

Round Bale Alfalfa Processing Method Does Not Influence Feeding or Mixing Characteristics in a Total Mixed Ration¹

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Introduction

Nutritionists and producers often assume that ingredients in a total mixed ration are uniformly mixed. However, many factors may affect ration homogeneity, including particle size, shape, and density and mixer discharge location. Forages are often ground prior to mixing in a total mixed ration to reduce variation in forage particle length. However, preprocessing forages while baling may facilitate particle length reduction and eliminate the need to grind forages prior to mixing. Objectives of this study were to determine the effects of forage processing method on uniformity and particle length of the total mixed ration at different discharge locations throughout mixing.

Experimental Procedures

Seventy-five bulls (697 lb initial body weight) were used to evaluate the effects of alfalfa hay processing method on total mixed ration uniformity at different mixer discharge locations. One field of alfalfa in northeast Kansas was swathed and raked in mid-July 2008. The three treatments were: 5 × 4 ft conventional alfalfa bales, 5 × 4 ft precut alfalfa gales, and 5 × 4 ft conventional alfalfa bales that were later tub ground. Precut bales were baled with a round baler equipped with serrated knives that cut the alfalfa into 3- to 8-in. sections as packer fingers moved the forage from the header to the baling chamber. No knives were present on the outer 6 in.; therefore, the ends and the perimeter of the bale were composed of full stem length forage, which maintained the structural integrity of the bale.

Prior to the start of the experiment, conventional bales were unrolled on a concrete slab, precut bales were broken apart by being raised approximately 16 ft with a tractor grapple fork and dropped onto concrete, and tub-ground bales were ground with a Haybuster H-1000 (DuraTech Industries International, Inc., Jamestown, ND) using a 2-in. screen.

Rations (Table 1) were prepared with a horizontal mixer (Forage Express; Roto-Mix, Dodge City, KS) and fed at an average of 2.33% (dry matter) of body weight for 15 days. Plastic containers (12 × 9 × 6 in.) were placed at the first, middle, and last third of the bunk line for collection of discharge location samples. Bale cores, discharge location samples, and refusals were analyzed for dry matter, crude protein, acid detergent fiber, and neutral detergent fiber. Diet particle length was determined by measuring the

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² John Deere, Ottumwa, IA.

geometric mean of the percentage of forage remaining on the top two screens (>12.7 mm), the overall geometric mean length, and geometric standard deviation.

Data were analyzed by using the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). Individual bale was the experimental unit. Main effects were declared significant at $P < 0.05$ and regarded as tendencies at $P < 0.10$. Contrasts were used to compare differences in bale processing method.

Results and Discussion

Average dry matter intake for the 15-day feeding period was 16.3 lb/animal each day. Average final body weight for the 15-day feeding period was 748 lb, and average daily gain was 3.3 lb/day. Diet samples from the beginning third and middle third of the mixer discharge had a smaller ($P=0.03$ and $P=0.07$, respectively) percentage of forage length of the total mixed ration (>12.7 mm) than samples from the last third of the mixer discharge (Tables 2 and 3). Additionally, diets containing tub-ground alfalfa had a smaller ($P=0.01$) percentage of forage length of the total mixed ration (>12.7 mm) than both the conventional and precut bale types. Samples taken from different discharge locations and bale types had similar ($P > 0.23$) geometric mean lengths and standard deviations.

Chemical analysis revealed no ($P > 0.80$) mixer discharge site by bale type interactions. Alfalfa processing method did not influence ($P > 0.28$) dry matter and crude protein (Tables 4 and 5). There was no difference in acid detergent fiber ($P > 0.17$) between samples from the first and middle third, but samples from the first third tended to have higher ($P=0.07$) neutral detergent fiber. Acid detergent fiber and neutral detergent fiber levels of feed samples from the last third of the mixer discharge were greater ($P=0.03$) than those of samples from the beginning third and similar ($P > 0.44$) to those of samples from the middle third. Moreover, conventional bales had greater ($P=0.05$) neutral detergent fiber and tended to have a greater ($P=0.08$) percentage of acid detergent fiber than tub-ground bales.

