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Effect of grazing muzzles on the rate of pelleted feed intake in horses

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ABSTRACT

Esophageal obstruction or "choke" is a relatively common occurrence in the equine industry. It often results from improper mastication, consuming feed too quickly, dehydration or a decrease in saliva production. Esophageal obstruction is a medical emergency during which a horse cannot dislodge a bolus of feed from the esophagus and must wait for human intervention o rfor the block to be softened and moved by peristalsis. This condition may result in the formation of ulcers, esophageal rupture, aspiration pneumonia, and possibly death. Grazing muzzles have been shown to slow the rate of forage intake. We hypothesized that grazing muzzles could also be used to decrease the rate of pelleted feed intake and so possibly reduce the risk of equine esophageal obstruction in horses fed large meals of pelleted feed. The objective of this research was to compare the rate of pelleted feed intake for horses wearing grazing muzzles to those wearing no muzzle. Utilizing a crossover design, horses were randomly assigned to three groups with each horse receiving each treatment. Treatments were as follows: No Muzzle (NM), Easy Breath Grazing Muzzle (EBGM), or Tough 1 Nylon Grazing Muzzle (TNGM). Eight adult stock-type horses age 5 ±1 years, were offered 2.27 kg of pelleted concentrate to consume in a 10-minute period once daily. The study was comprised of three periods (5 days each) with a two-day resting period between each. Horses were weighed daily and no significant change in bodyweight was observed. Data for daily intake were analyzed using the PROC MIXED procedure of SAS with significance established at $P < 0.05$. Both the EBGM and the TNGM reduced rate of intake ($P < 0.05$) during a 10-minute feeding interval as compared with NM. The findings of this study revealed that grazing muzzles may be a viable option to reduce the rate of

intake of pelleted feed, which may benefit horses susceptible to choke as a result of rapid feed ingestion.

Keywords: "choke", equine, grazing muzzle, feed intake

INTRODUCTION

Equine esophageal obstruction, or "choke", is a dangerous condition and the most common source of esophageal complications (Duncanson, 2006). Choke occurs when a bolus of foodstuff becomes lodged in the esophagus and must be removed either through the action of salivary lubrication, which is often inadequate, or human intervention (Hillyer, 1995). Choke is generally a result of improper or inadequate mastication, consuming pelleted feed too quickly (bolting), or insufficient salivary production (Kobluk et al., 1995). Signs of esophageal obstruction include dysphagia, excessive drooling, nasal drainage, coughing, halitosis, spasms of the neck muscles and repeated swallowing (Hillyer, 1995). In addition, there may also be a visible mass in the throat area. Esophageal obstruction blocks the esophagus and prevents the passage of feed and liquid and, if present for long periods of time, can cause permanent damage to the esophagus. Damage due to choking includes esophageal ulcers, impaction colic, aspiration pneumonia, and potentially death (Kobluk et al., 1995). Treatment for choke is problematic as it involves insertion of a tube down the afflicted horse's throat and flushing out the bolus. This procedure can cause additional trauma to the esophagus and, in severe cases, surgical removal of the bolus may be necessary (Hillyer, 1995).

Since a majority of choke incidents are caused by rapid intake of feedstuff, decreasing the rate of intake and encouraging proper mastication is critical to prevent choke (Frape, 2008). Many horse owners utilize grazing muzzles to slow the intake of forages (Glunk et al., 2014; Longland et al., 2011). We hypothesized that grazing muzzles could also be used to decrease the rate of pelleted feed intake and possibly reduce the risk of equine esophageal obstruction. The objective of this research was to compare the rate of pelleted feed intake for horses wearing two different types of grazing muzzle with those wearing no muzzle.

METHODS

Institutional Animal Care and Use Committee (IACUC) approval was obtained prior to the initiation of this study. All research was conducted at Southern Illinois University Equine Center, Carbondale, Illinois. Eight Southern Illinois University-owned horses, two geldings and six mares, age 5 ±1 years (mean ±SD), and with a bodyweight of 491 ±35 kg (mean ±SD), current with vaccinations and in good dental health were used. The grazing muzzles included, the Easy Breathe Grazing Muzzle (EBGM; JT International Distributors, Inc., Indianapolis, Indiana) and Tough 1 Nylon Grazing Muzzle (TNGM; JT International Distributors, Inc., Indianapolis, Indiana). The EBGM has a single central rectangular opening with an area of 6.35 cm. The TNGM has a single circular opening with an area of 1.99 cm.

