lesion scores or severity, there were no changes in behavior noted at either location.

Finally, during the pre-study gastroscopy at both locations, bot larvae (*Gasterophilus* spp.) were seen in the stomachs of several horses. Reddened spots were documented in some horses where bots may have detached. The presence of bots has been linked to increased incidence of EGUS (Cardona et al., 2016). Before beginning the feeding trial, all horses at location A were dewormed with ivermectin. Post supplement gastroscopy exams showed no bot larva present. Horses at location B were not dewormed, and bots were present in some horses during post supplement evaluation. Regardless whether or not horses were dewormed, ulcer scores and severity improved after supplementation.

Supplements are important because horse owners and managers want alternatives to expensive medications in order to manage horses with EGUS. There are many factors in today's horse management practices, particularly including housing and exercise, which can result in ulcers. The United States Department of Agriculture's (2014) 2012 census found that most horse farms were located on 10 to 49 acres. Horse farms are often comprised of barns, buildings for hay and equipment storage, and riding areas. These facilities may take up the majority of acreage, leaving little space for pasture and requiring horses to spend more time in stalls, predisposing horses to EGUS (Husted et al., 2008). Exercise can also result in gastric ulcer formation (Begg and O'Sullivan, 2003; McClure et al., 2005), which may be made worse if access to hay or pasture is limited. Availability of oral supplements shown to lessen severity of gastric ulcers may enable equine professionals to make better management decisions regarding EGUS in horses in suburban environments and on small farms.

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