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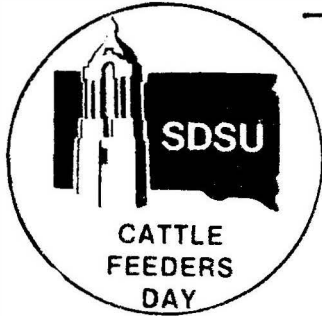
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SOURCES OF SUPPLEMENTAL PROTEIN WITH CORN SILAGE FOR GROWING CATTLE

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Summary

One hundred ninety-two Hereford, Angus and Hereford-Angus steer calves averaging 520 lb initially were fed for 105 days. Corn silage was supplemented with various sources of protein which differed in amino acid profile and protein solubility.

Diets consisted of 90% corn silage and 10% supplement on a dry basis. Corn silage (34% DM) was stored in two tower silos. Silage in one served as a control and forage in the other was treated with a microbial silage additive. Twenty-four pens with 8 steers each were used for six dietary treatments (four replications). Corn silage treatments were balanced according to protein treatment groups. Dietary supplements were control, urea, soybean meal, heat-treated soybean meal-whole soybeans (SBM-SB), urea-dehydrated alfalfa meal and soybean meal-dehydrated alfalfa meal and provided protein levels of 9.19, 11.64, 11.22, 11.29, 11.20 and 11.23%, respectively, in the dry diets.

Results showed that average daily gain increased with increasing weight and time on experiment. Faster rates of gain ($P < .01$) were obtained by steers fed protein-supplemented diets as compared to the control group. No differences in weight gain were observed between protein-supplemented steers at 105 days. However, urea-fed steers showed lower rates of gain than the other protein-supplemented groups during the first 26 days (1.77 vs 1.92 lb). Higher ($P < .05$) amounts of feed were consumed by steers fed supplemental sources of protein as compared to the control group with no differences ($P < .05$) between protein sources.

Steers fed protein supplements had lower ($P < .05$) feed requirements than controls. Among protein-supplemented calves, those fed soybean meal or heat-treated SBM-SB supplements had lower feed requirements than steers fed supplements which contained urea. No differences ($P > .05$) in feed efficiency were observed between the other protein-supplemented groups.

Introduction

Previous research studies at this station compared the effects of conventional soybean meal, special heat-treated soybean meal or urea in supplements for finishing cattle fed ground ear corn. These supplements represent variations in protein solubility and amino acid composition. The objective of the

studies was to determine effects of these characteristics on performance of cattle fed corn grain and low protein roughage (cob portion of the ear corn) finishing diets. Results showed a good response to protein supplementation in terms of feedlot performance with essentially no differences between supplements.

Research studies reported in the literature have explained some of the principles of protein utilization in the ruminant as affected by amino acid profile (protein quality) and protein solubility. Some studies have indicated that feed protein reaching the lower gut has an effect on nitrogen metabolism of the ruminant, that availability of amino acids for absorption is influenced by solubility characteristics of dietary protein, and that some amino acids can be limiting in microbial protein. Other studies with protein sources varying in protein solubility have suggested that the value of protein which escapes degradation in the rumen may lie in the ability to complement amino acid composition of microbial proteins.

In this experiment lighter weight cattle were used than in the first study. Corn silage was supplemented with various sources of protein which differed in amino acid composition, protein solubility and (or) degradability in rumen fluid. The objective was to determine effect on performance of these protein sources as supplements to corn silage for growing cattle.

Procedures

One hundred ninety-two Hereford, Angus and Hereford-Angus steer calves averaging about 520 lb were used in the experiment. They were selected from a larger group purchased at a local livestock auction about 6 wk (preliminary period) prior to beginning of the experiment. Upon arrival the steers were fed a mixture of low-quality grass and alfalfa hay at about 12 lb per head daily. Whole corn grain was started at 2 lb per head daily and increased by 1 lb daily to 5 lb. Alfalfa-brome grass haylage (65% DM) replaced the hay after 1 wk at a level to supply a similar amount of dry feed as hay. A corn supplement with dicalcium phosphate, trace mineral salt, Aureo-S 700 (chlortetracycline and sulmet) and vitamin A was fed at 1 lb per head daily during the first 4 wk of the preliminary period.

Two weeks prior to the beginning of the experiment, the alfalfa-brome haylage, whole corn grain and supplement were replaced with a full feed of corn silage (34% DM) without supplemental protein. This practice was carried out to adapt the cattle to the corn silage basal diet prior to starting the experiment. To accomplish this, each animal received an average of 15 lb of corn silage and then feed increased gradually to about 35 lb on an as fed basis. During the 2-wk period, the cattle had access to dicalcium phosphate and trace mineral salt on a free-choice basis.

During the preliminary phase, the steers were processed and procedures included placement of an ear tag in each ear, implantation with 36 mg of zeranol (Ralgro), application of Warbex (pour-on) for parasite control, vaccination against Bovine Virus Diarrhea (BVD) and Bovine Rhinotracheitis (IBR), and injection of Clostridium-chauvoei-septicum-novyi-sordelli bacterin.