Implications

There was more ingredient segregation in total mixed rations made from conventional or precut bales than in rations made with tub-ground forage. Precutting forages resulted in responses similar to those for conventionally baled forages at the dietary inclusion levels and conditions of this experiment.

Table 1. Ingredient composition of diet

Ingredient, % dry matter basis	
Alfalfa hay	60.00
Wet corn gluten feed	32.00
Steam-flaked corn	4.09
Premix ¹	3.91
Total	100.00
Calculated composition	
Dry matter, %	76.74
NE _m , Mcal/lb	0.67
NE _g , Mcal/lb	0.41
Crude protein, %	17.11
Calcium, %	1.25
Phosphorus, %	0.49

¹ Provided 1,500 IU/lb vitamin A; 10 IU/lb vitamin E; 0.3% salt; 0.1 ppm cobalt; 10 ppm copper; 0.5 ppm iodine; 60 ppm manganese; 0.25 ppm selenium; 60 ppm zinc; 30 g/ton Rumensin (Elanco Animal Health, Greenfield, IN); and 9 g/ton Tylan (Elanco Animal Health).

Table 2. Effects of alfalfa bale type on diet particle length¹

Item	Bale type									SEM
	Conventional			Precut			Tub ground			
	First third	Middle third	Last third	First third	Middle third	Last third	First third	Middle third	Last third	
Fraction top two screens ² , %	19.9	21.4	26.1	15.6	17.5	23.7	3.7	2.6	5.6	3.08
Geometric mean length, mm	6.9	7.1	8.4	5.3	5.6	7.3	3.1	2.9	3.2	1.03
Geometric standard deviation, mm	4.5	5.1	6.1	4.0	4.3	5.7	2.9	2.8	2.9	0.42

¹45 samples of the complete diet were analyzed (ASAE Standard S424.1).

²Collected particles >12.7 mm.

Table 3. Probabilities of effects of alfalfa bale type on diet particle length¹

Item	Probability, P<							Site × Type
	First third vs. Middle third	First third vs. Last third	Middle third vs. Last third	Conventional vs. Precut	Conventional vs. Tub ground	Precut vs. Tub ground		
Fraction top two screens ² , %	0.75	0.03	0.07	0.16	0.01	0.01	0.90	
Geometric mean length, mm	0.83	0.96	0.79	0.50	0.28	0.68	0.91	
Geometric standard deviation, mm	0.91	0.66	0.74	0.72	0.41	0.24	0.26	

¹45 samples of the complete diet were analyzed (ASAE Standard S424.1).

²Collected particles >12.7 mm.

Table 4. Effects of alfalfa bale type and discharge site on total mixed ration composition¹

Item, %	Bale type									SEM
	Conventional			Prect			Tub ground			
	First third	Middle third	Last third	First third	Middle third	Last third	First third	Middle third	Last third	
Dry matter	72.3	70.6	70.8	68.5	70.6	72.4	72.7	73.0	73.0	2.53
Crude protein	23.4	23.8	23.7	24.7	23.9	23.5	24.1	24.2	24.6	0.74
Acid detergent fiber	23.2	25.3	26.0	22.3	23.8	24.9	22.5	23.1	23.6	1.21
Neutral detergent fiber	39.8	42.6	42.1	39.9	41.1	42.2	39.2	39.8	40.3	1.07

¹ Chemical analyses of total mixed rations made from alfalfa hay processed by different methods and discharged from the mixer in the beginning, middle, and final third of each batch.

Table 5. Probabilities of effects of alfalfa bale type or discharge site on total mixed ration composition¹

Item, %	Probability, P<							Site × Type
	First third vs. Middle third	First third vs. Last third	Middle third vs. Last third	Conventional vs. Prect	Conventional vs. Tub ground	Prect vs. Tub ground		
Dry matter	0.91	0.66	0.74	0.72	0.41	0.24	0.86	
Crude protein	0.83	0.96	0.79	0.50	0.28	0.68	0.80	
Acid detergent fiber	0.16	0.03	0.43	0.25	0.08	0.53	0.95	
Neutral detergent fiber	0.07	0.03	0.71	0.63	0.05	0.14	0.85	

¹ Probabilities (P-values) associated with feeding total mixed rations made from different alfalfa bale types and discharged from the mixer at the beginning, middle, or end of the mixer batch.