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A high rate of gain can be obtained with growing and finishing cattle fed ear corn adequately supplemented with protein, minerals and vitamins. The cob portion of the ear furnishes more roughage than has been reported to result in optimum gains with minimum problems frequently associated with high-concentrate diets. Other roughages are not indicated with ear corn where high rates of gain are desired.

Ear corn contains less protein than recommended in most diets for growing and finishing cattle. The low protein cob portion may not be an economical source of roughage in comparison to those considerably higher in protein unless there can be an effective and relatively cheap source of supplemental protein. Urea can be an effective source of protein at less cost than most plant sources under proper conditions of use. However, there are limitations in amount for the most effective results which vary with dietary conditions.

There are several advantages for harvesting corn at about 30% grain moisture. This high-moisture grain has been reported to have some advantages over dry grain for growing and finishing cattle. The advantages for the high moisture content over the dry form appears to be greater for ear corn than for shelled corn. Storage conditions for high-moisture grains must be adequate to prevent spoilage. Conditions vary with moisture content and length of time in storage.

The experiment reported here was conducted to study sources and levels of protein supplementation with high-moisture ground ear corn for growing and finishing cattle. Comparisons were also made between an upright concrete stave and an oxygen-limiting (Harvestore) silo as methods for storing the corn.

Procedures

One hundred sixty-eight steers were used in the experiment. They were allotted into 28 pens of 6 each for 14 replicated treatments. Those in 14 pens were fed high-moisture ground ear corn from a concrete stave silo (18 ft. x 50 ft.). The others were fed the ear corn from an oxygen-limiting silo (17 ft. x 50 ft.). Treatments within each silo group were no supplemental protein control, soybean meal to provide supplements with about 27, 32 and 37% protein, and urea at levels to provide the same levels of protein in supplements as with soybean meal.

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Diets consisted of ground ear corn and 3 lb. of supplement. Ingredient compositions of the supplements were as shown in table 1.

The ear corn was harvested from the same field for the two silos. The oxygen-limiting silo was filled first and the average moisture was 33.13%. The concrete stave was filled immediately thereafter, and the average moisture content was 30.17%. Average protein content of samples at harvest was 9.0% on a moisture-free basis (approximately 8% air-dry).

The cattle were full-fed ground ear corn with 3 lb. of the supplements top-dressed on the corn. Feeding was once daily with the high-moisture ear corn fed in amounts to be nearly consumed by the next feeding.

All pens of cattle were fed the ground ear corn without supplement for a period of 4 weeks. They were allotted into concrete stave or oxygen-limiting silo groups. After this preliminary period, they were reallotted on basis of weight within silo groups for the various levels and sources of supplemental protein.

The ear corn stored in the oxygen-limiting silo was fed up after 113 days following the preliminary period. The cattle were weighed without shrink at this time and the data summarized to this point.

Results

Oxygen-Limiting Silo

Results of the experiment with the oxygen-limiting silo are presented in table 2.

Samples of the corn were taken once each week during the course of the experiment. The average moisture content determined by a forced-draft oven was 31.54%. This was the approximate moisture (33.13%) as stored determined by the same method.

The control diet without supplemental protein was approximately 8.0% protein on an air-dry basis. Those with the first level of supplemental protein were approximately 10.5%. Subsequent increases in supplement added about 0.7 percentage units of protein to the air-dry diets.

Rates of gain shown were high during the 113 days of the experiment. The weights were without shrink for both initial and final ones. Rates of gain would be expected to be reduced as the cattle were fed to heavier weights and a higher finish than those at termination of this phase of the experiment.

Rate of gain was at a high rate (3.04 lb. daily) for the cattle fed ground ear corn without supplemental protein. However, there was a substantial increase when fed supplemental protein from either soybean meal or urea. There appeared to be no advantage from levels more than furnished by 3 lb. of the supplement with about 27% protein (approximately 10.5% in the air-dry diet).