Prior to the start of this study, horses were acclimated to both muzzles for one week by wearing them during normal morning feeding. Horses were randomly assigned to treatment groups with data collection occurring during three periods (5 days each) with a two-day resting period. The study was designed such that the third and final period served as the control for all eight horses. This was done in an effort to prevent negative associative behavior that may arise with daily muzzle use. Authors were concerned that the horses would become "trained" to the muzzles and would delay eating until the muzzles were removed. Prior research has demonstrated that horses are adept at learning and can discriminate between new stimuli with very few reinforcements needed (McCall, 1990). Additionally, the horses utilized for this study had been recently cecally-cannulated (90 days ±1) utilizing a two-stage surgical technique (Beard et al., 2011) and the authors wanted to be certain that all control measurements were collected simultaneously in order to ensure that the surgical healing process was similar across treatments. The adaptation of this randomized, crossover design was utilized with a repeated measures component such that each horse would provide data in each period and would receive each treatment (Vonesh and Chinchili, 1997).

At the start of each period, each horse was removed from grass pasture at approximately 1600 hours and placed in separate identical 3×4 meter stalls with *ad libitum* access to water and a salt block. Each horse was offered 2.27 kg of pelleted grain (Strategy® Purina Animal Nutrition LLC, Shoreview, MN) and 2.27 kg of mixed grass hay. At approximately 2200 hours, the hay was removed from the stalls and horses were weighed using a digital livestock scale. Horses were fasted overnight in order to ensure adequate appetite for the morning meal. At approximately 0600 hours, the horses were offered 2.27 kg of pelleted feed in 68-Liter, oval pans

(Tuff Stuff Products, Terra Bella, California) for a 10-minute feeding interval. Following the completion of the 10-minute feeding interval, feeding pans were removed from the stall. Spillage and orts were measured in order to calculate total consumption. The horses were then allowed to finish any uneaten portion (as required for IACUC compliance) prior to being turned out to pasture for the day. Air temperature was taken every morning at 0600 hours.

Data were analyzed using SAS version 9.4 (Cary, North Carolina). Each treatment had eight horses except TNGM, which had seven horses due to an unrelated health issue in a single horse. Consumption data were analyzed as repeated measures (Littell, et. al., 1998) using the MIXED procedure of SAS (Cary, North Carolina) with significance established at $P < 0.05$. Spillage data were analyzed using the PROC NPAR1WAY procedure of SAS with the Kolmogorov-Smirnov test to check for significance between treatment groups.

Consumption data are reported as the differences of least square means with fixed effects of horse, time, treatment, and treatment*time analysis using a Tukey's post-hoc test to test for significance between each group. Spillage data are reported as means per morning feeding event.

RESULTS

Both the EBGM and the TNGM grazing muzzles caused a decrease ($P < 0.001$) in rate of pelleted feed intake during the 10-minute feeding interval as compared with the NM treatment (Figure 1). Although there was no effect of day ($P > 0.05$), there was an effect of treatment*day ($P < 0.05$). The authors have concluded that this interaction effect may be the result of a behavioral artifact associated with the NM group and their reduced intake on day 1. Student observers reported that the horses appeared to be standing and waiting to begin eating. This unexplained behavior was isolated to day 1 and all horses appeared to resume normal intake behaviors for the remainder of the period. In addition, horses wearing the TNGM appeared to increase their rate of intake over time, such that by the fifth day of the period, intake was not different from that of the NM group (Figure 2). This suggests that the horses may have been learning to manipulate the muzzle. Mean air temperature was reported as 19 ±2.1 ° C and was considered seasonally typical. Thus, the authors do not attribute any change in intake to temperature fluctuation (NRC, 1981).

