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UTILIZATION OF CHOPPED, WAFERED, AND PELLETED NATIVE MEADOW HAY BY WEANED HEREFORD CALVES [1]

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NUMEROUS workers have studied the effects of pelleting on the utilization of alfalfa hay and certain other roughages for ruminant animals (Neale, 1953; Blaxter and Graham, 1956; Webb *et al.*, 1957; Weir *et al.*, 1959; Lindahl and Reynolds, 1959). The feeding value of alfalfa wafers for dairy cows was investigated by Jones *et al.* (1958) and for growing sheep by Meyer *et al.* (1959b). There are, however, limited data available on the feeding value of meadow hay as influenced by different methods of preparation.

The refusals of coarsely chopped meadow hay generally contain higher amounts of crude protein and lower amounts of fiber than the hay initially offered. This relationship is probably due to physical properties rather than to a particular preference by the animal for certain portions of the hay. Since pelleting greatly reduces hay refusals it could enable an animal to consume a higher quality diet in the case of meadow hay.

The purpose of the work reported in this paper was to compare the performance of weaner calves fed coarsely chopped, wafered, or pelleted mountain meadow hay as their sole diet and to make digestibility comparisons between the three forms of hay.

Experimental Procedure

Feeding Trial. Eighteen steer and 12 heifer calves were stratified by weight and randomly allotted to three lots of 10 animals each. Six steers and four heifers were assigned to each lot. Each lot was group fed (*ad libitum*) either coarsely chopped, wafered, or pelleted meadow hay as their sole diet. The different forms of hay for each respective lot were weighed into sheltered mangers daily and the refusals were weighed weekly. Water, salt, and a salt: bonemeal mix were available to the animals at all times. During the 126-day study, individual weights were taken at periodic intervals following overnight restriction from feed and water. Initial and final weights were averages of two consecutive day weights.

All hay used in the experiment was from the same meadow on the Squaw Butte Station. The hay consisted primarily of rush (*Juncus* spp.) and sedge (*Carex* spp.) with minor amounts of grass and native clover (*trifolium* spp.). The hay was harvested in early July, coarsely chopped (approximately 2-in. lengths), and stored. A portion was processed into 4-in. wafers by a commercial feed plant. The fineness of the hay processed into wafers was similar to that of the chopped hay. The portion fed as pellets was ground through a 1/8 in. screen and processed into 3/8 in. pellets. Density of the chopped hay was reduced slightly more than three times as result of wafering and more than seven times by pelleting. The chemical composition of the three forms of hay used in the feeding and digestion trials is shown in table 1.

Digestion Trial. At the end of the feeding trial, three uniform steers from each lot were placed in individual feeding stalls and kept on their respective diets during the digestion trial. All diets were fed at a level calculated to provide approximately 120% of maintenance. A 10-day preliminary period and a 5-day total collection period were used. Aliquots amounting to 10% of the daily fecal output were composited over the 5-day period. Composite samples were obtained for each diet from daily samples taken during the collection period.

Gross energy was determined by an oxygen bomb calorimeter. Cellulose was determined by the method of Crampton and Maynard (1938) and other determinations were made according to standard A.O.A.C. (1955) procedures.

Results and Discussion

Feeding Trial. The higher cellulose and energy values and the lower crude protein con-

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TABLE 1. CHEMICAL COMPOSITION [a] OF EXPERIMENTAL DIETS

Constituent	Form of hay		
	Chopped	Wafered	Pelleted
Ash, %	11.05	10.8	12.1
Cellulose, %	30.8	32.4	29.1
Crude protein, %	8.9	7.0	9.5
Gross energy (T/lb.)	1.90	1.94	1.90

[a] Dry matter basis.

tent of the wafered hay (table 1) may be partially explained by a considerable loss of the finer, leafier particles and possibly some dirt or foreign material during the wafering process. The portable "foragizer" used in wafering was located outside and high winds prevalent during the operation were assumed responsible for the losses. The protein content of the pelleted hay was slightly higher than that of the chopped hay (table 1).

Pellet-fed calves gained at a significantly faster rate ($P<0.01$) than those fed chopped or wafered hay (table 2). The difference in gain of animals fed chopped and wafered hay was not significant. The lower crude protein content of the wafered hay (table 1) may explain why calves on this diet gained slightly less. Processing the hay into wafers increased consumption by a small margin. Meyer *et al.* (1959b) reported slight increases in feed intake and rate of gain as result of wafering alfalfa hay for lambs. These workers concluded, however, that the main advantage in wafering hay was probably the improvement in physical handling characteristics.

Hay consumption was significantly higher ($P<0.01$) and refusals significantly lower ($P<0.01$) for calves receiving pelleted hay compared to those receiving either chopped

TABLE 2. RESULTS OF FEEDING TRIAL [a]

Item	Form of hay		
	Chopped	Wafered	Pelleted
	lb.	lb.	lb.
Initial wt.	358	357	360
Daily gain	0.37	0.30	0.71 [b]
Daily hay fed	12.14	11.84	12.65
Daily hay cons.	9.90	10.09	12.29 [b]
Daily hay refused	2.24	1.75 [c]	0.36 [d]
Hay cons./lb. gain	26.8	33.7	17.3
Hay fed/lb. gain	32.8	39.5	17.8

[a] Average of 10 calves per treatment.
[b] Significantly higher ($P<0.01$) than calves fed chopped or wafered hay.
[c] Significantly lower ($P<0.01$) than calves fed chopped hay.
[d] Significantly lower ($P<0.01$) than calves fed chopped or wafered hay.

or wafered hay. Pelleting meadow hay reduced dust and eliminated interference of foxtail barley (*Hordeum jubatum* L.) which is commonly found in meadow hay and can, in some instances, reduce intake through mechanical irritation to the animals.

