



## Original Research

## A Comparison of Three Conventional Horse Feeders with the Pre-Vent Feeder

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## ABSTRACT

This study compared a feeder with molded cups on the bottom (Pre-Vent feeder) with a commonly used rubber tub and hanging bucket feeder to determine differences in time spent eating and feed wastage. Nine Quarter Horse geldings were fed a 12% crude protein pellet diet at 0.75% body weight twice daily from one of the three feeders twice daily for 3 days, and then switched to the next feeder, following a  $3 \times 3$  replicated Latin square design ( $n = 9$ ). The horses spent more time eating from the cup feeders ( $31.15 \pm 1.43$  minutes) than from bucket ( $19.39 \pm 0.42$  minutes) and tub ( $18.87 \pm 0.49$  minutes,  $P < .0001$ ) feeders. When fed from cup feeder, horses dropped significantly less feed ( $3.2 \pm 0.52\%$ ) of their ration than when fed from bucket ( $10.2 \pm 1.75\%$ ) and from tub ( $7.0 \pm 1.32\%$ ,  $P = .001$ ) feeders. When the most wasteful horse was fed from the cup feeder, he lost a mean of 8.7% of his ration, compared with 32.8% when fed from the bucket, and 26.2% when fed from the tub feeders. The cup design is useful for increasing time spent eating and reducing feed wastage.

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### 1. Introduction

As a prey species, horses are very alert and well equipped to detect danger. A prey animal must react instantly to a perceived predator to be able to survive [1]. Being very vigilant and possessive of its feed, a horse will often attempt to ingest as much feed as possible between episodes of head-lifting and turning to observe its surroundings. This behavior can result in significant amounts of feed falling from the horse's mouth onto the bedding or ground while its head is lifted out of the feeder. Excessive feed waste can occur as a result of eating from traditional horse feeders.

Choke and sand colic are economic and health issues that present concerns for horse owners across the industry. Choke is caused when partially chewed food becomes lodged in the esophagus and is often attributed to a horse

bolting its food. Signs of choke are noted immediately or soon after the horse has been fed [2]. Feeding on the ground increases waste, feeding cost, parasitism, and dirt ingestion, the last of which increases the risk of sand colic and intestinal impactions [3]. Often, parasites are regarded as the primary cause of colic in horses, and colic is the single most common cause of death [4].

The cup feeder (Pre-Vent) contains eight cup-like structures, 12.7 cm in diameter and 8.89 cm in depth, molded into the bottom of the feeder. It is 60 cm across the inside top, 46 cm across the interior of the bottom, and 38.7 cm deep to the surface of the cups (Fig. 1). Proponents of the Cups design believe that it may reduce feed waste, choke, and sand colic by reducing the speed at which a horse can eat and the amount of feed that a horse drops and then eats off the ground. The cups are a unique feature that are claimed to make the horse use its lips and tongue to retrieve the feed, and hence reduce the amount of feed that a horse can eat at one time.

Two commonly used feeders, 16-L flat-back buckets (Bucket) and 28.4-L rubber feeder tubs (Tub), were

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Fig. 1. Overhead view of the cup (Pre-Vent), bucket, and tub feeders (not to scale).

compared with the cup feeder under controlled conditions to determine whether the cup design provided an advantage over the two commonly used conventional horse feeders.

## 2. Materials and Methods

### 2.1. Study Design

Nine Quarter Horse geldings ranging in age from 8 to 22 years from the Texas A&M University Horse Center were used in this 9-day study. Each day, the nine horses were brought from pasture at 07:15 AM and again at 16:15 PM. Each horse was placed in a 3-m  $\times$  3-m concrete-floored stall made from pipe panels. All nine geldings were fed a 12% crude protein pellet diet at 0.75% body weight from each of the feeders, following a 3  $\times$  3 replicated Latin square design. That is, each horse was randomly assigned to be fed from one of the feeders for 3 days (the three replications). After each set of 3 days, the horses were assigned to another feeder for 3 days, followed by 3 days with the remaining feeder from which a horse had not been previously fed. Having each horse eat from a particular feeder for 3 days allowed for quantification of behavior and feed loss as the horses became accustomed to the different feeders.