Spillage was also affected by treatment (Figure 3). The EBM group had greater spillage amounts and a greater number of spillage incidents as compared to TNGM or NM ($P < 0.05$).

Although the reason for the difference in spillage is unclear, it may be related to the design differences between the muzzles. Notably, the EBM features a larger central opening.

DISCUSSION

Ingesting feed too quickly, bolting, or improper mastication are common causes of choke. Grazing muzzles are commonly used to reduce forage intake rates (Glunk et al., 2014; Longland et al., 2011). This is accomplished through slowing the consumption of forage by restricting the amount a horse can ingest (Longland et al., 2011). Utilization of a grazing muzzle while feeding pelleted feed was shown to reduce intake rate in this study. Subsequently, this may reduce the potential for esophageal obstruction and related injuries. Potential pitfalls regarding the use of grazing muzzles include a potential in increased feed waste and insufficient time to complete the meal. These may be overcome by the use of a taller feeding pan and by allowing greater time for meal consumption.

Some work has been done identifying the impact of different feeding systems on rate of intake for both hay and grain. Wasting forage due to improper storage combined with losses during feeding (spillage) has led to over 40% of forage being lost (Belyea et al., 1985). In a previous study, feeders with molded cups at the bottom of a bucket were utilized to slow horse consumption of grain (Carter et al., 2012). The same study also found these feeders reduced grain spillage and waste.

Although horses may be naturally designed to consume small meals throughout the day, grazing time and pasture intake appear to be inversely related (Siciliano et al., 2012). Thus, other alternatives must be explored that may provide solutions to inappropriate acceleration in consumption. Hay nets are another option that can be used to slow the rate of forage intake and come in a variety of sizes. Rate of intake may be affected by selection based on size of the openings. In a recent study, the use of small and medium-sized hay nets extended the total time of forage consumption when used to feed adult horses (Glunk et al., 2014). The length of feeding time closely resembled the natural foraging time of feral horses. Additionally, grazing muzzles are frequently used to hinder mass consumption of forage. Overall, researchers have found that horses can easily adapt to new feeding systems with short acclimation periods (Artistizabal et al., 2014; Carter et al., 2012; Glunk et al., 2014).

Although both muzzles reduced rate of intake, the horses wearing the EBM recorded greater spillage while eating. In order to address this problem, owners should use taller feed pans or incorporate a mechanism for catching spilled grain so that waste is minimized.

In conclusion, given a one-week acclimation period, horses can adjust to a feeding regimen that incorporates a grazing muzzle. The grazing muzzle has been shown to reduce rate of pelleted feed intake and may mitigate the incidence and effects of choke. Further work is needed to identify the frequency with which owners may utilize grazing muzzles and still maintain reduction in pelleted feed intake rates. Future projects should consist of longer treatment periods with longer feeding intervals in order to identify effect of frequency and longevity of use associated with use of grazing muzzles. Additionally, a closer examination should be given to the type of muzzle best suited for pelleted grain to minimize spillage.

CONFLICT OF INTEREST

None of the authors of this original research have any declared financial interest. No conflict of interest of either a financial or personal nature is reported.

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ETHICAL APPROVAL

Institutional Animal Care and Use Committee (IACUC) approval was obtained prior to initiation of this study.

AUTHORSHIP

The idea for the paper was conceived by Dr. Erin Venable. The experiments were designed by Dr. Erin Venable. The experiments were performed by undergraduate and graduate students named as co-authors on this manuscript. The data were analyzed by Dr. Erin Venable and Stephanie Bland. The paper was written by Dr. Erin Venable, Michael Halpin, and Stephanie Bland

