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Wheat Middling Versus Alfalfa Hay Supplements for Lactating Beef Cows Wintered on Ammoniated Wheat Straw

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Introduction

Most cow-calf producers in areas with substantial winter snow cover remain dependent on mechanically harvested and stored forages to winter their cow herds. On-ranch hay production may be limited by drought and other factors necessitating the purchase of stored forages if cow numbers are to be maintained. On many operations, cow herd size is limited not by the availability of spring/summer grazing but by the winter feed supply. Also if fixed production costs are to be controlled by increasing the number of cows on an operation, off-ranch purchase of winter forages would be necessary.

Low-quality forages (LQF) such as cereal straws and stalks are much less expensive than hay or other stored forages on an absolute and cost per unit of energy basis. Although most LQF are deficient in crude protein, energy, vitamins and most minerals relative to cow requirements, these deficiencies can be economically overcome by strategic supplementation programs. In addition, chemical treatment of LQF with alkalizing agents such as anhydrous ammonia will not only increase the energy availability of LQF but will also increase crude protein content. With the combination of proper supplementation and chemical treatment, LQF diets can be successfully used to sustain beef cows through late gestation and early lactation.

Supplementing LQF diets with alfalfa hay (AH) is a common practice since it is readily available and is readily consumed by all cattle. In addition, AH does not require a specialized delivery system and is relatively high in crude protein. However, AH can be quite expensive depending on market conditions. An alternative supplement for LQF diets would be wheat

middlings (WM), which is a by-product of the wheat flour industry. Unlike the corn and soybean by-product industries that are concentrated in the Midwestern states, wheat flour mills are distributed throughout the Intermountain West, so WM are readily available with reduced freight costs. Wheat middlings contains crude protein levels comparable to AH, but contain about 25% more energy. In addition, WM is much higher in phosphorus and trace minerals than AH and thus more closely matches these deficiencies in LQF. The objective of this study was to compare the performance of fall-calving, lactating beef cows when wintered on ammoniated wheat straw (AWS) supplemented with either AH or WM.

Material and Methods

Sixteen fall-calving, crossbred (Angus x Hereford) beef cows with suckling calves at side were stratified into four groups of four cows each based on body weight (BW), body condition score (BCS), and calf BW. Cows were of a frame score of 5 to 6 and weighed 1250 lbs in BCS 5. Each group of cow-calf pairs was assigned to one of four pens. Groups were placed in pens about December 1 when calves averaged 90 days of age. All pens received ad-libitum access to AWS. The AWS was produced in the following manner: 1) wheat straw was baled into medium sized square bales early in the morning to incorporate as much dew as possible to enhance the ammoniation process; 2) straw was immediately stacked and then enveloped and sealed with a sheet of black 6-mil polyethylene anchored at the base of the stack with road-base gravel; 3) anhydrous ammonia was then slowly injected into the stack at 3% of dry matter through a 1.0 inch (i.d.) steel pipe embedded near the base of the stack; 4) straw was ammoniated in August and remained sealed until the following November when the polyethylene was removed from one end of the stack to allow dissipation of excess ammonia. The AWS was fed directly from the bales without processing and was 10.6% crude protein (CP) and 70.8% neutral detergent fiber (NDF) (dry matter basis). Each pen was equipped with a creep feeding area for the calves that was stocked with AH (18.7% CP and 41.2% NDF, dry matter basis). In two of the pens, cows received AH (17.6% CP, 46.6% NDF, dry matter basis) at a rate of 9.0 lbs DM/cow/day. The other two pens received WM (15.7% CP, 27.9% NDF, dry matter basis) at a rate of 7.25 lbs DM/cow/day. The amounts of supplement offered were designed to provide the same amount of energy rather than CP since the CP level of the diets was not limiting. Intake of AWS was carefully monitored each day. The apparent digestibility of the diets was estimated after the cows had received the diets for the initial 35 days of the study.

Results and Discussion

Digestibility of DM, fiber (NDF), and CP as well as AWS DM intake and digestible DM intake are presented in Table 1. Although nutrient digestibilities were numerically higher when cows were supplemented with WM versus AH, the differences could not be substantiated statistically. Therefore, it must be concluded that the type of supplement had no effect on nutrient digestibility. However, cows receiving the WM

supplement consumed nearly 40% more AWS than those supplemented with AH. This increase in AWS intake was likely due to an increased rate of fiber fermentation in the rumen, and also due to the lower bulk density of the WM compared to AH, which simply allowed more room for AWS consumption. As a result of increased AWS intake, cows receiving the WM supplement were receiving about 42% more digestible dry matter than those receiving the AH supplement, which is equivalent to about 42% more energy.

When this study was conducted the market values of AH, WM and AWS were $.0445/lb DM, $.04/lb DM, and $.0223/lb DM, respectively. Based on AWS and supplement intakes, diet cost for cows supplemented with AH was $.8117/cow/day, and it was $.8649/cow/day when the WM supplement was fed (Table 2). The major reason for higher daily cost of the WM-supplemented diet was the increased intake of AWS. Including supplement plus AWS, cows fed the AH-supplemented diet consumed a total of 27.44 lbs DM/day (9.0 lbs AH + 18.44 lbs AWS), while those fed the WM-supplemented diet consumed 33.03 lbs DM/day (7.25 lbs WM + 25.78 lbs AWS) (Table 2). Dry matter digestibility was similar between the two types of supplements, so the increased dry matter intake (DMI) observed with the WM-supplemented diet improved the efficiency of digestible dry matter (DDM) or energy production (DDM intake ÷ total DMI). The WM supplemented diet produced .5036 lbs of DDM/lb of DMI, while the WM-supplemented diet produced .5961 lbs of DDM/lb of DMI (Table 2). Consequently the cost per unit of DDM (diet cost ÷ DDM intake) was decreased when the WM-supplemented diet was used compared to the AH-supplemented diet, $.0439/lb of DDM versus $.0587/lb of DDM, respectively (Table 2). This constitutes a 25% decrease in diet energy cost.

