

The Effect of EGUSIN® SLH and EGUSIN® 250 on Reducing Gastric Ulcer Scores in  
Thoroughbred Horses

**Final Report**

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## Abstract

Equine gastric ulcer syndrome (EGUS) is a common condition and current medications are effective in treatment. However, these pharmaceutical agents are expensive, require a prescription to obtain, must be administered orally, and alter stomach pH. The development of a less expensive and natural alternative supplement that could be added to the feed would be desirable. EGUSIN® SLH (E-SLH) and EGUSIN® 250 (E-250) are supplements containing sodium bicarbonate, Beta Glucan, insoluble oat fiber, polar lipids and natural antioxidants which have been shown in other species to protect the normal stomach against generation of oxygen free radicals. The purpose of this study was to evaluate these two supplements added to the feed twice daily on treatment and prevention of gastric ulcer in horses confined to stalls and undergoing feed-deprivation.

Nine healthy adult Thoroughbred and Thoroughbred-cross horses were used and all horses received the three treatments (control, E-SLH, and E-250) mixed with grain per label directions for 28 days in a three period cross-over designed study. Gastroscopy was performed before treatment, after the 3 week feeding protocol, after the alternating feed-deprivation period, and at one week after feed deprivation with the resumption of treatment. Gastric juice pH was measured and gastric ulcer scores were assigned by a clinician masked to the treatment. Also, blood gases were performed during periods 1 and 3, before, 2, 6, 12, 24, and 48 hours after treatment.

Gastric ulcer scores decreased in all groups after 3 weeks of treatments, but this was not significant. Gastric ulcer scores significantly increased in all groups on week 4, after the feed-deprivation period, indicating that the model of ulcer induction was successful. Gastric ulcer scores decreased significantly in SLH and 250-treated horses after 5 weeks of treatment when compared to untreated controls. Partial pressure of CO<sub>2</sub> (PCO<sub>2</sub>) was significantly increased 2 hours after administration of the EGUSIN® supplements, but there was no significant increase in bicarbonate or total CO<sub>2</sub> in any treatment groups. Gastric juice pH remained low and did not change significantly over the treatment periods.

Horses continuously fed and given EGUSIN® SLH and EGUSIN® 250 tended to have lower ulcer scores after 3 weeks, but this was not significant. However, following a severe feed-deprivation challenge in week 4, EGUSIN-treated horses demonstrated significant improvement in ulcer scores within one week.

## Introduction

Equine gastric ulcer syndrome (EGUS) continues to be a conundrum for horse owners, trainers and veterinarians. The high prevalence of gastric ulcers in horses, vague clinical signs and negative effect on performance make it a significant clinical and economic problem within the horse industry.<sup>1-14</sup> Current pharmaceutical agents (omeprazole and ranitidine) are effective in treatment of EGUS, but these treatments are expensive and there is a high rate of recurrence after treatment.<sup>15-17</sup> Preventative measures, such as increased pasture turnout, *ad libitum* hay feeding, reduced training levels, and stress reduction are essential to prevent recurrence; however these measures may not be possible or effective in some situations.<sup>18</sup>

Current pharmaceutical agents used to treat gastric ulcer disease in horses are expensive and require a minimum of 28 days of treatment, and frequently have to be given continuously during the training and racing season. Development of less expensive and easier to administer alternatives to prevent gastric ulcers once treated, would be desirable.

Commercial products (EGUSIN® SLH and EGUSIN® 250 pellets) containing Beta Glucan, insoluble oat fiber, polar lipids, and natural antioxidants have been shown in other species to support and protect the normal stomach lining, support normal digestive function, and protect the stomach against generation of damaging oxygen-free radicals. The purpose of this study was to evaluate EGUSIN® SLH and EGUSIN® 250 pellets in treatment and prevention of gastric ulcers in stall confined horses. The hypothesis of this study is that EGUSIN® SLH and 250 treats and prevents gastric ulcers in horses housed in stalls and fed a hay and grain diet and subjected to alternating feed-deprivation.

## Material and Methods

### Experimental design

**Horses** – Nine healthy adult Thoroughbred and Thoroughbred-cross horses from the LSU Equine Health Studies Program (EHSP) herd were used in this study. Horse ranged in age from 2 to 12 years of age. A full physical examination was performed prior to the beginning of the study to exclude presence of clinical disease. Body weights were measured on all horses at each gastroscopy examination.

**Design** – Three-period cross over design, with all horse being their own controls and receiving the two treatments (EGUSIN® 250, and EGUSIN® SLH) (Figure 1).

