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Casey Wilson
University of Nebraska-Lincoln

Galen E. Erickson
University of Nebraska-Lincoln, gerickson4@unl.edu

Ryan Mass
University of Nebraska-Lincoln

Terry J. Klopfenstein
University of Nebraska-Lincoln, tklopfenstein1@unl.edu

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Terry Klopfenstein[1]

High-ash pork meat and bone meal is a viable escape protein source for growing cattle. Non-enzymatic browning increased escape values but did not improve growth performance.

Summary

Individually fed steer calves (n=90) were used to evaluate different rendering procedures of pork meat and bone meal on protein quality as compared to soybean meal. Treatment proteins included an urea control, soybean meal, high-ash pork meat and bone meal, pork meat and bone meal control and non-enzymatically browned (NEB) pork meat and bone meal. High-ash meat and bone meal protein efficiency was higher than other treatments. However, the escape values determined by the ammonia release procedure were higher for NEB meat and bone meal, suggesting efficiency should have been improved relative to the control and high-ash meat and bone meal.

Introduction

To optimize production, growing calves are often supplemented with undegradable intake protein (UIP) to

meet their metabolizable protein requirements. Meat and bone meal (MBM) is a rendered animal byproduct often used as a source of UIP. Different rendering procedures can have varying effects on the composition of MBM. Non-enzymatic browning is one method used to increase the UIP content in some products.

The non-enzymatic browning (NEB) of soybean meal with xylose-containing sulfite liquor has been shown to increase the UIP value from 30 to 75 percent (as percent of CP). Non-enzymatic browning of meat and bone meal with xylose-containing sulfite liquor has also been shown to increase the UIP from 51.9 to 66.0 percent (Nebraska Beef Report 1996 pp. 29-31).

Although soybean meal (SBM) is a commonly used source of protein for growing cattle, it has a lower UIP value than MBM. Using supplements with increased UIP protein values has previously been shown to increase gains in growing cattle.

The objectives of this research were to evaluate how different rendering procedures of pork meat and bone meal affected protein quality, as compared to soybean meal, for growing calves. We also investigated the effect of NEB and rendering time on the UIP concentration of pork bone and pork digestive tract.

Procedure

A laboratory trial was conducted to investigate the effect of xylose-containing sulfite liquor addition and rendering time on the UIP concentration of pork bone and pork digestive tract. The tissues were ground and placed in aluminum pans. Treatments were applied utilizing three rendering times at 250°F (60, 90 and 120 minutes) and four levels of sulfite liquor (0, 1.5, 2 and 2.5 percent of DM). Sulfite liquor contained approximately 30 percent xylose (DM basis). Tissues were dried at 140°F for 48 hours and the fat was extracted using petroleum ether. The tissues were then ground through a 1-mm screen using a Wiley mill. Analysis of UIP was conducted using the *in vitro* ammonia release procedure. Rumen fluid was collected from a ruminally fistulated steer and strained through four layers of cheese cloth. A bicarbonate buffer solution was added to the rumen fluid and 30 mL of the fluid mixture was added to test tubes containing enough sample to provide 20 mg of CP. Six tubes were incubated for each sample. Tubes were stoppered and incubated; three for 18 hours and three for 24 hours, at 102°F. The ammonia concentration of each tube's fluid was used to calculate UIP relative to standards measured *in vivo*.

A calf growth trial was conducted using 90 steer calves (534 lb) individually fed diets (DM basis) of 44 percent sorghum silage, 44 percent corncobs and 12 percent supplement (Table 1). The steers were assigned randomly to treatment and level of treatment protein. Treatments consisted of: 1) urea (control); 2) SBM; 3) high-ash MBM; 4) MBM control and 5) NEB-MBM. Protein sources were fed at 30, 40, 50 and 60 percent of the supplemental nitrogen with urea supplying the remainder. Regardless of the assigned level, all steers consumed a diet containing 11.5 percent CP (DM basis). Rumen protected methionine was included by feeding 3 grams/day of Smartamine M™ (Rhone-Poulenc Animal Nutrition, Atlanta, GA) with each supplement.

All steers were implanted with Synovex-S on day one. The steers were individually fed (at an equal percentage of body weight) once daily using Calan electronic gates. Weights were collected before feeding on three consecutive days at the beginning and end of the 84-day trial. Protein efficiency, calculated as gain above the urea control versus natural protein intake, was plotted for each treatment using the slope-ratio technique.

Table 1. Supplement composition (percent DM basis).

	Supplement				
Ingredient	Urea	SBM	High-ash MBM	MBM control	NEB-MBM
Soybean meal	—	82.6	—	—	—
High-ash MBM	—	—	66.7	—	—
MBM control	—	—	—	55.0	—
Treated MBM	—	—	—	—	55.0
Urea	15.7	—	—	—	—
Soybean hulls	70.1	—	19.6	31.3	31.3
Limestone	—	.4	—	—	—
Dicalcium phosphate	7.6	5.5	—	—	—
Salt	2.5	2.5	2.5	2.5	2.5
Tallow	1.7	1.7	1.7	1.7	1.7
Ammonium sulfate	1.7	1.7	1.7	1.7	1.7
Trace mineral premix	.4	.4	.4	.4	.4
Selenium premix	.1	.1	.1	.1	.1
Vitamin premix	.3	.3	.3	.3	.3
Smartamine M[a]	—	.7	.7	.7	.7

[a]Smartamine M provided 3 g per head of rumen protected methionine.