Rates of gain remained relatively constant with each increase in amount of protein with soybean meal. When urea was used, the highest rate of gain was obtained with the lowest addition of supplemental protein. In this instance, rate of gain

was higher than for soybean meal (0.24 lb. daily). Higher levels of protein from urea resulted in lower rates of gain.

Feed intake was improved by supplementing ground ear corn with additional protein. However, there appeared to be little effect of level or source of supplemental protein.

The lower feed intake by the steers fed no supplemental protein resulted in only slightly higher feed requirements in comparison to those fed soybean meal. Steers fed diets with urea and about 10.5% protein and making the fastest rate of gain had the lowest feed requirements. Higher levels of urea which resulted in lower weight gain also resulted in higher feed requirements.

Concrete Stave Silo

Results obtained with the ear corn stored in the concrete stave silo are presented in table 3. Average moisture content of samples taken once each week during the experiment was 21.88%. This represents a decrease of 8.29 percentage units from the moisture content when stored. The feeding rate averaged approximately 4 inches daily. The material as removed was noticeably drier than that from the oxygen-limiting silo. It appeared to be little different from dry ground ear corn, while that from the oxygen-limiting silo had a moist appearance and a slight odor of fermented feed.

Rate of gain for steers fed the ear corn from the concrete stave silo without additional protein supplementation was at a slightly higher rate (0.11 lb. daily) than for those fed the comparable diet from the oxygen-limiting silo. During the 4-week preliminary period when all the cattle were fed ear corn without protein supplementation, those fed from the concrete stave silo also gained at a faster rate (0.31 lb. daily). Gains were at a low rate during the preliminary period which may have had a bearing on the rather high rates of gain obtained during the 113-day experiment.

When the ear corn was supplemented with soybean meal, there was a substantial improvement in rate of gain in two of the three treatments. Except for one treatment being slightly lower, weight gain was quite similar for ear corn from the two silos. Feed intake by steers fed from the oxygen-limiting silo was slightly lower with some lower feed requirements on an air-dry basis as determined by a forced-draft oven. Some research has indicated that this method may have biased feed data in favor of the more moist feed from the oxygen-limiting silo.

Steers fed the ear corn supplemented with urea gained at a lower rate than those fed comparable diets with soybean meal. Rates of gain decreased with increasing levels of urea as encountered with the oxygen-limiting silo.

Feed consumption on an air-dry basis was higher for steers fed the diets supplemented with soybean meal. However, there were only small differences in feed efficiency but in favor of the soybean meal supplement.

Summary and Comments

Steers were fed ground ear corn stored at about 30 to 33% moisture in a concrete stave or an oxygen-limiting silo. Moisture content as fed determined by a forced-draft oven was about that as stored for the oxygen-limiting silo but was 8.29 percentage units less for the concrete stave silo. Feeding rate averaged about 4 inches daily.

Results indicated a need for protein supplementation with the rates of gain obtained in the 113-day experiment. However, there appeared to be no advantage for more than the lowest level used giving diets with about 10.5% protein on an air-dry basis.

Increasing levels of protein with soybean meal resulted in rather consistent rates of gain with only small differences between the two silos.

Increasing levels of protein from urea resulted in decreasing rates of gain with ear corn from either silo. Levels of urea in the supplements provided about 1.0, 1.3 and 1.6% urea in the air-dry diets. Amounts of urea with the two higher levels of protein are in excess of commonly recommended maximum levels (1% of total air-dry diet). The two higher levels also exceed the amount of urea supplementation that can be utilized efficiently with these ear corn diets calculated from the urea fermentation potential (UFP) as proposed by Iowa researchers.

Steers fed ear corn without supplemental protein gained at a slightly higher rate when fed from the concrete stave silo. Similar performance was obtained from steers fed from each silo when soybean meal was the supplemental protein. With the urea supplement, steers fed from the oxygen-limiting silo showed an advantage in weight gain and in feed efficiency over those fed from the concrete stave silo in all comparisons. The highest rate of gain with the lowest feed requirements resulted with ear corn from the oxygen-limiting silo and the urea supplement to give a diet with about 10.5% protein.