**Groups** – The study consisted of three groups of three horses each, control, EGUSIN® SLH (E-SLH), and EGUSIN® 250 (E-250) treatment groups. During the 1<sup>st</sup> period of the study, horses were randomly allocated either to a treatment group or a control group and each horse served as its own control during the study. Control and treatment horses were allowed a 2-day

acclimatization period before initiation of the study and all horses were observed daily, morning and evening, to ensure that no signs of colic were present.

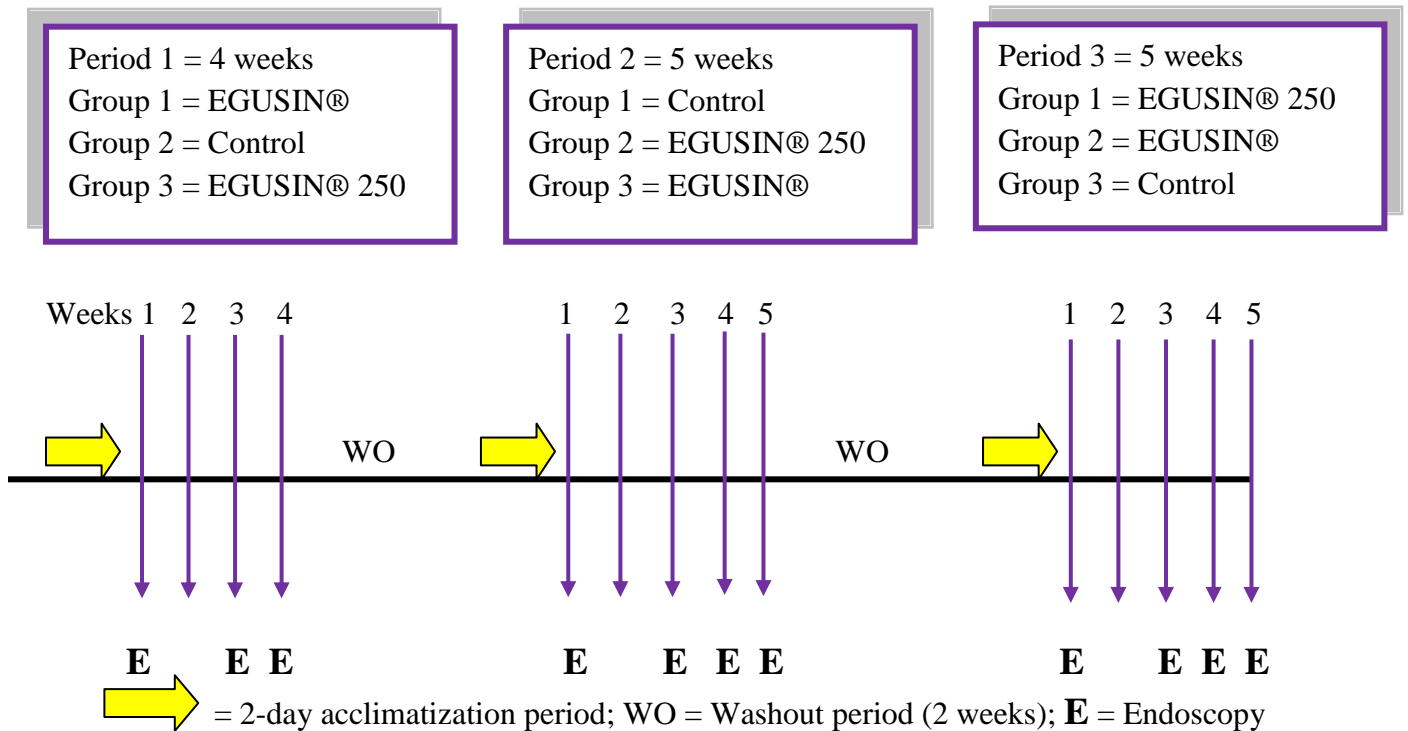
**Control group** – Horses were housed in 3 m X 3 m stalls and fed hay (1.5% body weight) and grain (Omelene® 100, Purina Mills, LLC, Gray Summit, MO) per label directions without any EGUSIN® supplementation for the periods.

**Treatment group** – Horses were housed in 3 m X 3 m stalls and fed hay and grain, as above, and fed E-250 (125 gm, twice daily) and E-SLH (0.25 gm/100 kg, twice daily) added directly to the grain ration as indicated on the product label twice daily for the study period.

**Periods** – There were three periods, the first period lasted 4 weeks and the second and third periods lasted 5 weeks. The first 3 weeks involved stall confinement and EGUSIN®-treatment or no treatment. During the 4th week, horses were fed intermittently as previously described<sup>16</sup>. To determine if gastric ulcers induced during week 4 would heal up or improve with treatment, horses were scoped on week 5 in periods 2 and 3. This data was analyzed separately. During the feed-deprivation week, horses were maintained on treatment. During this period, EGUSIN®-treated or control horses were fed the same amount of grain containing EGUSIN® supplementation or grain alone.

