DIGESTIBILITY OF LONG STEM ALFALFA, PELLETED ALFALFA OR AN ALFALFA/BERMUDA STRAW BLEND PELLET IN HORSES

J.D. Pagan and S.G. Jackson

Kentucky Equine Research, Inc.
Versailles, KY 40383

Introduction

A combination of climate and access to irrigation make Arizona an ideal place to grow alfalfa hay. Hot, dry days along with elaborate irrigation systems allow alfalfa growers to produce multiple cutting of leafy, well cured forage. Because of the abundance of good quality alfalfa and because grass hay is difficult to grow in this environment, alfalfa has become the staple forage for horses in this region.

Many horsemen feed alfalfa in a long stem form either on the ground or in hay feeders while others feed a pelleted version of the hay. Still other producers have begun feeding a pelleted blend of alfalfa and bermuda straw. What effect does pelleting have on the nutritional value of alfalfa hay and how does the alfalfa/bermuda blend compare to pure alfalfa as a source of nutrients for the horse? The following series of experiments were conducted to answer these questions and provide horsemen with information about which form of forage is best for their management situation.

Materials and Methods

Four mature horses (three Thoroughbreds and one Quarter Horse) were used in a series of complete collection digestion trials to determine the effect that pelleting has on the digestibility of alfalfa hay and to compare these to a pelleted product containing 60% alfalfa and 40% bermuda straw.

In experiment one, two tons of irrigated alfalfa hay were harvested in Arizona. One ton of this hay was pelleted into 3/8 inch pellets and the other ton was left in square bales. The alfalfa was shipped to Kentucky Equine Research in Versailles, Kentucky where it was fed to the horses in a replicated 2X2 latin square design digestion trial. During the first period of this digestion trial, two horses were fed the long stem hay and two were fed the pelleted hay for a three week adjustment period followed by a five day complete fecal collection period. At the end of the first period, the diets were switched and the horses were allowed another two week adjustment period followed by another five day collection period.

In experiment two, all four horses were fed a commercially available pelleted blend of alfalfa and bermuda straw. The horses were fed this product for three weeks followed by a five day fecal collection period.

During all three experiment periods, each horse was fed the same daily intake of each of the different forages (table 1).

	HORSE			
	1	2	3	4
Alfalfa Hay	7.25	8.20	9.10	8.64
Alfalfa Pellets	7.25	8.20	9.10	8.64
Alf/Bermuda	7.25	8.20	9.10	8.64

Table 1.Daily Hay and Pellet Intakes (kg per day)

During each collection period, daily hay or pellet intake was carefully monitored and total fecal output measured. Subsamples of daily feed and feces were taken and frozen. These subsamples were dried and composited for chemical analysis. Both hay and feces were analyzed for dry matter (DM), crude protein (CP), crude fiber (CF), acid detergent fiber (ADF), neutral detergent fiber (NDF), fat, calcium, phosphorus, magnesium, potassium, zinc, copper, manganese, iron, molybdenum, ash.

Apparent digestibilities were determined for each nutrient by subtracting the total amount of nutrient excreted in the feces from the total intake of that nutrient during the collection period. Estimated true digestibility of calcium and phosphorus were calculated by assuming a constant amount of endogenous loss from each horse daily. Total digestible nutrients (TDN) were calculated by adding together digestible protein, fat X 2.25, crude fiber, and nitrogen free extract (NFE).

Results

Table 2 contains the nutrient analysis of the forages used in these digestion trials. The alfalfa hay and pellets contained more crude protein than the alfalfa/bermuda blend pellet. The blend pellet also contained much more neutral detergent fiber than the alfalfa.

Table 3 contains the digestibilities of the organic nutrients found in each of the forages. There was no significant difference between the digestibilities of any of the nutrients in the long stem or pelleted alfalfa with the exception of fat. Fat was more digestible (50.4% vs 40.2%) in the long stem hay. Because there was so little fat in the hay (2.8 %), it is doubtful whether this difference is of any nutritional significance.

There were a number of differences between the digestibility of the alfalfa and the alfalfa/bermuda blend. Total digestible nutrients (TDN), dry matter (DM), crude protein (CP), and acid detergent fiber (ADF) digestibility were all significantly higher in the alfalfa than in the alfalfa/bermuda blend.

Table 4 contains the digestibilities of the minerals found in each of the forages. There was no significant difference between the digestibilities of any of the minerals in the long stem vs pelleted alfalfa. The digestibilities of calcium and copper were higher in the alfalfa/bermuda blend than in either the long stem or alfalfa hay. Ash digestibility was lower in the bermuda blend pellet than in the alfalfa. This is probably because much of the ash in the bermuda straw is in the form of silica which is indigestible. In all three type forages average zinc digestibility was negative. Average manganese digestibility was negative in the two alfalfa forages although these were not statistically different from the slight positive digestibility (6.6%) measured in the bermuda blend.

