simply because they had conformation scores in the acceptable feeder calf grades of low to average choice. If a producer feels that these three crossbred groups would sell for different prices at the market he generally uses, comparisons can easily be made using whatever price differentials thought appropriate. Since the same price structure was used for Hereford, Simmental and Brown Swiss sired calves, comparisons in gross income are the same as for pounds of calf produced per pregnant cow. As long as the Brown Swiss sired calves can be sold for the same price as Hereford x Angus calves these data would suggest that total income would be increased by $16.83 (11.8%) by use of Brown Swiss bulls. In fact, in these data, use of Brown Swiss bulls would return the most money per cow so long as there were no more than three cents per pound discrimination in selling price for Brown Swiss sired calves. Total income per pregnant cow was quite similar for Hereford and Simmental sired calves. The very slight advantage of $3.96 (2.8%) in favor of Simmental sired calves could be easily offset by a one cent per pound premium for Hereford x Angus calves or the added risk of calving difficulty from Simmental sired calves. Jersey sired calves were hardly competitive as income producers and should be seriously considered by the producer only under special circumstances like when there is particular concern about calving difficulty in first calf heifers or when Jersey cross heifers are desired for addition to the cow herd.

Effects of Winter Supplement Level on Roughage Intake and Digestibility of Three Breeds of Cows in Drylot[1]

K. S. Lusby, D. F. Stephens, Leon Knori and Robert Totusek

Story in Brief

Thirty-five lactating 4-year-old Hereford, Hereford x Holstein (Crossbred) and Holstein cows maintained in drylot and individually fed were

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used to determine the influence of breed and level of winter supplement (Moderate, High or Very High) on winter and subsequent summer roughage intake. Cottonseed hulls were fed free choice in two winter trials and alfalfa hay in three summer trials to simulate range forage.

Cows fed a high level of winter supplement consumed more cottonseed hulls in winter and had higher digestibility coefficients for acid detergent fiber and dry matter than cows fed a Moderate level. In summer, with free choice alfalfa hay and no supplement, cows previously wintered on the Moderate supplement level tended to consume more alfalfa hay than cows wintered on the High or Very High levels of supplement. Groups with the highest alfalfa intakes generally had the highest digestion coefficients for acid detergent fiber, dry matter and crude protein. Holsteins consumed more roughage than Crossbreds, and Crossbreds more than Herefords in both winter and summer.

These results and findings from range research indicate that increased supplementation causes an increased intake of harvested forage but a decreased intake of dry winter range grass. This information provides a possible explanation for the difficulty in markedly improving weight of range cows with increases in supplementation.

Introduction

High milking females produce heavier calves at weaning but require more forage and higher levels of winter supplementation to maintain body condition and rebreeding performance similar to that found in conventional beef cows. Any influence of increased forage intake or high winter supplementation levels on forage digestibility will be reflected in altered efficiency of the cow. Research has been conflicting with some workers reporting decreased digestibility with increased intake while others showed increased digestibility as intake increased. Previous research has shown that protein supplementation increases digestion of low quality hays.

The experiments reported herein were designed to study the influence of breed, reflecting level of milk production, and level of winter supplement on winter and subsequent summer roughage intake and digestibility by drylot cows.

Experimental Procedure

Thirty-five Hereford, Hereford x Holstein (Crossbred) and Holstein females were confined in drylot from the time they calved in December, January and February until their calves were weaned at 240 days of age. Trials discussed here were conducted when the cows were three and four-year-olds raising their second and third calves, respectively. All cows were individually fed to facilitate accurate feed intake information on a per cow basis.