We estimated the net energy for maintenance (NE_m) requirement of the cows to be 15.11 Mcal NE_m/day based on cow body size, weather conditions, and milk production. We also estimated the NE_m concentration of the AH-supplemented and WM-supplemented diet to be .4917 Mcal NE_m/lb DM and

.6414 Mcal NE_m/lb DM, respectively, based on lbs of DDM/lb DMI. Hence, cows consuming the AH-supplemented diet were receiving about 13.49 Mcal NE_m/day (.4917 Mcal NE_m/lb DM x 27.44 lbs DM), approximately 90% of their requirement. Cows receiving the WM-supplemented diet were receiving an estimate 21.19 Mcal NE_m/day (.6414 Mcal NE_m/lb DM x 33.03 lbs DM), about 140% of their estimated requirement. To meet the minimum estimated NE_m requirement of the cows being fed the WM-supplemented diet only 23.56 lbs of DM would have to be fed (15.11 Mcal NE_m/d ÷ .6414 Mcal NE_m/lb DM). Since the cost of WM-supplemented diet was estimated to be $.0262/lb DM ($.8649/cow/day ÷ 33.03 lbs DM/cow/day), this diet cost was estimated to cost $.6170/cow/day (Table 2). Although these cows were not required to travel long distances each day and they had some protection from wind and precipitation in the pens, this is a very inexpensive diet for lactating beef cows during winter months. When this study was conducted the market value of average-quality grass hay (.4864 Mcal NE_m/lb DM, 8.2% CP) was $.0333/lb DM. It would require 31.06 lbs DM (15.11 Mcal NE_m/d ÷ .4864 Mcal NE_m/lb DM) from this type of hay to meet the NE_m requirement of the cows on this study, which would cost about $1.034/cow/day (31.06 lbs DM/cow/d x $.0333/lb DM) (Table 2). Hence, the WM-supplement AWS diet would result in a 40% reduction in daily feed costs.

Implications

When off-ranch winter feed purchases are required on cow-calf operations because on-ranch production has been curtailed or when cow numbers are being increased, an ammoniated wheat straw diet supplemented with wheat middlings (ammoniated wheat straw, 18.17 lbs DM/d + wheat middlings, 5.17 lb DM/d; for 1250 lb lactating beef cows in good body condition) resulted in a 40% reduction in cost compared to the purchase of average-quality grass hay. An ammoniated wheat straw diet supplemented with alfalfa hay at .72% of cow body weight resulted in an energy intake of only 90% of that required and also resulted in a 25% increased cost per unit of available energy compared to an ammoniated wheat straw diet supplemented with wheat middlings.

Table 1. Utilization of ammoniated wheat straw by lactating beef cows supplemented with either alfalfa hay or wheat middlings during the wintering period.

Item	Supplement		p^2
	Alfalfa Hay	**Wheat Middling**	
Apparent diet digestibility, %			
Dry Matter	47.59	55.98	.18
Acid Detergent Fiber	35.87	42.38	.38
Neutral Detergent Fiber	47.79	53.67	.37
Crude Protein	56.94	58.83	.18
AWS[a] dry matter intake, lbs/cow/day	18.44	25.78	.04
DDMI[b], lbs/cow/day	13.82	19.69	.10

[a] Probability of a significant statistical difference, less than .10 means a difference due to type of supplement.
[b]Digestible dry matter intake, an indication of energy intake.

Table 2. Economic comparison of a grass hay diet and an ammoniated wheat straw diet supplemented with either alfalfa hay or wheat middlings for the wintering of lactating beef cows.

Diet	DMI[a],lbs/d	$/lb DM_b	$/cow/d	DDM[c]/DMI, lbs	$/lb DDM
GH[d]	31.06	.0333	1.0340	--	
AH[e] + AWS[f]	27.44	.0296	.8117	.5036	.0587
WM[g] + AWS[h] I	33.03	.0262	.8649	.5961	.0439
WM[i] + AWS[j] II	23.56	.0262	.6170	.5961	.0439

[a]Dry matter intake
[b]Dry matter
[c]Digestible dry matter
[d]Grass hay (crude protein (CP), 8.2% DM; net energy for maintenance (NE_m), .4864 Mcal/lb DM), fed to supply 15.11 Mcal NE_m/d
[e]Alfalfa hay (9.0 lbs DM/d) (CP, 17.6% DM; neutral detergent fiber (NDF), 46.6% DM)
[f]Ammoniated wheat straw (18.44 lbs DM/d, ad libitum) (CP, 10.6% DM; NDF, 70.8% DM)
[g]Wheat middlings (7.25 lbs DM/d) (CP, 15.7% DM; NDF, 27.9% NDF)
[h]Ammoniated wheat straw (25.78 lbs DM/d, ad libitum)
[i,j]Wheat middlings (5.17 lbs DM/d) + Ammoniated wheat straw (18.39 lbs DM/d) fed to supply 15.11 Mcal NE_m/d

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