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Wet Corn Gluten Feed as a Source of Rumen Degradable Protein for Finishing Steers

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Rumen degradable protein supplied by alfalfa, wet corn gluten feed, or corn steep liquor increased efficiency.

Summary

Three hundred twenty steer calves were used to evaluate wet corn gluten feed and steep liquor as degradable intake protein sources relative to soybean meal and to determine the need for rumen degradable protein. The metabolizable protein supplied in the diet was sufficient in all cattle except those fed steep, and all cattle were near or in excess of their degradable protein (includes NPN) requirement. Treatments designed to supply an increasing proportion of degradable intake protein as amino acids and peptides increased efficiency. Wet corn gluten feed provided better daily gain and efficiency than soybean meal. Steep liquor appears to have a higher energy value than corn.

Introduction

Improvements in finishing performance (both daily gain and efficiency) have been reported when high levels (5 to 10% of the diet DM) of soybean meal were fed with low quality roughage as the source of roughages in these high grain diets. According to the 1996 NRC Nutrient Requirements of Beef Cattle, finishing diets containing 5 to 10 % soybean meal contain excess rumen degradable and metabolizable protein. Thus, the response does not appear to be due to a protein deficiency. Replacing dry rolled corn with soybean meal may reduce acidosis resulting in higher feed consumption and greater daily gain. Also, it has been suggested that rumen microbes may require a portion of the degradable intake protein (DIP) in the diet be supplied in the form of amino acids and peptides. This requirement for amino acids and peptides by rumen microbes would not be met by urea or escape protein. Replacing 5 to 10% of the dry-rolled corn with SBM in diets containing urea would supply rumen microbes additional amino acids and peptides in the form of DIP. However, wet corn gluten feed or corn steep liquor may reduce acidosis and supply DIP as amino acids and peptides in the ration at a more economical cost than corn and soybean meal. Additionally, using alfalfa hay as a roughage source was evaluated with the hypothesis that alfalfa would supply more DIP as amino acids and peptides than corncobs. Therefore, the objectives of this research were to determine the need for degradable intake protein in the form of amino acids and peptides in finishing diets and to determine if wet corn gluten feed or corn steep liquor would provide a similar response to soybean meal.

Procedure

Three hundred twenty steer calves (596 lb) were used in a finishing trial. Steers were blocked by weight and randomly assigned, within block, to one of eight pens (10 head/pen). Each pen was randomly assigned to one of eight dietary treatments. Treatments were based on the addition (DM basis) of soybean meal (5.0 or 10.0%), wet corn gluten feed (10.4, 20.8, or 38.2%), or corn steep liquor (10.4%) to a basal diet comprised of dry rolled corn, corncobs, and urea. It should be noted that the steep liquor used in this trial was actually a blend of steep and distiller's solubles. A dry rolled corn diet with alfalfa as the roughage source was also included. Steers were adapted to final finishing diets using four adaptation diets containing (DM basis) 45 (3 days), 35 (7 days), 25 (7 days), and 15% (7 days) roughage.

Diets (Table 1) were formulated to contain a minimum of 11.5% CP, .70% Ca, .30% P, and .65% K, 25 g/ton Rumensin, and 10 g/ton Tylan. Steers were implanted with Revalor-S at the start of the trial and re-implanted with Revalor-S at 90 days. Diets were also formulated to meet the rumen degradable protein requirement (TDN x .081), based on 1996 NRC Nutrient Requirements of Beef Cattle. Steers were finished for an average of 169 days. Final weights were calculated by dividing hot carcass weight by a common dressing percentage (62). Fat thickness at the twelfth rib, quality grade, yield grade, and liver abscess score were recorded.