From the date of calving until April 15, all cows were fed free choice cottonseed hulls daily to simulate winter range forage. In addition, each cow was fed .5 lb alfalfa pellets per day. Two levels of a 30% natural protein supplement, Moderate and High, were fed to five cows of each breed from calving to April 15. The Moderate level was calculated to allow good rebreeding performance in mature Hereford females with a 10-15% weight loss from fall to spring. The high level was established for the Crossbred females and consisted of that amount of supplement estimated necessary to maintain a physiological condition and rebreeding performance similar to that of the Moderate Herefords. A Very High level was fed only to five Holsteins and consisted of that amount of supplement estimated necessary to maintain a body condition similar to that of the Moderate Herefords and High Crossbreds. Within each supplement level the quality of supplement fed to each female was adjusted for differences in body size. Supplement intake by breed and level of supplement is shown in Table 2.

From April 15 until calves were weaned, all cows received free choice chopped or baled alfalfa hay to simulate summer range forage. Chemical analyses of feeds are shown in Table 1.

Two digestion trials were conducted in March of 1972 (Trial I) and 1973 (Trial II) when all cows were fed cottonseed hulls and three levels of supplement. Three trials were conducted in June of 1972 (Trial

Table 1. Chemical Composition of Feeds.

Feed	Trial No.	As % of dry matter	
		Crude Protein	Acid detergent fiber
Cottonseed hulls	I	4.70	73.05
	II	4.55	72.76
Alfalfa meal, pelleted	I	18.35	31.00
	II	18.60	31.50
Supplement[1]	I	31.20	12.93
	II	30.60	12.90
Alfalfa hay			
Chopped	III	17.60	42.80
Baled	IV	15.85	44.40
Chopped	V	15.70	44.80
Sorghum grain	III	10.60	1.95

[1] Supplement composition: Soybean meal, 60.1%; sorghum grain, ground, 30.3%; alfalfa meal pellets, 5.0%; dicalcium phosphate, 2.9%; Masonex, 1.2%; salt, 0.5%; vitamin A, 900 IU/lb.

Table 2. Feed Intake and Digestibility, Winter.

	Breed and level of winter supplement						
	Hereford		Hereford X Holstein		Holstein		
Item	Moderate	High	Moderate	High	Moderate	High	Very High
Trial 1, March, 1972							
Daily intake							
Alfalfa pellets, lb	.99	.99	.99	.99	.99	.99	.99
Supplement, lb	2.71	5.70	2.68	5.85	3.19	6.36	9.0
Cottonseed hulls, lb	23.34[1]	33.48[2]	26.20[1]	36.54[2]	35.53[2]	44.22[3]	49.65[4]
Cottonseed hulls (adjusted)[7]	0.13[1]	0.15[2,3]	0.14[2,2]	0.17[3]	0.17[3]	0.19[4]	0.20[4]
Supplement: roughage ratio[6]	0.10	0.16	0.10	0.16	0.08	0.14	0.18
Digestibility %							
Dry matter	52.18[1]	58.98[2]	50.21[1]	58.45[2]	48.83[1]	58.69[2]	67.61[3]
Acid detergent fiber	51.39[1,2,3]	55.28[3,4]	48.23[1]	54.91[2,3,4]	49.97[1,2]	58.07[4]	56.38[3,4]
Trial II, March, 1973							
Daily intake							
Alfalfa pellets	.99	.99	.99	.99	.99	.99	.99
Supplement, lb	2.71	6.38	2.73	6.84	3.17	7.19	10.67
Cottonseed hulls, lb	18.55[1]	33.95[3]	24.73[2]	38.57[4]	31.97[3]	46.64[5]	51.28[5]
Cottonseed hulls (adjusted)[7]	0.11[2]	0.19[2,3]	0.16[2]	0.20[3]	0.18[2,3]	0.26[4]	0.28[4]
Supplement: roughage ratio[6]	.14	.18	.11	.17	.10	.14	.20
Digestibility %							
Dry matter	59.12[1,2,3]	62.64[2,3]	49.70[1]	64.11[3]	52.84[1,2]	56.14[1,2,3]	63.23[3]
Acid detergent fiber	53.50[1,2]	59.59[1,2]	50.08[1]	62.05[1,2]	55.04[1,2]	55.97[1,2]	64.32