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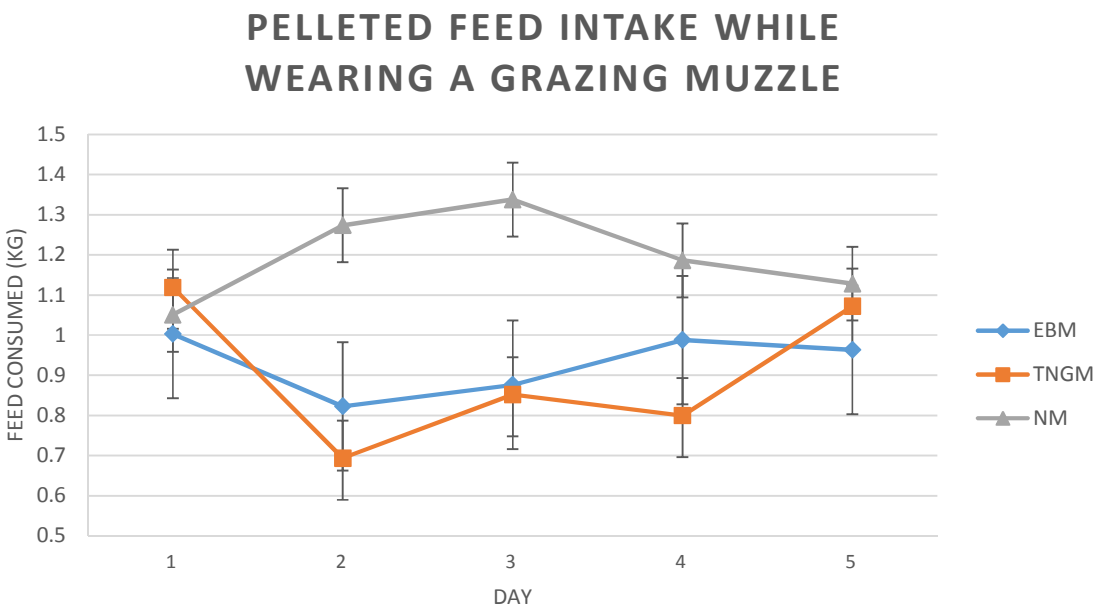
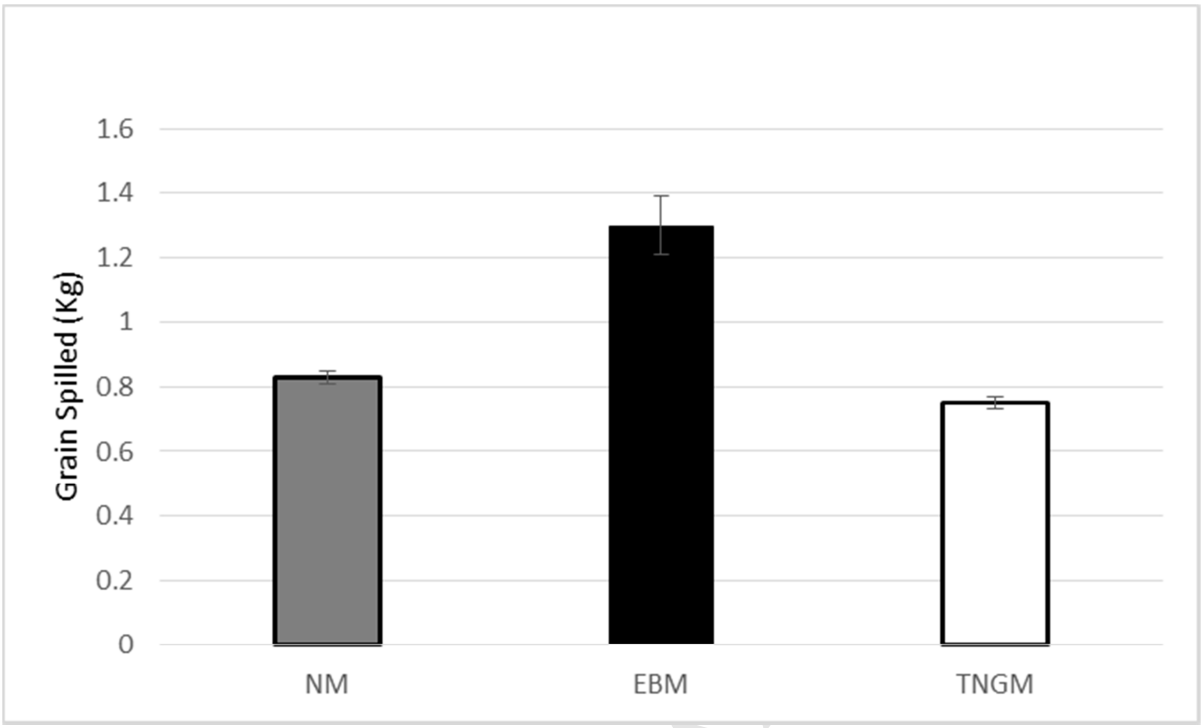