The initial weight was a shrunk weight obtained after an overnight stand of about 18 hr without water or feed. The steers were then allotted into 24 pens on basis of weight and breed group with six Hereford and two Hereford-Angus or Angus per pen. Dietary treatments were replicated four times and consisted of a diet containing 90% corn silage and 10% supplement on a dry basis. Supplements used during this experiment included:

1. Control supplement
2. Urea supplement
3. Soybean meal supplement
4. Heat-treated soybean meal-whole soybean supplement
5. Urea-dehydrated alfalfa meal supplement
6. Soybean meal-dehydrated alfalfa meal supplement

Ingredient composition of supplements is shown in table 1. The control supplement without a high protein ingredient served as a measure of response to the various sources of supplemental protein.

The urea supplement was formulated to supply similar levels of protein as did the other protein-supplemented diets with .84% of urea on a dry basis. This supplement was used to test effects on animal performance of a protein source devoid of amino acids and totally solubilized in rumen fluid.

The soybean meal supplement consisted of soybean meal flakes (50% crude protein on a dry basis) processed under conventional procedures by Triple "F" Feeds, Des Moines, IA. It considered a high quality protein as measured by amino acid composition but readily degraded in the rumen.

The heat-treated soybean meal-whole soybean product (manufactured by the same company) consisted of a mixture of 40% whole soybeans and 60% solvent processed soybean meal (44%). It will be referred to as heat-treated SBM-SB in this report. The blend was dry extruded and heat-treated at 320 F under pressure by the Instapro method. The processing was expected to reduce rate of ruminal degradation in comparison to soybean meal. This blend contained 6% ether extract and 7% crude fiber.

In the urea-dehydrated alfalfa meal supplement, each protein source provided similar levels of protein on a dry basis. Dehydrated alfalfa meal is considered to be solubilized

larger amounts of protein from alfalfa meal escaping rumen degradation. In combination with urea, alfalfa protein has been reported to improve utilization of total dietary nitrogen.

The soybean-meal dehydrated alfalfa meal supplement was formulated to determine benefits of alfalfa meal proteins combined with soybean meal. Each was used to measure the effect of combining ingredients of varying solubility as ways of improving protein utilization when fed as supplements to low protein diets for growing cattle.

The corn silage from the 1981 crop was stored in two tower silos, forage from one served as the control and the other silage treated with a microbial silage additive. Data for silage treatment are presented separately in this bulletin. Protein supplement treatments were balanced as to silage treatments.

Protein contents on a dry basis for control, urea, soybean meal, heat-treated SBOM-SB, urea-dehydrated alfalfa meal and soybean meal-dehydrated alfalfa meal diets were 9.19, 11.64, 11.22, 11.29, 11.20 and 11.23%, respectively (table 1).

Upon initiation of the experiment, supplements were fed for the first time on day one. Total feed (corn silage plus supplement) offered at this time was about 9 lb (dry) per animal and was increased gradually to a full feed of about 13 lb (dry) per head in about 9 to 11 days. Feed offered daily on an as fed basis was determined by examining the feed bunk for each pen and then referring to a feed record book for amounts fed on previous days. Distribution between corn silage and supplement on an as fed basis was determined by using a prepared schedule. Rate of feeding was regulated to amounts that would be nearly consumed by the next feeding. Diets were batch mixed according to the feeding schedule for each pen and fed once daily.

Prior to each weigh period during this experiment, the steers were left for an overnight stand of about 18 hr without water or feed. The experiment was terminated after 105 days when the steers averaged about 770 lb. Data accumulated by weigh periods and over the 105-day experiment for average daily gain, average feed intake and average feed efficiency were analyzed statistically using least squares procedures.

Results

There was no significant statistical interaction between silage treatments and sources of supplemental protein. Feedlot performance data are therefore presented as averages for silage storage treatments.

Weight Gain

Weight gain data accumulated at periodic intervals are presented in table 2. Average daily gain increased with increasing time and weight during the experiment. Steers fed each

source of supplemental protein with corn silage gained at faster rates than controls without supplemental protein. A good response to supplemental protein was obtained at all weigh periods during the experiment. At 105 days, the advantage over controls in average gain per head for protein-supplemented cattle ranged from 63 to 72 lb.

At the first weigh day after 26 days, steers fed the urea supplement had made the lowest daily gain and those fed heat-treated SBM-SB supplement the highest. Steers fed other supplements were intermediate between these two treatment groups with only small differences between supplemental sources of protein.

Differences in average daily gain between supplemental sources became less at subsequent weigh periods of the experiment. However, a small advantage for the heat-treated SBM-SB in pounds of gain over the urea treatment at the first weigh period was still evident upon termination of the experiment at 105 days. Combining dehydrated alfalfa meal with urea in the supplement appeared to offer no improvement over urea as the supplemental protein with corn silage.

Weight gains for steers fed soybean meal supplement were only slightly different from gains of steers fed heat-treated SBM-SB supplement throughout the experiment. Replacement of one-half of the supplemental protein from soybean meal with dehydrated alfalfa did not appear to affect performance at any stage of the experiment.