A ‘wash-out’ period of at least 2 weeks was allowed between the first two study periods. During the ‘wash-out’ period horses were turned out to pasture and provided time for EGUSIN® effects to wash out and prevent carry-over effects<sup>25</sup>. After the ‘wash-out’ period, horses that received E-250 in the first period acted as controls and those who received E-SLH received E-250 supplement in the second period. Treatments were changed in the third period so that all horses received all of the treatments.

**Figure 1: Experimental Design**



**Stabling** – All horses were placed in box stalls for 2 days prior to the starting date of each study period and during the length of the three study periods. During the wash-out period, horses were in the pasture.

**Diet** – The horses in this study were fed grass hay (1.5% of body weight) and grain as per label directions twice daily. The alternating periods of feed-deprivation have been successfully used to induce progressive ulceration of the gastric mucosa<sup>19</sup>. Horses in prior studies have tolerated the protocol without medical problems and no clinical signs of discomfort have been observed. Additionally, previous prevalence studies have shown high numbers of horses with gastric ulceration without clinical signs<sup>1,4,19</sup>.

**Feed deprivation** – During the last week of the study, all of the horses were muzzled and deprived of feed for 24 hours, then fed with hay and grain for 24 hours until a total of 96 hours of cumulative feed deprivation was achieved. The horses had free access to water at all times.

During the feed-deprivation period, the horses continued to receive the daily dose of E-SLH and E-250 added to the grain meal, while the control horses received the same amount of grain with no addition of EGUSIN®.

***Gastrosocopy*** - Endoscopy of the stomach (gastrosocopy) was performed in all horses on Day 0 before entering the trial, after the stall confinement phase (Day 21), after the feed deprivation phase (Day 28), and in period 2 and 3, 1 week (Day 35) after the feed deprivation phase. Feed was withheld for 16-18 hours and water for 3-4 hours prior to gastrosocopy to improve the visualization of the stomach. Horses were sedated with xylazine (0.4mg/kg, IV) for the gastrosocopy procedure. Prior to insufflating the stomach, gastric juice was aspirated and pH measured using both a portable and table top pH meters. All horses' stomachs were evaluated using a 3-m endoscope (Karl Storz, El Segundo, CA).

***Classification of the ulcers*** – Each horse's stomach was assigned an ulcer score based on ulcer number and severity and ulcer size (EGUS Ulcer Score) (Table 1) and ulcer size.<sup>15,20</sup> Digital pictures of the stomach were recorded at each endoscopic procedure using a digital capture system attached to the endoscope. Scoring of lesions was done at the time of endoscopy. After the endoscopic procedure the horses were fed as per usual. The clinician (FMA) issuing the ulcer scores was masked to the treatment received by the horses. Scores were assigned for glandular and non-glandular mucosa and nonglandular ulcer size based on two ulcer scoring systems.

## Explanation of Scoring Systems

**Table 1: Gastric Ulcer Number and Severity Scoring System<sup>20</sup>**

<b>Lesion Number - Grade</b>	<b>Descriptions</b>
0	No lesions
1	1 - 2 localized lesions
2	3 – 5 localized lesions
3	6 – 10 lesions
4	10 or more lesions or diffuse (very large) lesions
<b>Lesion Severity - Grade</b>	<b>Descriptions</b>
0	No lesions
1	Appears superficial (only mucosa missing)
2	Deeper structures involved (> depth than Number 1)
3	Multiple lesions and variable severity (1,2, and/or 4)
4	Deeper structure involved (> depth than Number 1) and has active appearance (hyperaemic and/or darkened lesion crater)
5	Same as Number 4 plus hemorrhage or adherent blood clot

## EGUS Scoring System<sup>15</sup>

0. No evidence of ulcers (may have hyperemia or hyperkeratosis)
1. Small focal or multifocal ulcers
2. Large focal or multifocal ulcers
3. Extensive multifocal ulcers often coalescing with apparent depth

## Blood Gas Analysis

On Day 1, 2 and 3 of periods 1 and 3, blood was collected from the jugular vein of the horses before, 2, 6, 12, 24 and 48 hours after treatment. Blood gases (pH, pCO<sub>2</sub>, PO<sub>2</sub>, bicarbonate, and TCO<sub>2</sub>) were measured using an automated blood gas analyzer.

## Statistical analysis

Means and SEM were reported on all variables using the 5 week data values. Data was analyzed statistically using SAS® (SAS 9.1, SAS Institute, Inc., Cary, NC). The SAS MIXED procedure was used to analyze the data as a repeated measures analysis of variance of a mixed effects model. When significant differences were found, post-hoc pairwise comparisons were conducted with t tests of least-squares means for main effects and for interaction effects. All comparisons were considered significant at  $P < 0.05$ .