Figure 2. Consumption of pelleted feed intake during a ten minute interval while wearing No Muzzle (NM), Easy Breathe Muzzle (EBM), and Tough One Grazing Muzzle (TNGM) over time.



**Means differ among groups (P < 0.05)*

Figure 3: Effects of No Muzzle (NM), Easy Breathe Muzzle (EBM), and Tough One Grazing Muzzle (TNGM) on pelleted feed spilled (kg) during a ten minute feeding event.

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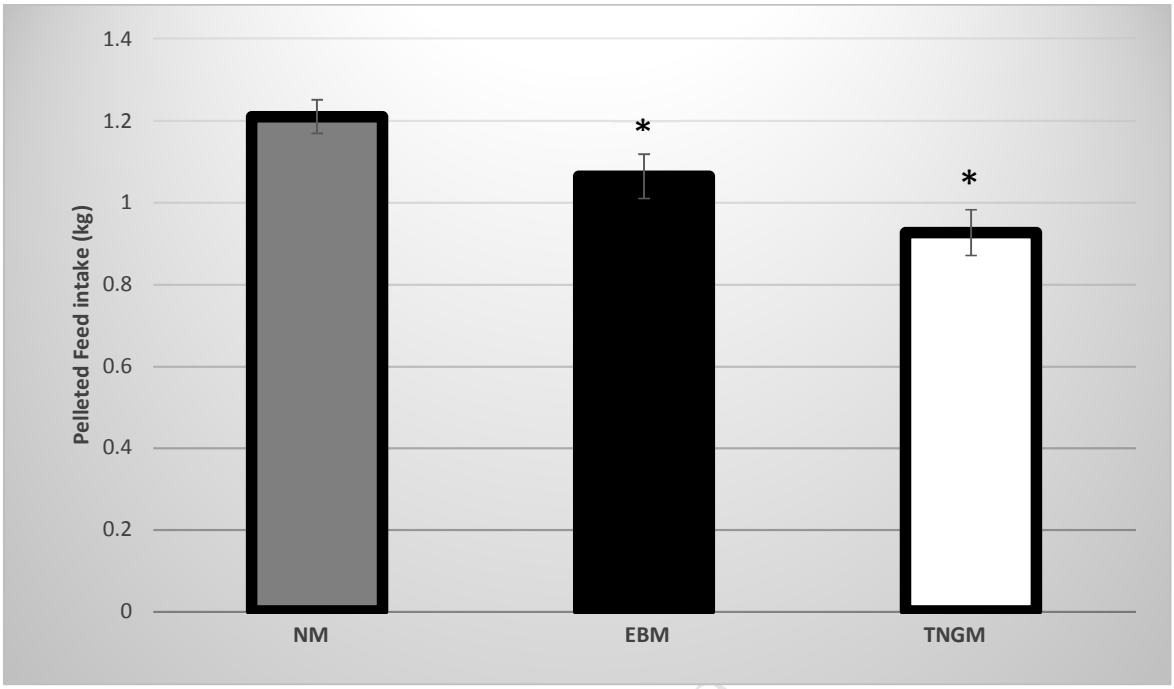

**Means differ among groups (P < 0.05)*

Figure 1: Effects of No Muzzle (NM), Easy Breathe Muzzle (EBM), and Tough One Grazing Muzzle (TNGM) on pelleted feed intake (kg) consumed in a ten minute feeding event.

HIGHLIGHTS

We examined the change in rate of intake between two different grazing muzzles.

Grazing muzzles have been demonstrated to reduce the rate of intake for horses consuming forage in pasture.

Grazing muzzles can be used to slow the rate of intake of pelleted feed.