

Effects of Hay and Grain Biscuits Versus Baled Forage and Grain on Growth and Apparent Digestibility in Weanling Horses

Kelly B. Snell, KH Kline

INTRODUCTION

Previous studies have found that feeding forage and grain processed together into a total mixed ration (TMR), either as complete pellets or TMR biscuits resulted in improved growth and feed efficiency in young horses when compared to the horses being fed forage and grain separately. These studies found that horses eating the forage and grain diets may bolt the grain and slowly eat the forage, while the horses on TMR tended to eat more slowly over time [1]. In addition to equine TMR research, a study in high producing Holstein cows showed that consuming a TMR diet versus a high quality pasture diet led to higher body condition score, higher milk production, and higher milk protein [2]. However, feeding these differently processed types of feeds in open feed tubs may have facilitated more unidentified feed wastage from horses fed separate forage and grain. Therefore, this study was designed to test the hypothesis that weanling horses fed baled hay and grain fed separately in a combination feeder designed to minimize waste of both hay and grain would not have different growth rates or feed efficiency when compared to weanlings fed the same proportions of forage and grain as a complete biscuit in a feeder specifically designed for biscuits.

MATERIALS AND METHODS

Sixteen Standardbred weanling horses, 8 fillies and 8 colts, were blocked by sex and initial weight then randomly assigned to either the hay/grain biscuit diet (Biscuits), or the baled hay and grain diet (Baled). Horses were housed separately in run-in sheds with attached exercise pens of approximately 750 square feet. Horses were allowed to acclimate to their experimental diets for 7 days, and then were weighed on a digital platform livestock scale before data collection began and weekly thereafter. Rations were adjusted weekly based on body weight. Horses were led to and from the scale with minimal restraint using lead ropes and halters that all horses were previously trained to accept. Horses were fed 2.5% of their body weight daily divided in 2 feedings between 7:00 and 9:00 and between 19:00 and 21:00 for 63 days. In the case of the Baled diet, horses received 1% of their body weight as alfalfa hay and 0.25% of their body weight as whole oats twice daily [3]. Horses on the Baled diet were fed in specially designed feeders that incorporate both a hay rack and a solid manger beneath the hay rack. In the case of the Biscuit diet, horses were fed 1.25% of their body weight of hay/grain biscuits twice daily in feeders specifically designed for feeding cubed/biscuit diets. At each feeding, all feed remaining in the feeders was collected and weighed in order to be able to determine feed refusals and feed efficiency by recording average daily gain and gain to feed ratio for each feed type. Also, each week samples of the different forms of feed were collected. These samples were used at the end of the study in addition to fecal collections. Differences in the apparent digestibility of the treatment diets was determined by collecting freshly voided fecal samples, am and pm samples, from all horses for the final 4 days of the trial, and using the internal marker acid insoluble ash (AIA) to calculate apparent dry matter digestibility in addition to calculating crude protein (CP) digestibility. **(Analysis of variance or T-tests?)**

Results

The mean weekly weight (kg) for each treatment was calculated with a line of best fit to show the trends between the two diets (Figure 1 and Figure 2).

Figure 1:

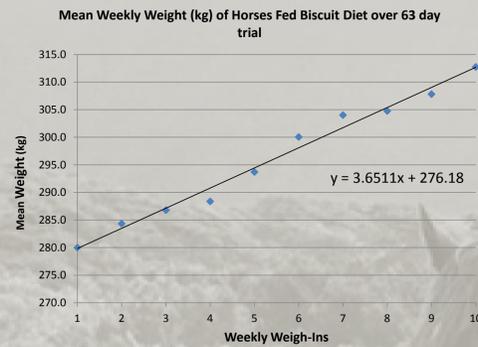
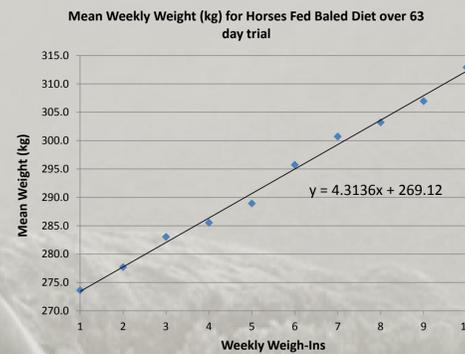


Figure 2:



With the mean weights calculated, the ADG and G:F ratio were calculated and graphed with standard error in order to determine which diet resulted in the most growth compared to the amount of feed consumed by the horse (Table 1, Figure 4, Figure 5).

