Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 1114

1983

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Recommended Citation

Young, B.; Ilg, H.; and Bolsen, K. (1983) "High-moisture or dry corn, roughage sources, and protein supplements for short-fed finishing steers," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.2517

Abstract

Dry corn, stave ensiled high-moisture corn (HMC), stave ensiled HMC treated with urea, and Harvestore ensiled HMC were evaluated in a steer finishing trial. Alfalfa hay and corn silage were the roughages and soybean meal or urea, the nitrogen sources. There were no differences in steer performance for corn treatments, but steer performance was significantly improved when alfalfa hay rather than corn silage was the roughage. Urea supplements significantly depressed steer performance compared with soybean meal additions; a combination of urea and soybean meal gave intermediate performance.

Keywords

Cattlemen's Day, 1983; Report of progress (Kansas State University. Agricultural Experiment Station); 427; Beef; Corn; Finishing steers; Performance; Protein

High-moisture or Dry Corn, Roughage Sources, and Protein Supplements for Short-fed Finishing Steers.

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Summary

Dry corn, stave ensiled high-moisture corn (HMC), stave ensiled HMC treated with urea, and Harvestore ensiled HMC were evaluated in a steer finishing trial. Alfalfa hay and corn silage were the roughages and soybean meal or urea, the nitrogen sources. There were no differences in steer performance for corn treatments, but steer performance was significantly improved when alfalfa hay rather than corn silage was the roughage. Urea supplements significantly depressed steer performance compared with soybean meal additions; a combination of urea and soybean meal gave intermediate performance.

Introduction

Feeding values for dry and high moisture corn (HMC) in cattle finishing rations are nearly equal but a major advantage of HMC is reduced field losses during harvest. However, changes in roughage or supplemental nitrogen source fed with HMC may affect cattle performance more adversely than with dry corn. Corn silage and urea supplementation have shown conflicting results when fed with HMC, so we compared combinations of urea, corn silage, soybean meal and alfalfa hay. We also compared adding urea to HMC at ensiling with traditional urea additions in the supplement.

Experimential Procedure

One thousand bushels of HMC harvested at 72 to 74% dry matter were stored in two 10 x 50 ft concrete stave silos. Another 4000 bushels were stored in a Harvestore. Stave silo HMC treatments were: 1) no additive (stave) and 2) 42 lb of a urea and water solution (50:50 wt./wt.) per ton of HMC, added prior to ensiling (NPN stave). All corn treatments were of the same variety and from the same field. An additional 1000 bushels of field dried corn was harvested and stored in an aerated bin. Stave silo HMC was coarsely cracked by a roller mill before ensiling. Harvestore HMC was ensiled whole. Harvestore and dry corns were coarsely rolled before feeding.

The three structures were opened after 25 days and complete mixed rations were full-fed for 71 days to 96 yearling Hereford steers (24 pens of four steers per pen). There were two roughage sources, alfalfa hay or corn silage; four nitrogen sources, soybean meal (SBM), urea, combination (urea for the first 21 days; soybean the last 50 days), or stave urea (urea added to the corn prior to stave ensiling); and four corn treatments, dry, Harvestore, stave, and NPN stave. Treatments were combined as shown in Table 17.1.

Corn silage (14 x 60 ft stave silo) was early-dent, 38% dry matter (DM), and yielded 153 bushels of grain per acre. Grain was 47% of the corn silage (DM basis). The alfalfa hay was 88% DM, 16% crude protein (CP) and was tub ground to lengths of 1 to 3 inches.

Net energy for gain (NEg) values assigned to corn, alfalfa, corn silage, and supplements were 66.3, 20.0, 45.7, and 50.0 Mcal per 100 lb, respectively. Fat was added to the supplements to make them isocaloric (Table 17.5) and the rations were formulated to 60.5 Mcal NEgain per 100 lb, 12.0% CP, .60% calcium, .33% phosphorous, and .81% potassium. Crude fiber in the corn silage rations was 6.8%, while the alfalfa rations contained 5.3%. The alfalfa rations were 78.6% corn, 7.6% alfalfa, and 13.8% supplement; the corn silage rations were 69.0% corn, 17.2% corn silage, and 13.8% supplement (DM basis). All cattle were implanted with 36 mg of Ralgro and adjusted to full feed with intermediate energy rations over 21 days. Rumensin was gradually introduced over the first 21 days to a final level of 27.6 grams per ton of ration dry matter (304 mg per steer per day). Steers received 34,900 IU of supplemental vitamin A, 17,600 IU of vitamin D, and 23 IU of vitamin E per head daily, based on 22 lb of dry matter intake.