The bucket feeders were 16-L flat-sided plastic buckets that were 30 cm deep, with a 32-cm  $\times$  29-cm inside diameter at the top and 24-cm inside diameter at the bottom. The tub feeders were common 28.4-L (1/3 bushel) rubber tub feeders that were 20 cm deep, with a 43-cm inside diameter at its top and 37-cm internal diameter at the base. Each of the nine feeders (three cups, three buckets, and three tubs) was secured to the center support post of the panel that formed the wall of the feeding pens toward the observers. Although horse owners may place feeders in the corners of a stall, all three types of feeders were placed in the middle of the side of the stall facing the observers so that the observers could clearly observe feeding behavior. This also minimized the horses reaching through the panels forming the feeding stalls or otherwise interfering with other horses that were eating in adjacent stalls.

The cup feeders were each placed on the cement floor and connected from one point on their top edge to the middle post of the stall with a few links of chain and a snap hook. The horses could move the cup feeders slightly from side to side, but not turn them over. The three bucket feeders were hung 1 m off the floor from the front middle post of the feeding stalls using their handle and a snap

hook. The bottom portion of the bucket feeder was stabilized using an elastic bungee that circled the bucket feeder and the post from which the buckets hung. The bungee was placed around the lower third of the bucket feeder so that it would be knocked off the bucket feeder if a horse shoved or pushed the bucket feeder while eating. If a bungee was knocked off the bucket feeder, it was not replaced during that feeding. Many horse owners using flat-sided buckets for feeding horses use the optional mounting brackets that hold these types of feeders relatively rigidly, so our use of the bungee was meant to be a compromise between rigid-mounted buckets and buckets that were merely hung from their handle. Each of the tub feeders was placed on the cement floor of the stall and secured with a short chain to the middle post using one of the three "eyes" on the top edge of the tub feeder. Although the horses could still move the tub feeders while eating, securing them at the one point kept horses from picking up the feeder, flipping the feeder over, or shoving it out of the feeding stall.

Time spent eating started when feed was first available to each horse and ended when the horse turned away from its feeder for a period exceeding 5 minutes. The floor of each stall was cleaned thoroughly before each feeding to allow for accurate collection of feed that was dropped on the floor by each horse. Feed that horses dropped on the floor and any feed left in a feeder was considered wasted. Feed dropped on the ground was periodically swept out of reach of the horse during each feeding session to prevent the horses from eating any feed off the floor. Care was taken to minimize any disturbance to the horse when sweeping up feed. The feed recovered from the floor and any residual feed in the feeders were then collected and individually weighed.

### 2.2. Statistical Analysis

Data were first analyzed for normality, using Shapiro–Wilk test using SAS 9.1 (SAS Institute, Inc., Cary, NC). For data lacking normality, a Wilcoxon sum rank test was used, with individual animal, day fed, time of feeding (morning or evening), and type of feeder as independent variables to predict time spent eating and feed wastage. *P* values < .05 were reported as significant. Means and standard errors were reported for each treatment.

## 3. Results

The horses in this study tended to spend more time eating during the morning feeding (24.03  $\pm$  1.06 minutes)

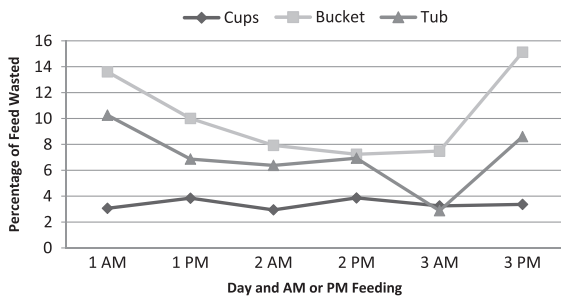


Fig. 2. Average time spent eating for each morning and evening feeding from each of the feeders; feeding was at 07:15 AM and 16:15 PM each day.