The results indicate that urea had its greatest value when fed with ear corn from the oxygen-limiting silo where the feed had more moisture and characteristics of an ensiled grain. Urea may have contributed to a more favorable rumen environment under these conditions as well as being an efficient source of protein in comparison to soybean meal when fed at proper levels.

Table 1. Ingredient Composition of Supplements

Ingredient	Control	Soybean Meal Supplement			Urea Supplement		
		Approximate protein level in total diet (% air-dry)					
		10.5	11.2	11.9	10.5	11.2	11.9
	%	%	%	%	%	%	%
Corn	88.55	35.65	22.10	8.30	77.75	76.55	74.25
Soybean meal (44%)	--	55.00	68.55	82.35	--	--	--
Urea (45% N)	--	--	--	--	7.70	9.00	11.00
TM salt	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	6.70	6.00	6.00	6.00	6.00	5.50	5.40
Dicalcium phosphate	1.40	--	--	--	1.40	1.40	1.40
Calcium sulfate[a]	--	--	--	--	2.00	2.40	2.80
Potassium chloride	--	--	--	--	1.80	1.80	1.80
Aureomycin-10[b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin A premix[c]	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Vitamin E premix[d]	0.03	0.03	0.03	0.03	0.03	0.03	0.03

[a]To furnish 1 part sulfur to 10 parts nitrogen from urea.
[b]75 mg. daily of chlortetracycline.
[c]10,000 I.U. vitamin A per pound of supplement.
[d]30 I.U. vitamin E per pound of supplement.

Table 2. Levels and Sources of Protein With High-Moisture Ear Corn Stored in Oxygen-Limiting Silo (April 16 to Aug. 7, 1973--113 days)

	Approximate protein level, %						
	8.0	10.5	11.2	11.9	10.5	11.2	11.9
Supplemental protein	None	Soybean			Urea		
No. animals	12	12	12	12	12	12	12
Avg. init. filled wt., lb.	570	566	567	565	567	566	569
Avg. final filled wt., lb.	913	944	954	946	973	956	936
Avg. daily gain, lb.	3.04	3.35	3.43	3.37	3.59	3.45	3.25
Avg. daily ration, lb.							
Ground ear corn							
As fed	21.82	24.18	24.06	23.86	24.38	24.56	24.17
Air dry	16.60	18.40	18.30	18.15	18.54	18.68	18.39
Suppl.	2.79	2.79	2.79	2.79	2.79	2.79	2.79
Total air dry	19.39	21.19	21.09	20.94	21.33	21.47	21.18
Feed/100 lb. gain, lb.							
Ground ear corn							
As fed	721	722	702	709	680	713	745
Air dry	549	549	534	539	517	542	566
Suppl.	92	83	82	83	78	81	86
Total air dry	641	632	616	622	595	623	652

Table 3. Levels and Sources of Protein With High-Moisture Ear Corn Stored in Concrete Stave Silo (April 16 to Aug. 7, 1973--113 days)

	Approximate protein level, %						
	8.0	10.5	11.2	11.9	10.5	11.2	11.9
Supplemental protein	None	Soybean			Urea		
No. animals	12	12	12	12	12	12	12
Avg. init. filled wt., lb.	589	586	591	583	576	580	581
Avg. final filled wt., lb.	945	966	951	969	938	932	924
Avg. daily gain, lb.	3.15	3.36	3.19	3.42	3.20	3.12	3.04
Avg. daily ration, lb.							
Ground ear corn							
As fed	21.08	23.13	21.54	22.38	20.82	21.32	20.19
Air dry	18.30	20.08	18.70	19.43	18.07	18.51	17.53
Suppl.	2.79	2.80	2.79	2.79	2.79	2.79	2.79
Total air dry	21.09	22.88	21.49	22.22	20.86	21.30	20.32
Feed/100 lb. gain, lb.							
Ground ear corn							
As fed	670	699	676	655	652	685	667
Air dry	582	598	587	568	566	595	578
Suppl.	89	85	88	82	87	90	92
Total air dry	671	683	675	650	653	685	670