Urea furnished 28% of the ration CP for the alfalfa rations (treatments 2 and 6) and 34.8% for the corn silage rations (treatments 4 and 8). SBM provided 31% of the ration CP for the alfalfa rations (treatments 1 and 5) and 38.5 % for the corn silage rations (treatments 3 and 7). In treatments 9 and 10, urea was the supplemental nitrogen for the first 21 days; SBM for the last 50 days. Supplemental nitrogen in treatments 11 and 12 was from urea the first 21 days. Both SBM and urea were used the last 51 days. The SBM was added to the protein supplement; the urea came from NPN stave corn.

Ingredient samples were collected weekly and feed consumed was recorded daily. The quantity of complete ration offered was adjusted according to the amount the cattle would consume and feed was always present in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

At the start and again at the end of the feeding trial, all cattle were weighed individually after 16 hr without feed or water on 2 consecutive days and the averages of the two weights were used for initial and final live weights. Intermediate full weights were taken before the AM feeding on days 28 and 56. Final weights for steer performance calculations were derived from hot-carcass weights and a dressing percentage of 62.

Results

Performance of cattle for individual treatments are shown in Table 17.1. Individual treatment results are combined by corn harvest and storage method, roughage source, and supplemental protein source in Tables 17.2, 17.3, and 17.4, respectively.

Corn Harvest and Storage Methods (Table 17.2): There were no differences ($P>.05$) between dry, Harvestore, stave, and NPN stave corn for rate of gain or feed conversion. Daily feed intake was greater ($P<.05$) for rations containing dry corn than NPN stave corn (23.47 vs 21.96 lb).

Roughage sources (Table 17.3): Although steers fed alfalfa gained slightly faster than those fed corn silage (2.68 vs 2.50 lb per day) the difference was not statistically significant. Daily feed intake was greater ($P<.05$) for corn silage rations (23.61 lb) than alfalfa rations (22.15 lb), but feed conversions favored ($P<.05$) the alfalfa hay rations (8.36 vs 9.52).

Supplemental protein sources (Table 17.4): Average daily gain was greater ($P<.05$) when the supplemental nitrogen was SBM (2.93 lb) rather than the urea (2.27 lb) or stave urea (2.52 lb). Daily feed intake was highest ($P<.05$) for SBM. Feed efficiency was similiar for steers fed SBM, the SBM-urea combination, or stave urea; but, steers fed urea in the supplement were least efficient ($P<.05$).

Discussion

A NEg for corn silage of 45.71 Mcal per 100 lb represents 69% of the energy value used for corn grain. If corn is 47% by weight of the DM, then the roughage portion of the corn silage should be 14.5 Mcal NEg per 100 lb. Our cattle performances suggest that 45.7 Mcal per 100 lb overestimates the NEg of corn silage, at least as compared with good quality alfalfa hay. Rations containing 12% CP should contain excess protein for finishing steers that are within 70 days of slaughter. Thus, we were surprised to find SBM superior to urea. Although we have examined a number of alternative explanations, none seem to justify this observation.

Table 17.1. Performances by Steers Fed the HMC, Roughage and Nitrogen Source Treatments

Treatment	No. of pens	No. of steers	Final weight[1]	Initial weight	ADG	Daily intake[2]	Feed/gain[2]
Dry corn:							
1, alfalfa/soybean	2	8	1001	799	2.85^{ab}	21.99^{cd}	7.73^{a}
2, alfalfa/urea	2	8	983	801	2.57^{abc}	21.72^{cd}	8.49^{ab}
3, corn silage/soybean	2	8	1029	809	3.11^{a}	27.70^{a}	8.93^{abc}
4, corn silage/urea	2	8	958	802	2.20^{bc}	22.48^{bcd}	10.83^{c}
Harvestore corn:							
5, alfalfa/soybean	2	8	1015	798	3.07^{a}	24.00^{bc}	7.95^{ab}
6, alfalfa/urea	2	8	958	799	2.24^{bc}	21.01^{d}	9.44^{bc}
7, corn silage/soybean	2	8	993	800	2.72^{abc}	25.26^{ab}	9.29^{bc}
8, corn silage/urea	2	8	948	800	2.09^{c}	21.70^{cd}	10.38^{c}
Stave corn:							
9, alfalfa/combination	2	8	985	800	2.61^{abc}	21.48^{cd}	8.23^{ab}
10, corn silage/combination	2	8	984	801	2.57^{abc}	23.31^{bcd}	9.14^{abc}
11, alfalfa/stave urea	2	8	988	795	2.72^{abc}	22.72^{bcd}	8.34^{ab}
12, corn silage/stave urea	2	8	959	795	2.32^{bc}	21.20^{cd}	9.19^{abc}

[1]Final live weights adjusted to dressing percentage of 62.
[2]100% dry matter basis.

