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Undegradable Intake Protein Content of Corn Steep Compared to Soybean Meal

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Undegradable intake protein content of corn steep is approximately 30% of crude protein.

Summary

Thirty calves were used in an 84-day growth trial to evaluate protein efficiency of corn steep compared to soybean meal. Calves were individually fed a base diet supplemented with either 1) urea, 2) soybean meal, or 3) corn steep. Soybean meal and corn steep were fed at graded levels replacing urea. In vitro ammonia release analyses showed the protein in both corn steep and soybean meal to be approximately 30% undegradable in the rumen. Calves fed corn steep had similar protein efficiency to calves fed soybean meal, supporting the in vitro data.

Introduction

Corn steep, a byproduct of wet corn milling, is a combination of corn steep liquor and distillers solubles. Corn steep liquor is concentrated solubles from the steeping process, containing soluble protein, vitamins, minerals, and lactic acid. Distillers solubles contain sugar and yeast cells remaining after the distilling process.

Corn steep is added to beef cattle diets to supply both protein and energy. Corn steep is also added to corn bran to form wet corn gluten feed. Corn steep and wet corn gluten feed have been shown to improve performance in dry-rolled corn finishing diets (1997 Nebraska Beef Report, pp. 70-74). Degradable intake protein (DIP), or natural protein degraded in the rumen, has been implicated in the improved performance.

Corn steep has not been associated with having significant undegradable intake protein (UIP), due to the solubility of protein in steep liquor. However, the distillers solubles contain heated yeast cells. Heat processing has been demonstrated to reduce the solubility of protein. Feeding heated brewer's yeast to calves has produced lower rumen ammonia concentrations than feeding live brewer's yeast, indicating protein in the heated yeast was degraded to a lesser extent in the rumen. In vitro ammonia release data indicated protein in distillers solubles was 80.6% undegradable and protein in steep liquor protein was 13.2 % undegradable. This would make a typical corn steep product (36% CP, DM basis) have a UIP value of 33% of CP.

The UIP content of corn steep, as measured in the laboratory, has not been validated in a cattle feeding experiment. The hypothesis is that corn steep protein is degraded to a similar extent as soybean meal protein (30% UIP). The objective of this experiment was to compare the UIP value of corn steep to soybean meal in growing calf diets.

Table 1. Composition of supplements fed to growing calves (percentage of DM)[a].

Ingredient	Urea Control	SBM[b]	Steep[c]
Bran	82.8	35.8	—
Soybean meal	—	55.7	—
Corn Steep	—	—	88.9
Urea	7.6	—	1.6
Dicalcium Phosphate	4.0	2.2	—
Limestone	3.2	4.3	7.6
Salt	1.5	1.5	1.5
Ammonium sulfate	0.4	—	—
Trace Mineral Premix	0.3	0.3	0.3
Vitamin Premix	0.2	0.2	0.2
Selenium Premix	0.1	0.1	0.1

[a]Supplement included in diet at 20% of DM.
[b]Soybean meal supplement replacing urea control at 25, 50, 75 and 100% of supplement DM.
[c]Corn steep supplement replacing urea control at 25, 50, 75 and 100% of supplement DM.

Procedure

Thirty calves (476 $\pm$ 57 lb) were stratified by sex and randomly allotted to treatment and level within treatment. Three treatments were: 1) supplement to supply the degradable intake protein requirement with urea and corn bran (n = 6, urea control); 2) soybean meal replacing urea and bran in the supplement at 25, 50, 75, or 100% of the supplemental CP (n = 3 per level, SBM); and 3) corn steep replacing urea and bran in the supplement at 25, 50, 75, or 100% of the supplemental CP (n = 3 per level, Steep). Diets were 40% sorghum silage, 20% corncobs, 20% dry corn bran, and 20% supplement (DM basis; Table 1). Diets were formulated to contain a minimum of 11.5% CP. All calves were fed to the same percentage of body weight, with the feeding level starting at

(Continued on next page)

2.0% of body weight and increasing to 2.6% over the course of the experiment. Diets were individually fed with a Calan Gate system for 84 days. Three day weights were taken at the initiation and completion of the trial. Calves were implanted with Ralgro at the beginning of the experiment.