[1,2,3,4,5] Numbers with same superscript letter do not differ significantly ($P < .05$).
[6] Roughage calculated as cottonseed hulls and alfalfa pellets.
[7] lb/wt. 0.75

III) and June and July of 1973 (Trials IV and V, respectively) when free choice alfalfa hay was fed. The alfalfa was chopped through a hammer mill for Trials III and V, while baled alfalfa hay was fed in Trial IV. Feeding schedules during digestion trials were altered from once daily (8 am to 1 pm) to twice daily feeding periods from 6 am to 10 am and from 4 pm to 6 pm. Chromic oxide (20 grams/head/day) was fed twice daily (7 am and 5 pm) to each cow for 7 days prior to collection of fecal grab samples and for 7 succeeding days during which rectal grab samples (110 grams) were taken at the time of each chromic oxide administration. Chromic oxide was fed via the supplement in Trials I and II and with .5 lb ground corn as a carrier in Trials III, IV, and V when no supplement was fed.

Fecal grab samples were composited over the 7 day collection periods for each cow, dried at 212° F for 48 hr and analyzed for chromic oxide content. Samples of feed were taken daily, composited for the trial period, and analyzed for crude protein, dry matter and acid detergent fiber. Nutrient digestion coefficients were calculated using the nutrient concentration of the feed and feces and chromic oxide concentration of the feces.

Results and Discussion

In Trials I and II (Table 2) with three levels of supplement fed, cottonseed hull intake within each breed was higher for cows receiving the High supplement level than for cows fed the Moderate level. Very High Holsteins consumed more cottonseed hulls in Trial I and Trial II than High Holsteins. Holsteins consumed more cottonseed hulls than Crossbreds while Crossbreds consumed more than Herefords in both Trials I and II.

Dry matter digestibility coefficients for High supplemented females were greater than for Moderates in both Trial I and Trial II. Since digestion coefficients were determined on the total diet of each cow, a part of the increased dry matter digestibility observed in High and Very High females was due to a greater proportion of highly digestible supplement in the total diet of cows fed the High or Very High supplement levels. Dry matter digestibility differences between the Moderate and High level Herefords and Holsteins in Trial II could be explained on this basis. However, differences in dry matter digestibility between Moderate and High Crossbreds in Trial II and between Moderate and High level cows of all breeds in Trial I were too large to have resulted from the additional supplement fed to High level cows.

A better estimate of the influence of supplement on roughage digestibility was obtained from the acid detergent fiber (ADF) digestibility values. The supplement contained only 12.9% ADF and hence contributed little of this fraction to the total diet. High level females had higher ADF digestibility in Trial I than the Moderates. Differences in ADF digestibility in Trial II, while as high in magnitude as found in Trial I, were more variable. An explanation for the higher variation in digestibility coefficients incurred in Trial II compared to Trial I is not readily apparent. Results from these trials concur with previous work which showed increased intake and digestibility of low quality roughages in sheep when additional protein was added to the ration.

Protein digestibility was not measured in Trials I and II since cottonseed hulls contained little digestible protein and any digestion coefficient would only reflect the contribution of supplement protein.

Interpretation of results from Trials III, IV and V was made more difficult by factors which prohibited the feeding of alfalfa hay identical in quality and method of preparation in all summer trials. An attempt at the time of trial 3 to equalize weights between the drylot cows used in this experiment and similar groups of the same breeds and supplement levels on range forced the inclusion of 10% ground sorghum grain in the chopped alfalfa ration and led to higher digestion coefficients in Trial III than found in Trials IV and V. The alfalfa hay fed in Trials IV and V was poorer in quality than that used on Trial III, as Table 1 indicates. Further, difficulties with the feed mill forced the feeding of baled rather than chopped alfalfa in Trial IV.

Results of the three summer trials are shown in Table 3. A general trend existed for cows previously wintered on the Moderate supplement level to consume more alfalfa in summer than cows wintered on the High level in Trial III and Trial V but not in Trial IV. While this study was not designed to compare long and chopped forages, the lowered intake and overall greater digestibility of the long (baled) hay when compared to chopped hay has been noted in previous research. Adjustment of alfalfa intakes to a metabolic size basis (lb/lb wt. $^{0.75}$) showed that previous plane of winter supplement affected summer roughage intake in Trial III and Trial V but not in Trial IV.