[abcd]Means with different superscripts within columns differ ($P<.05$) as determined by one-way analysis of variance and Duncans mean seperation.

Table 17.2. Performance by Steers Fed the Corn Harvest and Storage Treatments

Item	Dry	Harvestore	Stave	NPN stave
No. of pens	8	8	8	8
No. of steers	32	32	16	16
Final weight, lb[1]	993	978	984	974
Initial weight, lb	802	799	800	795
Avg. daily gain, lb	2.68	2.53	2.59	2.52
Daily intake, lb[2]	23.47[a]	22.99[ab]	22.39[ab]	21.96[b]
Feed/gain[2]	8.84	9.26	8.68	8.76

[1]Final live weights adjusted to dressing percentage of 62.

[2]100% dry matter basis.

[ab]Means with different superscripts within rows differ(P<.05) as determined by one-way analysis of variance and multiple comparison LSD.

Table 17.3. Performance by Steers Fed the Source Treatments

Item	Alfalfa	Corn silage
No. of pens	12	12
No. of steers	48	48
Final weight, lb[1]	988	979
Initial weight, lb	798	801
Avg. daily gain, lb	2.68	2.50
Daily intake, lb[2]	22.15[b]	23.61[a]
Feed/gain, lb[2]	8.36[a]	9.52[b]

[1]Final live weights adjusted to dressing percentage of 62.

[2]100% dry matter basis.

[ab]Means with different superscripts within rows differ (P<.05) as determined by one-way analysis of variance and multiple comparison LSD.

Table 17.4. Performance by Steers Fed the Supplemental Nitrogen Source Treatments

Item	Soybean	Urea	Combination	Stave urea
No. of pens	8	8	4	4
No. of steers	32	32	16	16
Final wt., lb[1]	1010	962	984	974
Initial wt., lb	801	800	800	795
Avg. daily gain, lb	2.93[a]	2.27[b]	2.59[ab]	2.52[b]
Daily intake, lb[2]	24.74[a]	21.73[b]	22.39[b]	21.96[b]
Feed/gain[2]	8.47[a]	9.63[b]	8.68[a]	8.76[a]

[1]Final liveweights adjusted to dressing percentage of 62.
[2]100% dry matter basis.

[ab]Means with different superscripts within rows differ ($P<.05$) as determined by one-way analysis of variance and multiple comparison LSD.

Table 17.5. Supplement Formulations for the HMC Trial

Item	Alfalfa supplements			Corn silage supplements		
	Soybean	Urea	Stave urea	Soybean	Urea	Stave urea
Supplement ID	212	214	216	213	214	217
Fed to treatments[a]	1 and 5	2 and 6	11[b]	3 and 7	4 and 8	12[b]
			.... As fed %	....		
Ground corn	17.0	59.7	63.0	--	53.6	40.0
Soybean meal	61.5	--	15.0	76.0	--	35.0
Urea	--	8.5	--	--	10.5	--
Limestone	8.5	9.0	9.0	9.7	9.3	9.8
Potassium chloride	3.2	5.8	4.8	2.7	5.8	4.1
Salt	3.6	3.6	3.6	3.6	3.6	3.6
Dicalcium phosphate	.25	1.5	1.0	--	1.7	.6
Ammonium sulfate	.45	1.4	1.1	.8	2.0	1.4
Fat	3.0	3.0	--	4.7	11.0	3.0
Premix[c]	2.5	2.5	2.5	2.5	2.5	2.5

[a]Treatments 9 and 10 received the urea supplement (214 and 215, respectively) for days 1-21 and soybean supplement (212 and 213, respectively) for days 22-71.
[b]This is described as the "combination" protein supplementation.
Treatments 11 and 12 received the urea supplement (214 and 215, respectively) for days 1-21 and then stave urea supplements (216 and 217, respectively for days 22-71.