than in the afternoon ( $22.24 \pm 0.87$  minutes,  $P = .094$ ). When the horses were fed from the cup feeder (Fig. 2), they spent significantly more time eating ( $31.15 \pm 1.43$  minutes) than when fed from the bucket ( $19.39 \pm 0.42$  minutes) and the tub ( $18.87 \pm 0.49$  minutes,  $P < .0001$ ). Time spent eating from the bucket and the tub was not significantly different.

The percentage of feed dropped on the ground and considered waste (Fig. 3) was not significantly different in the morning ( $6.3 \pm 1.12\%$ ) than in the afternoon ( $7.3 \pm 1.09\%$ ). Percentage of feed dropped on the ground differed between the feeder treatments ( $P = .001$ ), with horses wasting an average of  $10.2 \pm 1.75\%$  when eating from the bucket,  $3.2 \pm 0.52\%$  when eating from the Pre-Vent feeder, and  $7.0 \pm 1.32\%$  when eating from the tub feeder. Wastage from the tub was less ( $P = .021$ ) than that from the bucket feeder.

One of the nine horses was considered a sloppy eater, wasting  $22.6 \pm 1.7\%$  of his feed overall. When fed from the Pre-Vent feeder, he wasted a mean of  $8.7\%$  of his ration, compared with  $32.8\%$  when fed from the bucket and  $26.2\%$  when fed from the tub feeder. The next most wasteful horse dropped only  $9.5\%$  of his feed, whereas three of the nine horses only wasted negligible amounts of feed, regardless of the feeder they used.

The percentage of residual feed left in the Pre-Vent feeder did not differ significantly between the morning and evening feedings. The amount of residual left in the

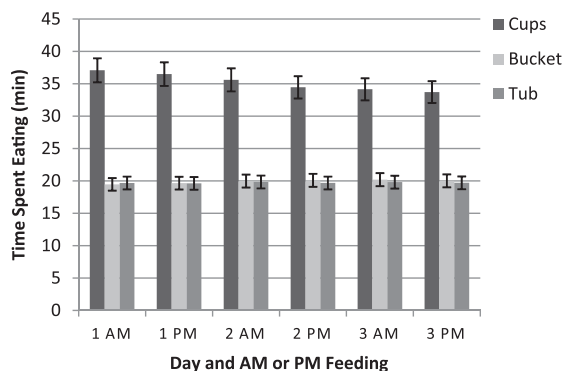


Fig. 3. Average percentage ( $\pm$ SE) of ration that was collected from the concrete floor and the feeders (waste) for the morning and evening feedings when eating from each of the feeders; feeding was at 07:15 AM and 16:15 PM each day.

Pre-Vent feeder treatments could not be compared statistically with the other treatments because the Pre-Vent feeder had the only recoverable residuals, which averaged  $0.20 \pm 0.04\%$  of each horse's ration.

#### 4. Discussion

When the cup feeder was presented for the first time, each horse spent from 21 minutes 9 seconds to 60 minutes eating from the feeder. They appeared to be very focused on how to retrieve the feed from the cups at the bottom of the feeder. Informal observations found that the cups made the horse slow down and use its lips and tongue to scoop the feed out of the cups. Three of the nine horses pawed at the feeder during the course of eating, perhaps in response to increase difficulty of retrieving feed from the feeder, or to loosen up feed that may be compacted at the bottom of the cups. There was a gradual decrease in the time spent eating when feeding from the cup feeder that was probably because of the horses acclimating to the feeder (Fig. 2).