Feed conversion favored the calves receiving pelleted hay. This was more noticeable when the calculations were based on total hay fed rather than on the amounts actually consumed.

Digestion Trial. Average amounts of the daily hay refusals during the digestion trial as well as their cellulose and crude protein contents are presented in table 3. When feed offered was limited to a level slightly above maintenance during the digestion trial the differences in amount of hay refused among diets

TABLE 3. AMOUNT AND COMPOSITION [a] OF HAY REFUSALS DURING THE DIGESTION TRIAL [b]

Item	Form of hay		
	Chopped	Wafered	Pelleted
Daily hay refused, lb.	0.49	0.56	0.24
Cellulose content, %	27.5	30.8	30.5
Crude protein content, %	11.3	8.0	9.0

[a] Dry matter basis.
[b] Average of three calves per treatment.

were not as large as those which occurred during the feeding trial (table 2).

Cellulose values were lower and crude protein contents were higher in both chopped and wafered hay refusals than in the feed as initially offered. These analyses would suggest that steers fed either coarsely chopped or wafered hay actually consumed a less nutritious diet than was offered. This relationship is in contrast to observations on sheep fed long hay as reported by Reynolds and Lindahl (1960). Conversely, pelleted hay refusals were higher in cellulose and lower in crude protein than the pellets initially fed. This would indicate that processing the hay into pellets not only reduced quantity of refusal but, perhaps more important, increased quality of intake.

Digestion coefficients were reasonably comparable between replications for each form of hay; however, with the number of animals used in the trial as designed, the differences were not sufficient to show significance by analysis of variance. The trends noted in apparent digestibility of dry matter, cellulose, and energy were higher in the chopped and

TABLE 4. APPARENT DIGESTION COEFFICIENTS[a] FOR EXPERIMENTAL DIETS

Constituent	Form of hay		
	Chopped	Wafered	Pelleted
	%	%	%
Dry matter	57.4	56.8	51.4
Ash	36.7	34.7	34.7
Cellulose	63.9	65.0	53.4
Crude protein	50.8	48.4	51.4
Gross energy	55.9	55.6	49.3

[a] Average of three calves per treatment.

wafered hay than in the pelleted hay (table 4). On the other hand, apparent digestibility of crude protein was slightly higher in the pelleted hay than in either chopped or wafered hay. This might be partially attributed to the higher level of protein in the pelleted hay as compared to chopped or wafered hay. The trends noted in fiber (cellulose) and protein digestibility for the chopped and pelleted diets are in close agreement with those reported by Wallace and Hubbert (1959). These results are also similar to those found by Meyer *et al.* (1959a) during a study comparing alfalfa fed in chopped and pelleted forms.

Reynolds and Lindahl (1960) observed that poor-quality long hays were consistently higher in digestibility of gross nutrients when conventional "as consumed" digestion coefficients were used. However, when coefficients were calculated on the basis of the nutrients offered, the pelleted hays were higher in digestibility. These workers reported refusals of 9.5 to 16.2% of long hays fed as compared with no refusal of the pelleted hay diets which, to a large extent, explained the reversal in digestibility values that occurred when the "as fed" method was used. The calculation of digestion coefficients on the basis of nutrients offered in this trial would not alter the digestibility trends established by the usual method of calculation since differences in amount of hay refused among diets were so small.

TABLE 5. ENERGY AND TDN CONTENTS[a] OF EXPERIMENTAL DIETS

Constituent	Form of hay		
	Chopped	Wafered	Pelleted
Gross energy, Kcal/Kg	4190	4268	4200
Digestible energy, Kcal/Kg	2359	2379	2074
TDN, %[b]	53.6	53.9	46.9

[a] Dry matter basis.
[b] Calculated according to Swift (1957). (2,000 Kcal digestible energy=1 pound TDN).

Energy and TDN values for the experimental diets are presented in table 5. Digestibility energy and TDN values for both chopped and wafered hays were higher than for the pelleted hay.

Summary

Native meadow hay was fed as the sole diet in coarsely chopped, wafered, and pelleted forms to weaned Hereford calves. Hay consumption and rate of gain were significantly increased while hay refusals were significantly decreased as a result of pelleting.

Apparent digestibility of nutrients among the three forms of hay was not significantly different. Digestibility trends did, however, indicate a depression in dry matter, cellulose, and energy digestion and an increase in protein digestion as a result of pelleting meadow hay.

Refused portions of chopped and wafered hays were consistently higher in crude protein and lower in cellulose content than these hays as offered. Conversely, pelleted hay refusals were higher in cellulose and lower in crude protein than the pellets initially fed.

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