Protein efficiency, calculated as gain above the urea control over natural protein intake above the urea control, was calculated for SBM and Steep using the slope ratio technique. Non-linear regression was used to determine the slope (protein efficiency) of the response lines before maximum gains were achieved. Slopes were compared with a Modified T-Test for unequal variances.

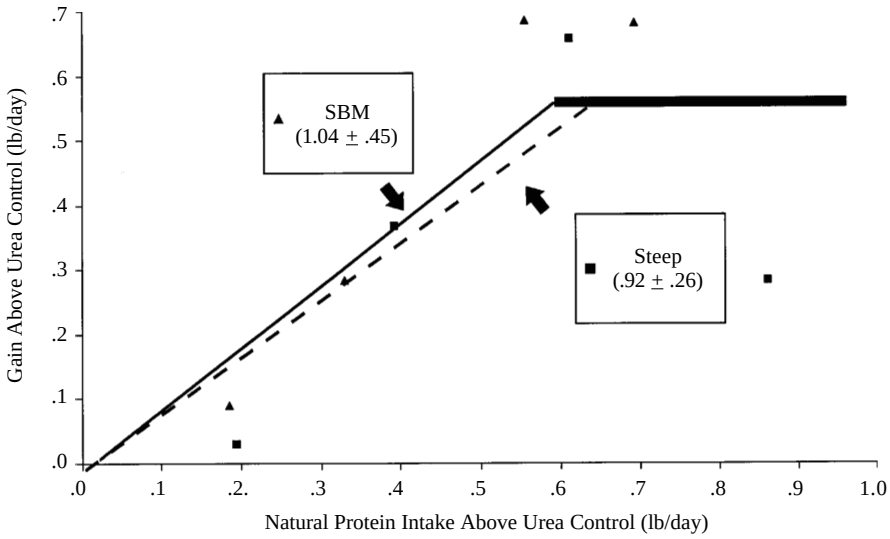

Figure 1. Protein efficiency of growing calves fed graded levels of soybean meal or corn steep (protein efficiency values in parentheses).

Results

Calves on the urea control gained 1.6 lb/day, and the maximum gain realized by calves supplemented with either SBM or Steep was 2.25 lb/day. The regression of gain above the urea control on natural protein intake above the urea control is shown in Figure 1. The maximum gain above urea control, .57 lb, was reached at .55 and .62 lb of natural protein intake above the urea control for SBM and Steep, respectively. The protein efficiency of Steep (.92 ± .26) was not different (P > .10) from SBM (1.04 ± .45). The base diet supplied 5.6% natural protein. Assuming the natural degradable protein requirement of rumen microbes was met by the base diet, any response above the urea control was due to UIP supplied by the Steep and SBM. Similar protein efficiency between Steep and SBM indicate similar UIP contents.

Nutrient concentrations in the urea control diet and the 100% SBM and 100% Steep diets are shown in Table 2. Both corn bran and steep were higher in protein than anticipated, so diets exceeded 11.5% CP. This does not change interpretation of results since 1) all diets supplied adequate DIP, 2) protein efficiency calculations take into account both protein intake and gain above the control, and 3) protein efficiency was calculated prior to maximum gain. In vitro ammonia release analyses on steep samples from this trial showed that corn steep protein was 32.8% undegradable, compared to 29.6% for soybean meal. These data are consistent with previous measurements in the laboratory.

Table 2. Nutrient composition of diets fed to growing calves.

Nutrient	Urea Control	100% SBM[a]	100 % Steep[b]
DM, %	49.9	49.9	45.5
CP, % of DM	12.0	13.0	14.4
Calcium, % of DM	0.60	0.64	0.76
Phosphorus, % of DM	0.28	0.28	0.52
Sulfur, % of DM	0.15	0.16	0.25

[a]Soybean meal supplement replacing urea control at 25, 50, 75 and 100% of supplement DM.
[b]Corn steep supplement replacing urea control at 25, 50, 75 and 100% of supplement DM.

While the standard errors are high for the protein efficiency values, the means are quite similar. The conclusion of equal UIP values for Steep and SBM is consistent with the in vitro ammonia release data. We conclude the UIP value of corn steep is approximately 30% of crude protein.

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