## Results and Conclusions

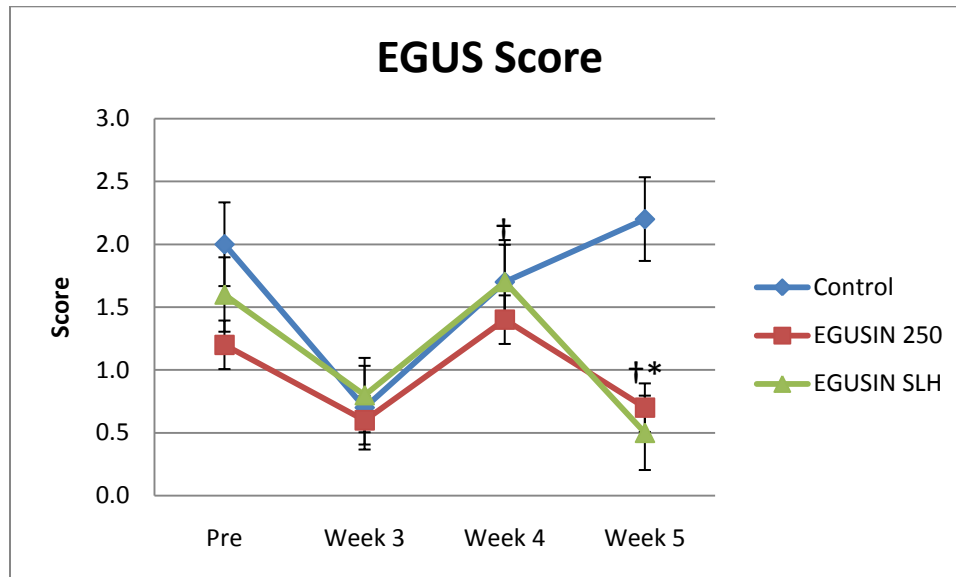


Figure 3. Mean  $\pm$  SEM Equine Gastric Ulcer Syndrome (EGUS) scores in horses fed EGUSIN® 250 Supplement, EGUSIN® SLH Supplement, and controls before treatment (Pre), after three weeks of treatment (Week 3), after 4 weeks of treatment, and after 5 weeks of treatment. A 7 day alternating feed-deprivation protocol was employed during Week 4. (†) denotes a significant ( $P < 0.05$ ) difference from scores from the previous week and (\*) denotes significant differences from control values for the same week.

### Conclusion:

1. During the first 3 weeks of the study during stall confinement, control, E-SLH- and E-250-treated horses tended to show lower ulcer scores when compared to horses before treatment, but this was not significant.
2. During the second phase of the study, the alternating feed-deprivation period (week 4) gastric ulcer scores increased in all groups denoting that stress had occurred leading to worsening of gastric ulcers. However, during the second week (week 5) of the second phase, gastric ulcer scores significantly improved in the E-SLH and E-250-treated horses when compared to controls.
3. Conclusion: Horses continuous fed and given EGUSIN® SLH and EGUSIN® 250 tended to have lower ulcer scores after 3 weeks but this was not significant. However, following a severe feed-deprivation challenge in week 4, EGUSIN-treated horses demonstrated significant improvement in ulcer scores within one week.