Results

Laboratory experiment

Extending rendering time from 60 to 120 minutes had no effect (P>.05) on the UIP value of either pork bones or pork digestive tracts. Increasing the level of xylose liquor created a linear increase in the UIP value of both pork tissues compared to the controls (P<.01). The controls were initially different with pork bone and pork digestive tract UIP values of 63.5 and 37.3 percent, respectively. High-ash MBM is higher in UIP relative to control MBM which may be due to greater concentration of bone (ash) tissue in high-ash MBM.

The UIP values of both tissues tended (quadratic, P=.09) to be optimized at 2 percent added xylose liquor treatment level with pork bone and pork digestive tract UIP values of 74.8 and 42.9 percent, respectively. There was also a pork tissue by sulfite liquor interaction (P<.01). The final results show adding sulfite liquor increased the UIP protein value of pork bone more than pork digestive tract (Table 2).

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Table 2. Non-enzymatic browning effects on UIP values determined by *in vitro* ammonia release.

Tissue type	Added yxlose liquor (percent of DM)	Percent UIP (percent of CP)
Pork digestive tract	0.0	37.3
	1.5	40.3
	2.0	42.9
	2.5	44.3
Pork bone	0.0	63.5
	1.5	70.0
	2.0	74.8
	2.5	78.5

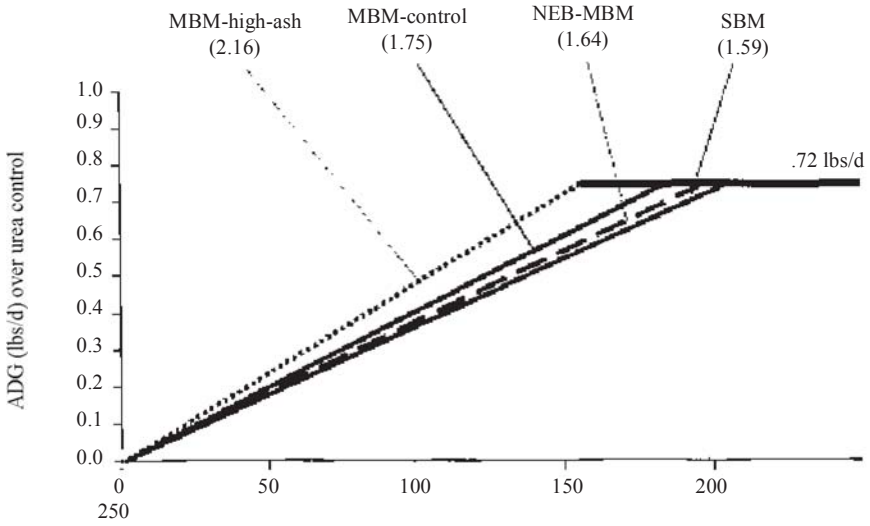

Figure 1. Protein efficiency diagram for gain above the urea control for the treatment protein sources with the protein efficiency values in parentheses.

Growth trial

The urea control steers gained .63 lb/day, while maximum gain due to protein supplementation, as determined by non-linear regression, was .72 lb/day above the urea controls. The increase in gain and protein efficiency was due to the additional metabolizable protein supplied by the MBM supplements as UIP. Steers receiving the SBM treatment had numerically lower gain and protein efficiency than the MBM treatments. Efficiency of protein utilization was greatest (P<.10) for steers fed the high-ash MBM over all treatments including NEB-MBM (2.16 versus 1.64, respectively; Figure 1). These data would also suggest the treatment of MBM by non-enzymatic browning was ineffective in increasing the MP supply to the animal. Using the ammonia release procedure, the treated MBM showed an increased UIP value over the high-ash MBM, 76.5 percent versus 68.4 percent respectively.

Treated MBM has been shown to provide an increase in gains over untreated MBM (1996 Nebraska Beef Report, pp. 29-31). This did not seem to be the case in this trial, with both treated and untreated MBM having similar gain and protein efficiency. It is possible the additional processing of the treated MBM had some effect on digestibility, masking any improvement observed in UIP content.

Results of this research indicate feeding high-ash pork MBM is a feasible means of increasing UIP protein values and protein efficiency in growing calves. The increased concentration of UIP with high-ash MBM is probably due to the bone tissue, as the laboratory experiment illustrated a significant difference between the bone and digestive tract protein. It also suggests treating MBM with xylose liquor was ineffective in increasing the gain and protein efficiency of growing calves. The UIP values determined with the ammonia release procedure indicates treated MBM should have promoted better performance and protein efficiency. Further study may be needed to determine the cause of the change in gains and protein efficiency with NEB-MBM, in particular the effect of non-enzymatic browning of pork MBM on lower tract digestibility.

[1]Casey Wilson and Galen Erickson, graduate students; Ryan Mass, laboratory technician; Terry Klopfenstein, professor, Animal Science, Lincoln.