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ORIGINAL RESEARCH

Effects of Feeding Distiller's Dried Grains with Solubles on Growth and Feed Efficiency of Weanling Horses

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ABSTRACT

The effects of replacing corn and soybean meal with distiller's dried grains and solubles in the weanling horse diet were examined. Sixteen weanling horses, 12 fillies and four colts, were fed completely pelleted diets consisting of 50% alfalfa in addition to 50% of a concentrate containing either corn and soybean meal (CS), or 30% of the concentrate replaced with distiller's dried grains with solubles (DDGS). There were no significant differences ($P > .05$) between the two diets in either average daily gain or gain-to-feed ratio. The CS diet had a higher apparent dry matter digestibility ($P < .0001$), and higher apparent digestibility of crude protein (CP), acid detergent fiber (ADF), and neutral detergent fiber (NDF) ($P < .01$). It was concluded that replacing a portion of the corn and soybean meal with distiller's dried grains with solubles in the weanling horse diet did not lead to significant growth depression. However, the diet containing DDGS had reduced apparent digestibility of dry matter, CP, and fiber. Therefore, it was concluded that it may not be advisable to replace more than 30% of the concentrate portion or 15% of the total diet with distiller's dried grains and solubles when alfalfa is used as the forage source constituting 50% of the weanling diet. Even less DDGS may be desirable to substitute for corn and soybean meal in weanling horse diets if the forage source is one with lower protein quality than alfalfa. It is possible that using DDGS for less than 30% of the concentrate portion of the diet along with high-quality alfalfa forage may produce comparable gain and feed efficiency results with less depression of apparent digestibility of dry matter, crude protein, and fiber.

Keywords: Horse; Growth; Digestibility; Distiller's dried grains with solubles

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INTRODUCTION

There is concern in the feed, livestock, and horse industries that corn is becoming scarce and expensive as a feed ingredient because of its increased use for ethanol production. The distillation co-product, distiller's dried grains with solubles (DDGS), may be a useful feed ingredient in equine diets; however, there has been limited equine research conducted on its use, and the quality may be variable.[1] One study conducted by Pagan[2] found that the addition of DDGS to the equine diet did not reduce palatability, and inclusion of up to 20% was suitable in the equine diet.[2] Leonard et al[3] also found that there was no reduced digestibility when DDGS was used up to levels of 18.2% in the equine diet. It was also found that the horse's cecum seems to be efficient in utilizing the cellulose components of DDGS.[3] A study in pigs found that DDGS can be used in phase 3 diets of nursery pigs at dietary levels up to 25% without negatively affecting growth and performance.[4] Additional research with dairy cows showed that yields of milk, fat-corrected milk basis, protein, and lactose did not differ between diets composed of DDGS or soybean meal.[5] An equine study[6] found that a similar product, brewer's dried grains, fed along with Bermuda grass hay did not have enough lysine to provide adequate growth in yearling horses. In this study, however, an alfalfa-based diet was used, with presumably better forage protein quality. Therefore, it was hypothesized that using up to 30% DDGS in the concentrate portion of an alfalfa-based diet should not produce negative growth effects in young, growing horses.

MATERIALS AND METHODS

Sixteen weanling Standardbreds, 12 fillies and four colts, with an average initial age of 8 months, and an average initial weight of 276 kg, were used to compare differences in average daily gain (ADG) and gain to feed ratio (G/F) when fed either a completely pelleted control diet using corn and soybean meal as the main concentrates (CS) or a diet that replaced 30% of the concentrate portion of the diet with distiller's dried grains and solubles (DDGS). Both the CS and DDGS diets were designed to meet the protein, energy, vitamin, and mineral requirements of weanlings as defined by National Research Council

Table 1. Feed ingredients in CS and DDGS diets

Ingredient	CS (kg)	DDGS (kg)
Alfalfa meal (17% CP)	454.5	454.5
Dried molasses	27.3	27.3
MoorMan's Gro-Strong mineral mix	13.6	13.6
Monosodium phosphate	13.6	13.6
Soybean meal (50% CP)	45.5	0
Distiller's dried grains and solubles (24% CP)	0	136
Na borate tetrahydrate (Borax)	0.4	0.4
Ground corn	354.1	263.6
Total	909	909

(NRC).[7] The calculated lysine value for the DDGS diet was 47.27 g/day, whereas the CS calculated lysine value was 56.74 g/day. These are both adequate according to the NRC, which lists the daily lysine requirement for a 6- to 12-month-old horse with expected mature body weight of 500 kg to be within the range of 29.1 g/day to 36.4 g/day.[7] The diets were fed for 90 days and were designed to be isocaloric and isonitrogenous based on an initial determination of approximately 24% CP in the DDGS. Table 1 lists the feed ingredients used in the CS and DDGS diets. Table 2 shows nutrient composition of the CS and DDGS diets. There was less than 5% difference in digestible energy (DE) and crude protein (CP) between the two diets, as determined by laboratory calculations. Horses were fed no additional feeds of any kind during the study and had constant access to water. The CS diet was the same creep feed that all horses on the study were accustomed to consuming since birth. Horses were weighed on an electronic platform scale before the beginning of the study, and then weekly for 3 months. Eight horses were randomly assigned to each diet from within initial groupings of similar weight, sex, and age and fed twice daily at 7:00 AM and 7:00 PM at a rate of 1.5% of body weight at each feeding. Horses were housed and fed in individual pens with rubber mats placed beneath the feeders in each pen. At the time of each feeding, leftover feed from the feeders and floor mats was recovered and weighed to determine actual feed consumption. Samples of the feed were collected and analyzed at the start and end of the study. Fecal samples were collected for 3 consecutive days, after 60 days of the study. Feces were composited, frozen, and stored at –4°C. Once all collections were complete, the samples were dried in an oven at 60°C. Both the feed and dried, composited fecal samples were then sent to a laboratory (Equi-analytical labs, Ithaca, NY) for determination of DE, CP, acid detergent fiber (ADF), neutral detergent fiber (NDF), and acid insoluble ash (AIA), using the methods of J.D. Pagan.[8] Apparent nutrient digestibilities were calculated using the following equation: 100 × (1 - [%AIA in feed/%AIA in feces] × [%nutrient in feces/%nutrient in feed]). Differences in ADG, G/F, and apparent nutrient digestibility in horses between diet treatments were determined using *t*-tests. The Institutional Animal Care Advisory Committee, University of Illinois, Urbana-Champaign, approved all animal care procedures.