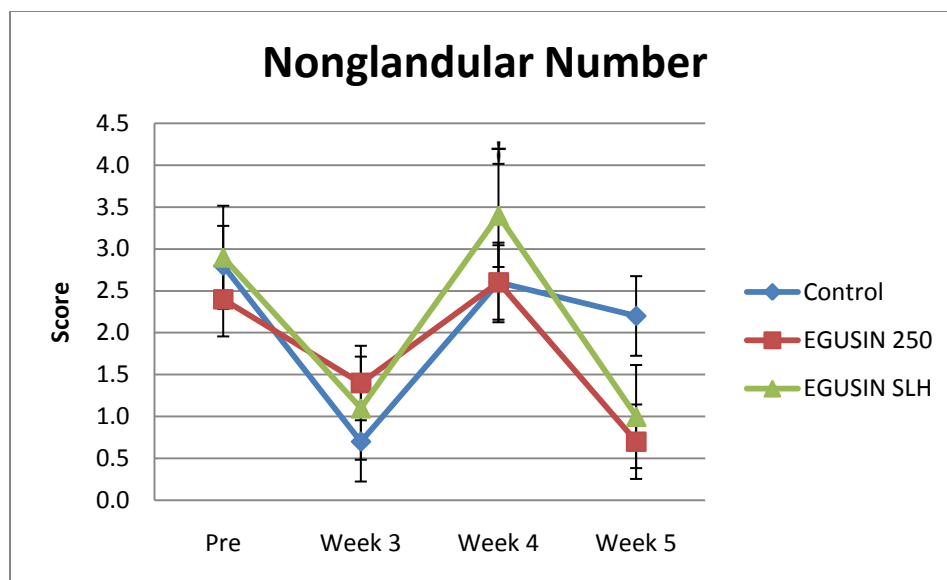


Figure 4. Mean  $\pm$  SEM nonglandular gastric ulcer number scores in horses fed EGUSIN® 250, EGUSIN® SLH, and untreated controls before treatment (Pre), after three weeks of treatment (Week 3), after 4 weeks of treatment, and after 5 weeks of treatment. A 7 day alternating feed-deprivation protocol was employed during Week 4. (†) denotes differences in scores from the previous week.

#### Conclusion:

1. During the first 3 weeks of the study during stall confinement, control, E-SLH- and E-250-treated horses tended to show fewer gastric ulcers when compared to horses before treatment, but this was not significant.
2. During the second phase (week 4-5) of the study, the alternating feed-deprivation period (week 4) gastric ulcer number scores increased in all groups denoting that stress had occurred leading to worsening of gastric ulcers. However, during the second week (week 5), gastric ulcer number scores improved in the E-SLH and E-250-treated horses, but this was not significant.
3. Conclusion: Horses continuously fed and given EGUSIN® SLH and EGUSIN® 250 tended to have lower ulcer scores after 3 weeks but this was not significant. Also, following a severe feed-deprivation challenge in week 4, EGUSIN-treated horses demonstrated fewer ulcers in one week, but this was not significant.

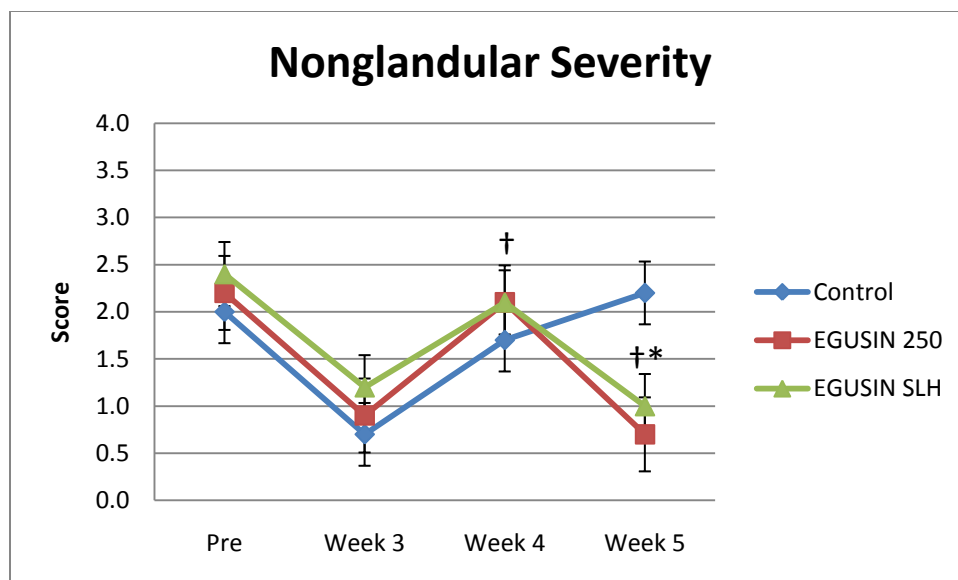


Figure 5. Mean  $\pm$  SEM nonglandular gastric ulcer severity scores in horses fed EGUSIN® 250, EGUSIN® SLH, and controls before treatment (Pre), after three weeks of treatment (Week 3), after 4 weeks of treatment, and after 5 weeks of treatment. A 7 day alternating feed-deprivation protocol was employed during Week 4. (†) denotes a significant ( $P < 0.05$ ) difference from scores from the previous week and (\*) denotes significant differences from control values for the same week.