Breed affected intake in Trial III, Trial IV and Trial V. Adjusted intakes were similar though differences were not as great in Trial IV and Trial V.

The effect of previous winter feeding level on digestibility of dry matter, protein and ADF was erratic but a trend was noted for groups with the greatest roughage intakes to also have higher digestion coefficients. These results agree with results of other researchers.

It is interesting to note that the High Herefords were generally the least efficient in digesting ADF, dry matter and protein in each summer

Table 3. Feed Intake and Digestibility, Summer.

Item	Breed and previous level of winter supplement						
	Hereford		Hereford X Holstein		Holstein		
	Moderate	High	Moderate	High	Moderate	High	Very High
Trial III, June, 1972							
Alfalfa intake (lb)[5]	25.34[1,2]	20.59[1]	27.41[2,3]	27.76[2,3]	37.38[4]	33.84[4]	32.82[3,4]
Alfalfa intake (adjusted)[8]	0.12[2]	0.10[1]	0.13[2,3]	0.13[2,3]	0.19	0.17[3,4]	0.15[2,3]
Digestibility %							
Dry matter	57.41[1,2]	51.37[1]	59.38[1,2]	60.25[1,2]	63.59[2]	59.35[1,2]	59.59[1,2]
Protein	68.60[1,2]	65.20[1]	70.45[1,2]	70.71[1,2]	72.38[2]	70.28[1,2]	70.20[1,2]
Acid detergent fiber	56.01[1,2]	53.80[1]	59.87[1,2,3]	60.33[1,2,3]	64.03[3]	63.16[3]	62.49[2,3]
Trial IV, June 1973							
Alfalfa intake (lb)[6]	23.08[1]	23.91[1]	25.15[1,2]	27.21[2,3]	28.14[2,3]	27.87[2,3]	29.76[3]
Alfalfa intake (adjusted)	0.11[1]	0.10[1]	0.11[1,2]	0.12[2]	0.12[2]	0.11[1,2]	0.11[1,2]
Digestibility %							
Dry matter	53.99[1,2,3]	48.10[1]	54.24[1,2,3]	58.16[2,3]	56.14[1,2,3]	53.58[1,2]	62.95[3]
Protein	59.94[1,2]	58.95[1,2]	65.42[1,2]	63.70[1,2]	60.02[1,2]	58.11[3]	68.22[2]
Acid detergent fiber	57.87[1,2,3]	52.73[1]	56.83[1,2]	63.62[2,3,4]	65.09[3,4]	58.50[1,2,3]	66.94[4]
Trial V, July, 1973							
Alfalfa intake (lb)[7]	28.45[1,2,3]	24.16[1]	31.20[2,3,4]	26.73[1,2]	35.02[4]	36.39[4]	33.35[3,4]
Alfalfa intake (adjusted)[8]	0.13[2,3]	0.11[1]	0.15[3]	0.12[1,2]	0.15[3]	0.15[3]	0.12[1,2,3]
Digestibility %							
Dry matter	52.18[3]	43.74[1,2]	52.10[3]	47.50[1,2,3]	49.76[2,3]	41.78[1]	47.01[1,2,3]
Protein	61.94[3]	54.72[1]	62.26[3]	59.75[1,2,3]	60.96[2,3]	55.47[1,2]	58.69[1,2,3]
Acid detergent fiber	54.97[3]	46.58[1,2]	51.57[2,3]	49.00[1,2,3]	51.38[2,3]	43.02[1]	46.73[1,2]

[1,2,3,4]Numbers with same superscript letters do not differ significantly (<P.05).
[5] Chopped hay, 90%; ground milo, 10%.
[6] Baled hay.
[7] Chopped hay.
[8] Lb/lb. wt. 0.75.