Results

Treatments designed to supply a higher proportion of DIP as amino acids and peptides tended to increase efficiency (Table 2). All treatments except 5 or 10% soybean meal (SBM) and 10.4% wet corn gluten feed (WCGF) had greater ($P<.10$) daily gains than the control. Feed efficiency was increased ($P<.10$) in all treatments versus the control and 10.4% WCGF, suggesting that amino acids and peptides were deficient in the control diet and as a result limited microbial activity. The 10.4% WCGF diet may not have supplied sufficient amino acids and peptides. Feed efficiency was improved with increasing levels of WCGF in the diet.

Feed efficiency was improved ($P<.10$) by replacing corncobs (DRC/COBS) with alfalfa (DRC/ALF) as the roughage source. However, it can not be determined if the response is solely due to the additional amino acids and peptides supplied by the alfalfa.

Table 1. Diet composition (% DM basis).

	Diet[a]							
Ingredient	DRC/ COBS	DRC/ ALF	5% SBM	10% SBM	10.4% WCGF	20.8% WCGF	38.2% WCGF	10.4% Steep
Dry rolled corn	83.50	83.50	78.50	73.50	73.10	62.70	36.40	78.10
Corncobs	7.50		7.50	7.50	7.50	7.50	7.50	7.50
Alfalfa hay		7.50						
Liquid 32		5.00	5.00	5.00	5.00	5.00	5.00	
Soybean meal			5.00	10.00				
WCGF					10.40	20.80	38.20	
Steep liquor								10.40
Urea	.39	.08	.39	.39	.38	.38		.93
Supplement[b]	3.61	3.92	3.61	3.61	3.62	3.62	4.00	3.07

[a]DRC = dry rolled corn; ALF = alfalfa; SBM = soybean meal; WCGF = wet corn gluten feed.
[b]Includes vitamins, minerals, and feed additives.

Table 2. Effect of DIP source on steer performance.

	Diet[a]							
Item	DRC/ COBS	DRC/ ALF	5% SBM	10% SBM	10.4% WCGF	20.8% WCGF	38.2% WCGF	10.4% Steep
Daily gain, lb	3.36[b]	3.77[de]	3.41[b]	3.49[bc]	3.49[bc]	3.78[de]	3.89[e]	3.66[cd]
DM intake, lb/day	19.72[b]	20.89[cde]	19.38[b]	19.58[b]	20.23[bc]	21.23[de]	21.48[e]	19.55[b]
Feed/gain[h]	5.88[b]	5.54[de]	5.68[cd]	5.60[de]	5.80[bc]	5.61[de]	5.51[e]	5.34[f]
Quality grade[i]	18.5[de]	18.6[de]	18.0[b]	18.2[bc]	18.8[ef]	18.4[cd]	19.0[fg]	18.6[de]
Yield grade	2.30[bc]	2.58[def]	2.35[bcd]	2.25[b]	2.61[efg]	2.77[fg]	2.80[g]	2.51[cde]
Fat thickness, in	.43[b]	.49[cde]	.44[bc]	.45[bc]	.51[de]	.52[de]	.53[e]	.47[bcd]

[a]DRC = dry rolled corn; ALF = alfalfa; SBM = soybean meal; WCGF = wet corn gluten feed.
[b,c,d,e,f,g]Means within a row with unlike superscripts differ (P<.10).
[h]Feed/gain analyzed as gain/feed. Feed/gain is the reciprocal of gain/feed.
[i]18 = high Select; 19 = low Choice.

Table 3. Protein requirements, supplies, and balances.