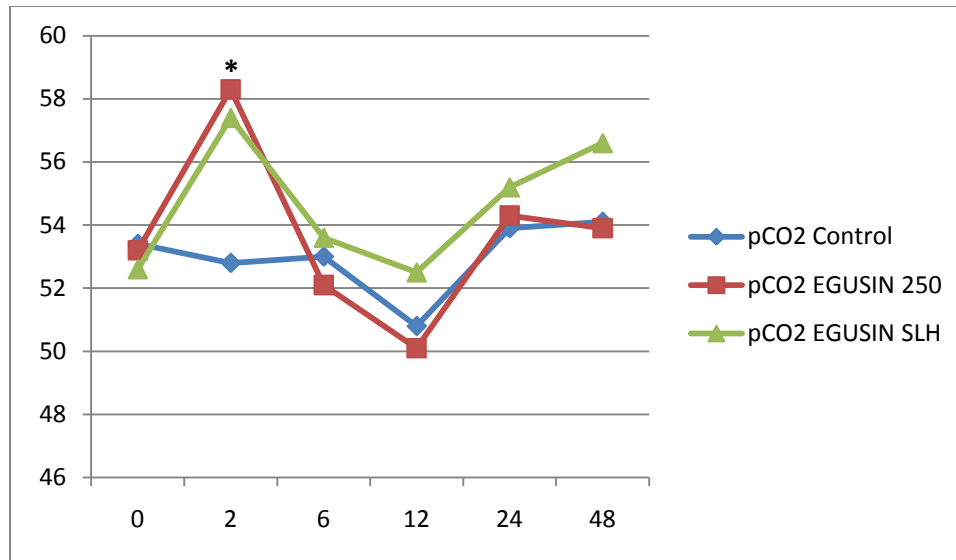
#### Conclusion:

1. During the first 3 weeks of the study during stall confinement, control, E-SLH- and E-250-treated horses tended to show lower gastric ulcer severity when compared to horses before treatment, but this was not significant.
2. During the second phase of the study, the alternating feed-deprivation stress (week 4) gastric ulcer severity scores increased in all groups denoting that stress had occurred leading to worsening of gastric ulcers. However, during the second week (week 5) of the second phase, gastric ulcer scores significantly improved in the E-SLH and E-250-treated horses when compared to controls.
3. Conclusion: Horses continuously fed and given EGUSIN® SLH and EGUSIN® 250 tended to have lower ulcer severity after 3 weeks, but this was not significant. However, following a severe feed-deprivation challenge in week 4, EGUSIN-treated horses demonstrated significant improvement in ulcer severity within one week.

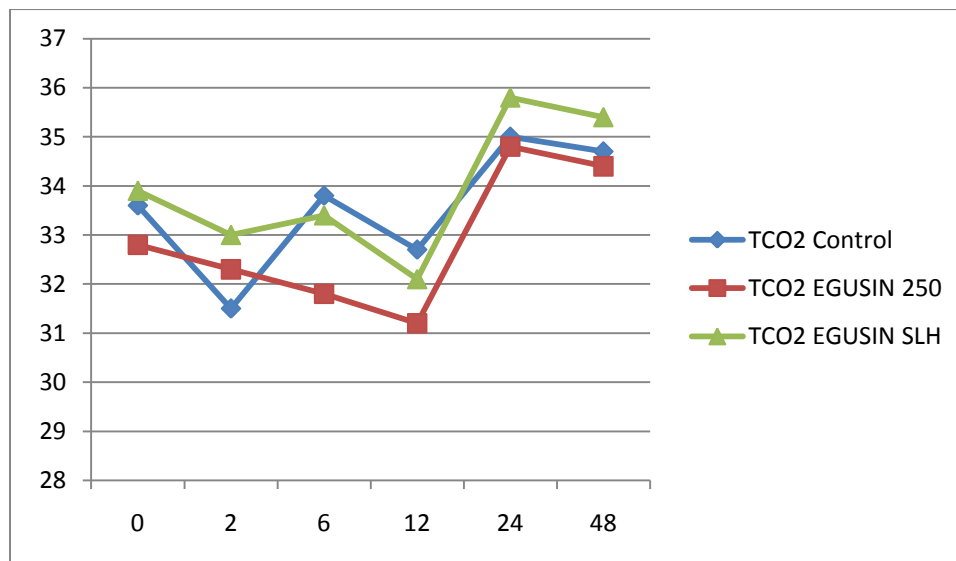
#### *Conclusions on Gastric Ulcer Scores*

In horses housed in stalls and continuously fed, EGUSIN® 250 and EGUSIN® SLH-treatment tended to result in smaller and less severe gastric ulcers after 3 weeks of treatment, but this was not significant. However, following a severe challenge in week 4, EGUSIN-treated horses demonstrated significant improvement in size and severity of gastric ulcers within one week.