RESULTS AND DISCUSSION

Table 3 shows the mean (±SEM) values for growth, feed efficiency and apparent digestibility of nutrients in foals consuming the CS and DDGS diets. Table 4 shows the results of *t*-tests for differences between diet treatments in growth and apparent digestibility variables in the foals. Neither growth rate nor feed efficiency was significantly different ($P > .05$) between diet treatments. Although horses on the CS diet grew at a slightly greater rate numerically compared with the horses on the DDGS diet, the growth rates of horses on both diets were within the normal range; ADG for 6 months of age with expected mature body weight of 500 kg is 0.72 kg/day and expected ADG for horses 12 months of age with expected mature body weight of 500 kg is 0.45 kg/day.[7] The trends observed related to growth were not attributed to a deficiency of lysine, because both the DDGS and CS diet met the lysine requirement range of 29.1 g/day and 36.4 g/day.[7] Sex also was not an observed source of variation in growth rate. The average daily feed refusal rate throughout the entire study was 22% and 23% for the CS and DDGS diets, respectively. More feed refusal was observed in the final 30 days of the study for both diets, therefore increasing the total percentage. Feed intake of young horses fed a total

Table 2. Nutrient composition of diets (dry matter basis)

CS Diet		DDGS Diet	
Digestible energy (DE), Mcal/kg	2.73	Digestible energy (DE), Mcal/kg	2.60
Crude protein (% of dry matter)	15.6	Crude protein (% of dry matter)	16.3
Acid detergent fiber (ADF) (% of dry matter)	23.6	Acid detergent fiber (ADF) (% of dry matter)	22.2
Neutral detergent fiber (NDF) (% of dry matter)	30.2	Neutral detergent fiber (NDF) (% of dry matter)	32.9
Sugar (% of dry matter)	4.5	Sugar (% of dry matter)	4.0

Table 3. Mean (±SEM) values for growth, feed efficiency and apparent digestibility of nutrients in foals consuming DDGS and CS diets

Variable	CS	DDGS
Average daily gain (kg/day)	0.73 ± 0.04	0.61 ± 0.08
Gain/feed ratio	0.103 ± 0.013	0.076 ± 0.006
Apparent digestibility of dry matter	67.18 ± 1.22	51.09 ± 1.97
Apparent digestibility of crude protein	64.05 ± 2.10	51.47 ± 2.25
Apparent digestibility of ADF	49.47 ± 2.99	14.71 ± 5.82
Apparent digestibility of NDF	50.42 ± 2.01	29.17 ± 4.37

mixed ration diet decreases between the age of 5 months and 1 year, irrespective of diet caloric content.[7] This is attributable to decreased feed requirements with advancing age and weight.

No digestive disturbances such as colic, diarrhea, or foul-smelling manure in the weanlings were observed in this study.

There were significant differences ($P < .01$) in the various apparent nutrient digestibilities between the two treatments. The CS diet had a higher apparent dry matter digestibility ($P < .0001$), as well as a higher apparent digestibility of CP, ADF, and NDF ($P < .01$). Although some apparent digestibility values were found to be different between the two diets, the results of this study supported our hypothesis that replacing up to 30% of the concentrate portion of the diet with DDGS when the forage component of the entire diet was composed of 50% alfalfa would not significantly depress growth rates in weanling horses. However, after observing the reduced apparent dry matter digestibility, along with the reduced apparent protein and fiber digestibility, it also was concluded that it may not be advisable to replace more than 30% of the concentrate portion of an alfalfa-based diet, when alfalfa constitutes 50% of the diet, with distiller's dried grains with solubles.

Further research may suggest that feeding a slightly lower percentage of DDGS in conjunction with high-quality alfalfa forage could still support adequate gain and feed efficiency, while having a lower reduction in apparent digestibility of DM, CP, ADF, and NDF. It may be that the DDGS would not allow for optimal growth if it is not used in conjunction with forage that provides high-quality protein, including adequate lysine, such as alfalfa. Therefore, the findings of this study should not be generalized to suggest that up to 15% of the overall weanling horse diet may be replaced with DDGS if the forage source is other than alfalfa. A poor-quality DDGS product may be deficient in protein or amino acid composition. Low-quality DDGS may also contribute to reduced consumption and response. It is possible that the DDGS used in this study was of a lower quality than DDGS used in previous equine studies of this feed ingredient.[2,3] Improper handling and storage of DDGS may lead to mycotoxin contamination, which can lead to illness or death. The DDGS used in an equine diet should be carefully regulated and screened for consistent quality.

Table 4. *T*-tests for differences between diet treatments

Variable	DF	*t* Value	*P*-Value
Average daily gain	14	1.35	.1972
Gain/feed ratio	14	1.80	.0931
Apparent dry matter digestibility	14	6.93	<.0001
Apparent crude protein digestibility	14	4.08	.0011
Apparent ADF digestibility	14	5.32	.0001
Apparent NDF digestibility	14	4.42	.0006

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