	Diet[a]							
Item	DRC/ COBS	DRC/ ALF	5% SBM	10% SBM	10.4% WCGF	20.8% WCGF	38.2% WCGF	10.4% Steep
MP[b] requirement, g/d	729.0	779.0	739.0	751.0	750.0	791.0	809.3	766.8
MP supply, diet g/d	743.8	803.5	767.8	813.8	772.8	821.0	872.3	715.0
DIP balance, g/d[cd]	-2.5	17.5	111.8	260.0	106.0	227.5	0	166.5
Peptide N Balance, g/d	-55.8	-44.8	-33.8	-12.3	-41.0	-24.8	7.3	-28.5

[a]DRC = dry rolled corn; ALF = alfalfa; SBM = soybean meal; WCGF = wet corn gluten feed.
[b] MP = Metabolizable protein.
[c]DIP = Degradable intake protein.
[d]Degradable protein content (% of CP): dry rolled corn = 40%; corncobs = 50%; alfalfa hay = 72%; liquid 32 = 100%; soybean meal = 60%; wet corn gluten feed = 80%; steep liquor = 100%; urea = 100%.

Adding steep liquor to the diet produced better (P<.10) feed efficiency than any other treatment. Since steep liquor is high in DIP, the response may be due in part to the additional amino acids and peptides supplied by steep liquor. However, the high feed efficiency of cattle fed steep liquor suggests that the steep has a higher energy value than dry-rolled corn or that it has an associative effect in finishing diets. This is consistent with results in another article within this Beef Cattle Report, titled Evaluation of Corn Bran and Steep Liquor for Finishing Steers.

The metabolizable protein (MP) requirement, MP supply, DIP balance, and peptide nitrogen balance (Table 3) were calculated using the NRC Nutrient Requirements of Beef Cattle 1996 software. The MP supplied in the diet was sufficient in all treatments except steep liquor. The MP balance (MP supplied by the diet - MP requirement) ranged from -51.8 to + 63 g/d for the steep liquor and 38.2% WCGF treatments respectively. Though calculated to be slightly deficient in MP, the superior feed efficiency of cattle fed steep liquor suggests that metabolizable protein was not deficient. We may have either underestimated the amount of MP supplied by the diet or overestimated the MP requirement of the steers. All treatments were near or in excess of DIP balance (0) with ranges from -2.5

to +260 g/d for DRC/COBS and 10% SBM, respectively. Therefore, it is unlikely that DIP supply (ignoring amino acids and peptides) limited microbial growth and subsequently reduced cattle performance in any of the treatments. Steers fed 38.2% WCGF had the highest peptide nitrogen balance at 7.3 g/d followed by 10% SBM at -12.3 g/d. Steers fed DRC/COBS, DRC/ALF, 5 or 10% SBM, 10.4 or 20.8% WCGF or steep had negative peptide nitrogen balances. Alfalfa supplied 11 g/d more amino acids and peptides than corncobs. Increasing levels of WCGF and SBM reduced the negative peptide balance.

When ingredients are substituted into the diet to replace corn, a number of effects may occur. Ingredients lower in starch than corn may reduce acidosis. Some ingredients may have more or less energy than the corn replaced or in the case of alfalfa, more energy than the corncobs replaced. Certainly, there was no clear relationship between peptide balance and feed efficiency. The 11 grams supplied by the alfalfa gave as much response in feed efficiency as 63 grams in the 38.2% WCGF diet. Certainly the other factors mentioned previously are affecting the feed efficiency response.

The NRC model (Level 2) calculates peptide balance assuming that all DIP would be in the form of protein and none as NPN. This explains the negative balances for diets such as the 10.4% steep liquor diet. The steep liquor contains some nonprotein nitrogen (actually non-amino acid nitrogen) in the form of ammonium lactate. While it seems likely that some portion of the DIP should be in the form of amino acids and peptides in finishing diets, it is not clear from these data just what this level should be.

Results from this research indicate that WCGF can elicit equal or superior responses in gain and efficiency when compared with SBM. Cattle fed 20.8 or 38.2 % WCGF gained faster and consumed more feed than those fed SBM (5 or 10%). Steep liquor markedly enhanced efficiency and appears to have a higher energy value than dry-rolled corn. This trial failed to show the increased daily gain and dry matter intake previously indicated when high levels of SBM were fed although feed efficiency was increased. In general, supplying additional degradable intake protein as peptides and amino acids in the diet improved performance.

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