Informal observations indicated that the horses tended to more frequently lift their head to look around when eating from the bucket than when eating from the cups. The bucket fed horses took large mouthfuls of feed, and after lifting their heads, several horses dropped large amounts of feed from their mouths while chewing. One of our nine horses swung the bucket (using his head) so much that feed fell to the ground. The bucket fed horses spent from 15 minutes 41 seconds to 26 minutes 21 seconds eating from the feeder.

When the horses first ate from the tub feeder, three horses pawed at the rim of the feeder. Because the tub feeder was secured to a post, the horses could not flip it over. The horses spent from 11 minutes 9 seconds to 29 minutes 11 seconds eating from the tub feeder. The horses tended to raise their heads up to chew instead of keeping their heads down in the tub feeder.

The results confirm that the cup feeders significantly slowed the horses' ingestion of their feed. The difference was most likely because of the difficulty the horses had in getting the feed out of the cups in the bottom of the feeder. Although not quantifiable in this study, informal observations indicated that the molded cups at the bottom of the feeder made the horses spend more time eating and making greater use of their tongues and lips.

The increased diameter of the cup feeders compared with the other feeders also likely contributed to less wastage. The cup feeders provided a larger area for the horses to actually place their heads in the feeder, perhaps reducing head lifting. The larger diameter of the feeder also was more likely to catch feed being dropped from the horses' mouth.

In this study, time spent eating commenced when a horse first started eating and lasted until the horse left the feeder for a period of more than 5 minutes. A 5-minute cessation in feeding is commonly used in nutritional studies to signal the end of a meal [5]. In this study, none of the horses returned to consume more feed after they had left their feeder for 5 minutes.

Although the horses used in this study left relatively little feed in the cup feeders, we washed the cup feeders

out every 2 days to remove any residual that was left in the bottom of the cups. It is likely that if a particular horse left a significant amount of feed in the cups in the bottom of the Pre-Vent feeder, the feed could dry and accumulate, or get spoiled during warm weather between feedings. In some situations, regular cleaning of the cup feeders will be needed, which will increase labor requirements. Another important consideration is that the cup design is larger in size and more bulky to handle than the other feeders used in this study.

In this study, the cup feeders were sitting directly on the floor of each stall in the middle of a side panel. Because horse owners more commonly mount the cup feeders so that the bottom is 0-25 cm off the ground in a corner of a stall, we conducted a short follow-up study in which all nine of the Quarter horses used in this study were fed from cup feeders that were hung 23 cm off the ground in the corner of the same stalls used in this study. This trial was replicated in that the horses were fed from the corner-mounted cup feeders for a morning and evening feeding, the day immediately following the completion of the main study. Hanging the cup feeders in a corner, a small distance off the ground, brought the feeder closer to the level of the horses' normal head carriage. We also hypothesized that using a corner would create a "funnel" effect around the horses' head, reducing the tendency of the horses lifting their heads out of the feeder to swing their head to the left or right when chewing, resulting in dropping feed out of their mouths onto the floor. The funnel effect was supported by a mean feed wastage of  $1.24\% \pm 0.45\%$  when the cup feeder was elevated and positioned in a corner for the follow-up study compared with  $3.19\% \pm 0.26\%$  mean feed wastage during the main study. Because the follow-up study was not balanced in relation to the main study, we could not perform a statistical analysis. However, these findings were useful in indicating that the effectiveness of this type of feeder appears to be influenced by a specific

method of mounting the feeder, and mounting in a corner is preferable. One would also expect that mounting the bucket and tub feeders used in this study in a corner would similarly decrease wastage from those feeders.

Molding cups into the bottom of tub-type feeders appears to be useful for horses that are considered sloppy or problem eaters, or for people who would like to experiment with a new feeder. However, the cup design will require more labor because cup feeders are more difficult to unhook than most conventional feeders that have only one point of attachment to a wall, and they may require periodic cleaning to remove unconsumed feed that may accumulate over repeated use. The cup feeders did significantly slow down a horse's intake of feed and reduced the amount of feed wasted, and the horses in this study became quickly accustomed to the feeder.

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