Statistical analysis of weight gain data over the 105-day experiment showed that protein-supplemented calves gained faster ($P < .01$) than unsupplemented calves with essentially no differences ($P > .05$) between sources of supplemental protein.

Feed Consumption

Accumulated average daily feed at periodic intervals during the experiment is shown in table 3. Steers fed supplemental protein with corn silage consumed more ($P < .05$) feed than nonsupplemented controls. Type of protein supplement did not appear to affect feed intake ($P > .05$).

Feed Efficiency

Feed efficiency data are shown in table 4. Feed requirements show efficient utilization of the 90% corn silage and 10% supplement (dry basis) diets. Improvement over nonsupplemented control ranged from 12 to 17% ($P < .05$).

There were only small differences in feed efficiency between protein supplement treatments. However, steers fed soybean meal or heat-treated SBM-SB supplements were slightly more efficient than those fed supplements with urea.

TABLE 1. INGREDIENT COMPOSITION OF DIETS FED DURING THE EXPERIMENT^a

Ingredients	Control	Urea	Soybean meal	Heat-treated SBM-SB ^b	Urea-dehydrated alfalfa	Soybean meal-dehydrated alfalfa
-----% of dry matter-----						
Corn silage	90	90	90	90	90	90
Supplement						
Ground corn grain	8.60	7.66	5.80	1.03	--	--
Soybean meal (50%)	--	--	2.87	--	--	4.50
Urea	--	.84	--	--	.49	--
Heat-treated SBM-SB (40%)	--	--	--	7.73	--	--
Dehydrated alfalfa meal	--	--	--	--	8.22	4.36
Limestone	.22	.09	.20	.26	--	.07
Dicalcium phosphate	.68	.68	.63	.48	.68	.57
Calcium sulfate	--	.23	--	--	.11	--
Trace mineral salt	.50	.50	.50	.50	.50	.50
Avg protein content as analyzed (dry)	9.19	11.64	11.22	11.29	11.20	11.23

^a Each diet contained 1,000 IU vitamin A, 15 mg of rumensin and 4 mg of tylan per pound.

^b SBM-SB was 60% soybean meal and 40% whole soybeans.

TABLE 2. CUMULATIVE AVERAGE DAILY GAIN BY WEIGH PERIODS AS AFFECTED BY DIETARY TREATMENTS

Item	Control	Urea	Soybean meal	Heat-treated SBM-SB ^a	Urea-dehydrated alfalfa	Soybean meal-dehydrated alfalfa
No of calves	32	32	32	32	32	32
Initial shrunk wt, lb	522	520	522	522	521	520
Final shrunk wt, lb	705	767	775	778	768	774
Avg daily gain, lb						
26 days	1.40	1.77	1.86	1.99	1.90	1.91
54 days	1.41	2.04	2.10	2.18	2.08	2.16
82 days	1.58 ^b	2.23 ^c	2.34 ^c	2.35 ^c	2.27 ^c	2.32 ^c
105 days	1.75 ^b	2.35 ^c	2.41 ^c	2.44 ^c	2.35 ^c	2.41 ^c

^a SBM-SB was 60% soybean meal and 40% whole soybeans.

^{bc} Means with unlike superscripts differ (P<.01).

TABLE 3. CUMULATIVE AVERAGE FEED INTAKE BY WEIGH PERIODS AS AFFECTED BY DIETARY TREATMENTS

Item	Control	Urea	Soybean meal	Heat-treated SBM-SB ^a	Urea-dehydrated alfalfa	Soybean meal-dehydrated alfalfa
b						
Avg feed intake, lb						
26 days	11.13	12.18	12.28	12.49	13.05	12.74
54 days	11.83	13.40	13.20	13.44	13.71	13.54
82 days	12.29	13.95 ^d	13.99 ^d	14.17	14.41	14.19 ^d
105 days	12.69 ^c	14.45 ^d	14.54 ^d	14.65 ^d	14.92 ^d	14.76 ^d

a SBM-SB was 60% soybean meal and 40% whole soybeans.

b Feed values shown in this table are on a dry basis.

cd Means followed by unlike superscripts differ (P<.05).

TABLE 4. CUMULATIVE AVERAGE FEED EFFICIENCY BY WEIGH PERIODS AS AFFECTED BY DIETARY TREATMENTS

Item	Control	Urea	Soybean meal	Heat-treated SBM-SB ^a	Urea-dehydrated alfalfa	Soybean meal-dehydrated alfalfa
b						
Avg feed/gain ratio						
26 days	795	688	660	628	687	667
54 days	839	657	629	617	659	627
82 days	778	626 ^{dc}	598 ^d	603 ^d	635 ^e	612 ^{de}
105 days	725 ^c	615 ^{dc}	603 ^d	600 ^d	635 ^e	612 ^{de}

a
SBM-SB was 60% soybean meal and 40% whole soybeans.

b
Feed values used were on a dry basis.

cde
Means with unlike superscripts differ (P<.05).