Table1. Mean values for ADG and G:F ratio for Biscuit and Baled Diets with Standard Error

	Biscuit Diet	Baled Diet
ADG ± Standard Error (kg/day)	0.520 ± 0.0321	0.624 ± 0.0329
G:F ± Standard Error	0.07162 ± 0.00339	0.08921 ± 0.00482

Figure 4. Mean ADG and Standard Error

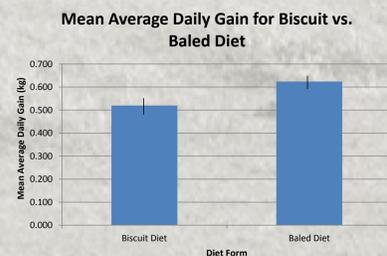
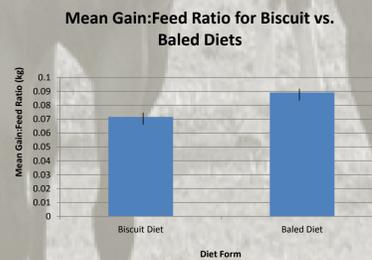


Figure 5. Mean G:F ratio and Standard Error



The apparent digestibility of dry matter and crude protein for the Biscuit diet versus the Baled diet was calculated from the collection of the fecal samples from each horse and the feed samples from each week (Table 2) using the equation $100 \times (1 - [\%AIA \text{ in feed} / \%AIA \text{ in feces}]) \times [\% \text{ nutrient in feces} / \% \text{ nutrient in feed}]$ assuming 100% dry matter nutrient digestibility [4].

Table 2. Calculated Apparent Digestibility of Dry Matter and CP for Biscuit and Baled Diet.

	Biscuit Diet	Baled Diet
Apparent Digestibility of Dry Matter (%)	65.7	58.6
Apparent Digestibility of CP (%)	95.5	94.8

Discussion

Figure 1 shows the mean weekly weight for the Biscuit diet with a best fit slope of 3.6511. Figure 2 shows the mean weekly weight for the Baled diet with a best fit slope of 4.3136. These slopes helped determine that the Baled diet had a greater change in weight gain over the 63 days. In concert with the trends found in the mean weekly gain (Figures 1 & 2), the Baled diet resulted in a higher ADG and a greater G:F ratio as calculated in Table 1 and visually seen in Figures 4 and 5. T-tests found no significant difference ($P > .05$) between the growth and feed efficiency of the two diets. After analysis of the apparent digestibility of the two diets (Table 2), the Biscuit diet was numerically higher in digestibility of dry matter, however the trend for higher ADG (figure 4) in the baled diet suggests that there may have been more undetected waste from the biscuit diet. There was a significantly greater ($P =$) Apparent Digestibility of Dry Matter for the biscuit diet but not in the Apparent Digestibility of CP.

The results of this study suggest that feeding differently processed forage and grain diets in feeders specifically designed to minimize feed wastage of each feed type resulted in no advantage for the TMR biscuits, contrary to findings in previous studies. The Biscuit diet offered no statistical advantage in growth, G:F ratio, or apparent digestibility of CP over the Baled diet. There was a significant difference in the apparent digestibility of dry matter with the Biscuit diet more easily digestible. There are numerous factors that may have influenced previous studies which found TMR diets resulted in higher growth and feed efficiency. The most obvious possibility observed in this trial was feed wastage. One of the observations made during this study was that there was less hay wastage in the Baled diet. When the weanlings would pull out the hay, much of it landed in the specially designed feeder where they were still willing to eat it. Hay that landed on the floor was often times covered in dirt or saw dust, even though there were rubber mats directly beneath the feeders. Weanlings were less likely to eat this feed that was trampled or otherwise tainted. The Baled diet feeders allowed for the horses to consume feed that would normally have reached the ground. Previous studies used open feeders for the forage, which likely resulted in greater undetected feed wastage, ultimately contributing to decreased growth and G:F ratio. Another possible reason for different results in this study may be related to different feeding behavior resulting from different feed processing. It was observed that the horses on the Biscuit diet ate their allotted amount within 2 hours after feeding, whereas horses on the Baled diet would continue to eat throughout the day. Typical horse behavior involves long durations of feeding throughout the day and night as seen in the study by Dulphy et. al [5]. Changes in the feeding schedule of the Biscuit diet might yield different results.

CONCLUSION

In this particular study, the hypothesis that weanling horses fed baled hay and grain fed separately in a combination feeder designed to minimize waste of both hay and grain would not have different growth rates or feed efficiency when compared to weanlings fed the same proportions of forage and grain as a complete biscuit in a feeder specifically designed for biscuits was supported by the collected data.

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