Table 2. Nutrient Composition of Forages (as fed basis)

	FORAGE TYPE		
	alfalfa hay	alfalfa pellets	alfalfa/ bermuda
DM %	90.8	89.9	90.4
CP %	17.5	18.2	12.2
ADF %	29.5	28.9	30.3
NDF %	32.8	33.3	51.9
Fat %	2.8	2.7	1.9
Ca %	1.17	1.25	0.98
P %	0.25	0.24	0.18
Mg %	0.24	0.24	0.24
K %	2.97	2.78	1.85
Zn (ppm)	21	19	23
Cu (ppm)	10	10	6
Mn (ppm)	29	32	36
Fe (ppm)	162	366	233
Mo (ppm)	4.3	4.3	2.3
Ash %	10.2	10.4	7.8

Discussion

Horsemen in Arizona often observe that it takes less pelleted alfalfa to maintain their horse's body condition than alfalfa hay. They also report that when their horses are fed pellets they seem to produce less manure. The results of this study indicate that these observations are not because of increased nutrient digestibility in the pelleted form. There are two other factors, however, which may explain the field observations. First, when long stem hay was fed to the horses, it shattered badly resulting in a great deal of dust and fines. Only specially designed metabolism stalls and continual sweeping prevented a great deal of wastage of the hay. Under normal management conditions wastage will almost certainly occur resulting in inefficient nutrient utilization. The pelleted hay was completely consumed from each horse's feed tub with no wastage. Therefore, horses kept under normal management conditions must be fed more hay than pellets to allow them to ingest the same amount.

Table 3. Organic Nutrient Digestibilities

	FORAGE TYPE		
	alfalfa hay	alfalfa pellets	alfalfa/ bermuda
TDN%	59.9[a]	58.5[a]	48.1[b]
DM %	66.0[a]	65.2[a]	51.8[b]
CP %	79.5[a]	80.0[a]	71.1[b]
CF %	37.3[a]	37.9[a]	36.4[a]
ADF %	41.3[a]	41.9[a]	32.2[b]
NDF %	39.0[a]	38.6[a]	39.1[a]
Fat %	50.4[b]	40.2[a]	39.2[a]

[a,b]shaded values within a row with unlike superscripts are different ($p < .05$)

Table 4. Mineral Digestibilities of Forages

	FORAGE TYPE		
	alfalfa hay	alfalfa pellets	alfalfa/ bermuda
Ca %[1]	69.9[a]	71.6[a]	74.3[b]
P %[1]	25.8[a]	25.4[a]	21.7[a]
Mg %	48.8[a]	49.9[a]	44.1[a]
K %	77.8[a]	84.1[a]	79.9[a]
Zn (ppm)	-6.8[a]	-13.5[a]	-8.7[a]
Cu (ppm)	10.0[a]	9.2[a]	36.2[b]
Mn (ppm)	-6.6[a]	-0.6[a]	6.6[a]
Ash %	71.4[a]	70.8[a]	55.3[b]

[a,b]shaded values within a row with unlike superscripts are different ($p < .05$)

[1]calcium and phosphorus digestibilities are estimated true digestibilities assuming endogenous fecal losses equal to 20 kg Ca/kg BW/day and 10 mg P/kg BW/day

Secondly, when the horses were fed long stem hay, they produced much wetter manure than when fed pellets (table 5). A horse fed 9 kg of long stem alfalfa hay per day would produce 16.8 kg of wet manure compared to 12.8 kg from a horse fed the same hay in a pelleted form. Since the dry matter digestibilities of the two forms are equal, the difference in fecal output is due to water loss. Horses fed 9 kg long hay would lose 4.0 more kg of water in their manure each day than horses fed 9 kg of pelleted hay. This is equal to 4 liters of extra water that would be lost through the manure and it would explain why horsemen observe that their horses produce more manure when fed long stem hay. This extra water loss may be an important factor in horses living in hot arid environments.

Table 5. Fecal dry matter and water content (%)

	FORAGE TYPE		
	alfalfa hay	alfalfa pellets	alf/berm pellets
fecal DM %	18.5[a]	24.8[b]	24.2[b]
fecal water %	81.5[a]	75.2[b]	75.8[b]

[a,b]Shaded values within a row with unlike superscripts are different ($p < .05$)

The alfalfa hay and pellets had much higher dry matter digestibilities and total digestible nutrients (TDN) than the alfalfa bermuda blend pellets. Assuming that one kg of TDN equals 4.4 Mcal of digestible energy (DE), a 500 kg horse would require 7.1 kg of alfalfa pellets per day to meet its maintenance energy requirement of 16.4 Mcal DE/day. The same horse would need to eat 8.6 kg of the alfalfa bermuda blend pellets to fulfill its maintenance energy requirement.