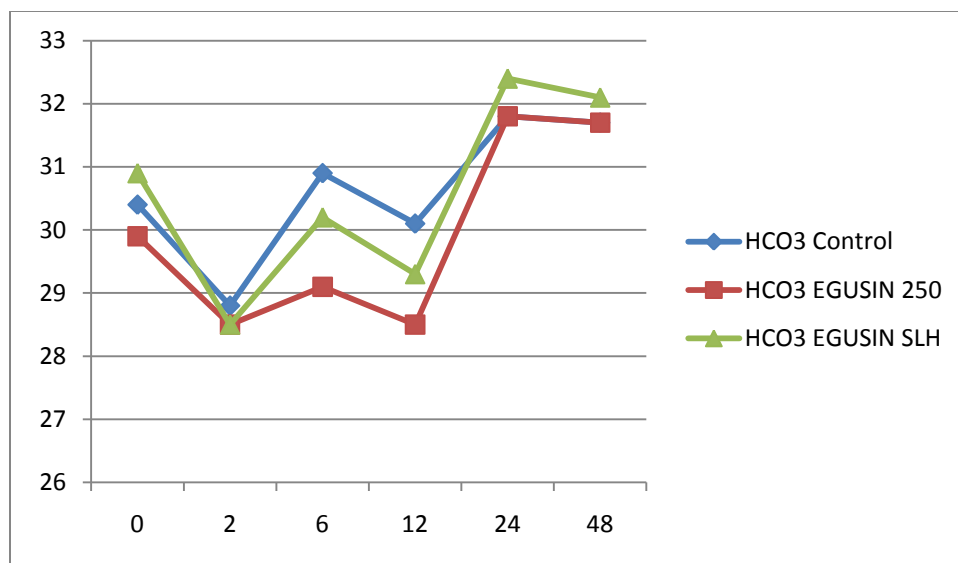
### Blood Gas Results and Conclusions:



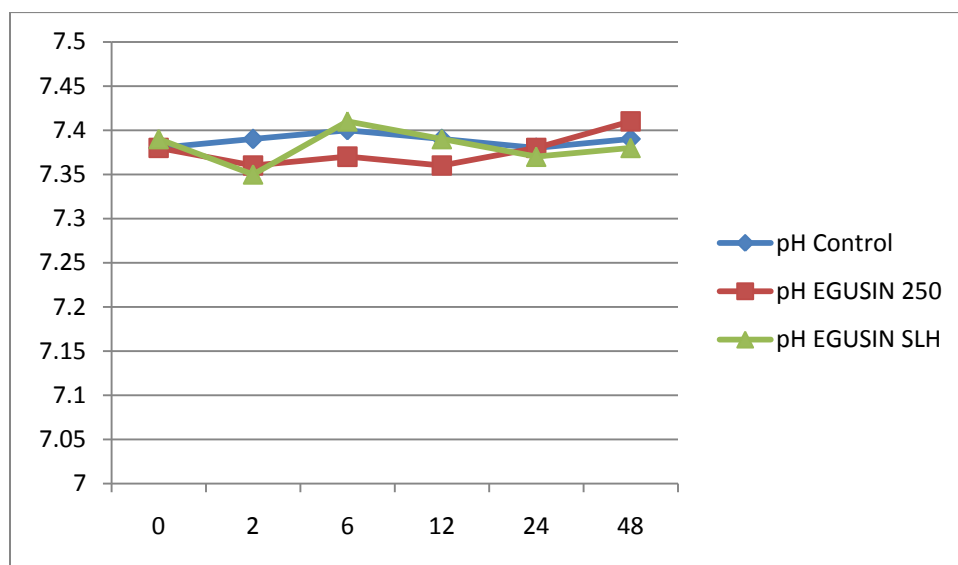
**Figure 6:** Mean partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) in whole heparinized venous blood in control, EGUSIN® 250, and EGUSIN® SLH treated horses before treatment (0), 2, 6, 12, 24, and 48 hours after treatment. \*Denotes a significant ( $P < 0.05$ ) increase in pCO<sub>2</sub> values at 2 hours compared to values at time 0 and other time points.



**Figure 7:** Mean total CO<sub>2</sub> (TCO<sub>2</sub>) in whole heparinized venous blood in control, EGUSIN® 250, and EGUSIN® SLH treated horses before treatment (0), 2, 6, 12, 24, and 48 hours after treatment. Note: There were no differences in TCO<sub>2</sub> values at anytime during the study.



**Figure 8:** Mean total bicarbonate concentration ( $\text{HCO}_3$ ) in whole heparinized venous blood in control, EGUSIN® 250, and EGUSIN® SLH treated horses before treatment (0), 2, 6, 12, 24, and 48 hours after treatment. Note: there were no differences in  $\text{HCO}_3$  values at anytime during the study.



**Figure 9:** Mean pH values (pH) in whole heparinized venous blood in control, EGUSIN® 250, and EGUSIN® SLH treated horses before treatment (0), 2, 6, 12, 24, and 48 hours after treatment. Note: there were no differences in pH values at anytime during the study.

### ***Conclusions regarding blood gas values***

1. There was a significant increase in  $\text{pCO}_2$  two hours after feeding on day 0 compared to the controls, however there were no significant differences in any values throughout the rest of the treatment period.

2. There were no significant differences in pH, bicarbonate, or total CO<sub>2</sub> values at any time points during the study.
3. Therefore, neither EGUSIN® 250 nor EGUSIN® SLH feeding causes changes in blood gas values.

## References

1. McClure, S.R., Glickman, G.T. and Glickman, N.W. (1999). Prevalence of gastric ulcers in show horses. *J. Am. Vet. Med. Ass.* 216, 1130-1133.
2. Vatistas, N.J., Sifferman, R.L., Holste, J., Cox, J.L., Pinalto, G. and Schultz, K.T. (1999). Induction and maintenance of gastric ulceration in horses in simulated race training. *Equine vet. J., Suppl.* 29, 40-44.
3. Sandin, A., Skidell, J. Häggström, J. and Nilsson, G. (2000). Post mortem findings of gastric ulcers in Swedish horses older than age one year: a retrospective study of 3715 horses (1924-1996) *Equine vet. J.* 32. 36-42.
4. Rabuffo, T.S., Orsini, J.A., Sullivan, E. Engiles, J., Norman, T. and Boston, R. (2002). Associations between age or sex and prevalence of gastric ulceration in Standardbred racehorses in training. *J. Am. Vet. Med. Ass.* 221. 1156-1159.
5. Begg, L.M. and O'Sullivan, C.B. (2003). The prevalence and distribution of gastric ulceration in 345 racehorses. *Aust. Vet. J.* 81. 199-201.
6. Dionne, R.M., Vrins, A., Doucet, M.Y. and Parè, J. (2003). Gastric ulcers in Standardbred racehorses: prevalence, lesion description, and risk factors. *J. vet. Intern. Med.* 17. 218-222.
7. Nieto, J.E., Snyder, J.R., Beldomenico, P., Aleman, M., Kerr, J.W. and Spier, S.J. (2004). Prevalence of gastric ulcers in endurance horses – a preliminary report. *Vet. J.* 167, 33-37.
8. Bezdekova, B., Jahn, P., Vyskocil, M. and Plachy, J. (2005a). Prevalence of equine gastric ulceration in Standardbred racehorses in Czech Republic. *Acta Vet. Brno* 74, 59-65.
9. Bezdekova, B., Jahn, P., Vyskocil, M. and Plachy, J. (2005b). Gastric ulceration and exercise intensity in Standardbred racehorses in Czech Republic. *Acta vet. Brno* 74, 67-71.
10. Bezdekova, B., Jahn, P. and Vyskocil, M. (2007). Pathomorphological study on gastroduodenal ulceration in horses: localization of lesions. *Acta vet. Hungarica* 55, 241-249.
11. Roy, M.A., Vrins, A., Beauchamp, G. and Doucet, M.Y. (2005). Prevalence of ulcers of the squamous gastric mucosa in Standardbred horses. *J. Vet. Intern. Med.* 19, 744-750.
12. Chameroy, K.A., Nadeau, J.A., Bushmick, S.L., Dinger, J.E., Hoagland, T.aA. and Saxton, A.M. (2006). Prevalence of non-glandular gastric ulcers in horses involved in a university riding program. *J. Equine Vet. Sci.* 26, 207-211.
13. Jonsson, H. and Engvall, A. (2006). Prevalence of gastric ulceration in Swedish Standardbreds in race training. *Equine Vet. J.* 38, 209-213.
14. Moghaddam, G. Hasanpour, A., and Mokhberdezhfli, M.R. (2008). A survey of risk factors for gastric ulceration in the Caspian Horses in Iran. *J. Anim. Vet. Med. Adv.* 7, 173-177.
15. Andrews FM, Sifferman RL, Bernard W. et al. (1999) Efficacy of omeprazole paste in the treatment and prevention of gastric ulcers in horses. *Equine Vet J, Suppl.* 29:81-86.
16. Furr, M.O. and Murray, M.J. (1989) Treatment of gastric ulcers in horses with histamine type 2 receptor antagonists. *Equine Vet. J. Suppl* 7: 77-79.
17. Murray, M.J., Haven, M.L., Eichorn, E.S., Zhang, D. Eagleson, J. and Hickey, G.J. (1997). Effects of omeprazole on healing of naturally-occurring gastric ulcers in thoroughbred racehorses. *Equine Vet. J.* 6:425-429.

18. Andrews, F.M. and Nadeau, J.A. (1999). Clinical syndromes of gastric ulceration in foals and mature horses. *Equine Vet. J. Suppl* 29:30-33.
19. Murray, M.J. and Eichorn, E.S. (1996). Effects of intermittent feed deprivation, intermittent feed deprivation with ranitidine administration, and stall confinement with ad libitum access to hay on gastric ulceration in horses. *Am. J. Vet. Res.* 11:1599-1603.
20. MacAllister, C.G., Andrews, F.M., Deegan, E., Ruoff, W., and Olovson, S.G. (1997). A scoring system for gastric ulcers in the horse. *Equine Vet. J.* 6: 430-433.