

# Kansas Agricultural Experiment Station Research Reports

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Volume 0  
Issue 1 *Cattleman's Day (1993-2014)*

Article 445

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1999

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### Recommended Citation

Whitham, N.G.; Coetzer, C.M.; Hunter, R.D.; Drouillard, James S.; Blasi, Dale A.; and Titgemeyer, Evan C. (1999) "Evaluating corn and corn gluten feed in growing cattle diets as a replacement for roughage," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. <https://doi.org/10.4148/2378-5977.1848>

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# Evaluating corn and corn gluten feed in growing cattle diets as a replacement for roughage

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## **EVALUATING CORN AND CORN GLUTEN FEED IN GROWING CATTLE DIETS AS A REPLACEMENT FOR ROUGHAGE<sup>1</sup>**

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### **Summary**

A 99-day study was conducted to evaluate growth performance of 216 beef heifers (average 524 lb) fed traditional roughage-based diets at 2.75% of body weight or limit-fed high-concentrate diets containing corn or corn gluten feed fed at 2.0% of body weight. Dietary treatments included roughage plus corn, roughage plus corn gluten feed, limit-fed corn, limit-fed corn with added Smartamine<sup>®</sup>-ML (providing 10 g/day ruminally protected lysine), limit-fed corn gluten feed, and limit-fed corn gluten feed with added Smartamine. Adding Smartamine-ML to the diet did not improve performance significantly compared to unsupplemented groups ( $P>.30$ ). Limit-fed diets containing corn and corn gluten feed resulted in more efficient growth than the respective roughage-based treatments ( $P<.01$ ). Limit-fed gluten feed diets resulted in gains that were approximately 88% of that with the corn-based diets. Performance was not different for corn and corn gluten feed when added to roughage-based diets.

(Key Words: Corn Gluten Feed, Smartamine-ML, Growing Cattle, Growth.)

### **Introduction**

Corn gluten feed (CGF) is the major by-product remaining after extraction of starch, gluten, and germ by the corn wet-milling process. CGF is used commonly as a source of protein for growing and finishing beef cattle. Its protein is roughly 70-75% degraded in the rumen, giving it a by-pass

protein value similar to soybean meal. Additionally, CGF is a valuable energy source and often is used to displace grains in finishing and in roughage-based growing diets.

Minimizing the roughage level in growing diets can be advantageous in terms of reducing manure production. Additionally, feeding restricted quantities of high-concentrate diets also can be cost competitive relative to roughage-based growing diets that are full fed. These factors have led us to compare performance of growing calves fed roughage-based or high-concentrate diets containing corn or CGF.

Both CGF and corn are believed to be deficient in the essential amino acid lysine. Therefore, in addition to our initial comparison of roughage vs. energy-dense diets containing CGF or corn, we also compared the energy-dense diets with and without supplementation of Smartamine-ML, which is a ruminally protected form of lysine and methionine.

Our objectives were to evaluate growth performance of heifers fed roughage or energy-dense diets and to determine the effects of supplementation of Smartamine-ML in CGF- or corn-based diets.

### **Experimental Procedures**

Two hundred sixteen crossbred beef heifers (average wt. 524 lb) were placed on experiment on August 4, 1998 at the KSU Beef Cattle Research Center. Six heifers were allotted randomly to each of 36 pens

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<sup>1</sup>This project was funded, in part, by the Kansas Corn Commission.

based on initial body weight, resulting in six pens per treatment. Treatments (Table 1) consisted of alfalfa hay plus corn, alfalfa hay plus CGF, limit-fed corn-based diet, limit-fed corn with added Smartamine-ML (to provide 10 grams/day ruminally protected lysine), limit-fed CGF-based diet, and a limit-fed CGF-based diet with added Smartamine-ML. Roughage diets were fed at 2.75% of BW, and all other diets were fed at 2.0% of BW. Intakes were increased weekly, assuming gains of 2.0 lb per day. Prior to initiation of the experiment, all heifers were fed a common diet (50% concentrate) at 2.5% of body weight. Treatments were fed for a 13-day adaptation period followed by a 71-day trial period. At the end of the study, heifers were fed a common series of step-up rations over a period of 15 days in order to minimize treatment effects on differences in gut fill. Heifers were weighed on days 13, 84, and 99 to determine growth performance during each phase.

## Results and Discussion

Table 2 summarizes growth performance of the heifers throughout the experiment. Performance between days 0 and 13 illustrates the dramatic effect of diet on differences in body weight. Cattle fed the roughage-based diets gained faster and were more efficient than cattle receiving the limit-fed diets ( $P < .05$ ). This appears to be a transient effect resulting from large differences in gut fill among the different dietary treatments. Gains during the period between 14 and 84

days are presumed to reflect actual changes in body weight more accurately, because differences in gut fill are accounted for. Performance between 0 and 99 days also provides a valid comparison, because cattle were fed common diets at the beginning and end of the experiment, thus minimizing differences in gut fill among treatments.

Gain and efficiency throughout the 99-day growing trial were very similar ( $P > .5$ ) when heifers were fed roughage-based diets containing corn or CGF. Heifers fed energy-dense corn diets at 2.0% of BW had similar average daily gains compared to cattle fed the roughage-based diets but gained faster and were more efficient than cattle consuming the limit-fed CGF diets ( $P < .05$ ). Limit-fed corn diets yielded the greatest efficiency of gain, followed by the limit-fed CGF diets. Cattle fed the roughage-based diets were the least efficient. Corn gluten feed was essentially equal to corn when included in roughage-based diets ( $P > .5$ ), but produced lower gains and poorer feed efficiencies when used to replace corn in high-concentrate diets ( $P < .05$ ).

Average daily gain and feed efficiency were not affected by the addition of Smartamine (a source of ruminally protected lysine) to energy-dense corn or CGF diets. Wet corn gluten feed can effectively replace corn in growing cattle diets, though its value is somewhat greater in high-roughage as compared to high-concentrate diets.

**Table 1. Compositions of Experimental Diets (% of Dry Matter)**

Item	Diet			
	Limit-Fed Corn <sup>ab</sup>	Limit-Fed Corn Gluten Feed <sup>ab</sup>	Roughage plus Corn <sup>c</sup>	Roughage plus Corn Gluten Feed <sup>c</sup>
Alfalfa hay	15.12	14.37	59.12	57.43
Dry-rolled corn	67.74	-	36.12	-
Corn gluten feed	-	82.59	-	42.14
Dehulled soybean meal	10.78	-	-	-
Cane molasses	4.03	-	4.16	-
Limestone	1.00	2.53	-	-
Urea, 46% N	.69	-	-	-
Salt	.35	.35	.30	.30
Calcium phosphate	.20	-	.23	-
Vitamin/mineral premix	.09	.16	.07	.13
Dry matter	88.06	65.55	85.48	73.56
Crude protein	16.33	21.67	13.54	19.71
Calcium	.72	1.13	.93	.83
Phosphorus	.35	.91	.30	.59
Thiamin, ppm	-	15.11	-	12.97

<sup>a</sup>Supplemented with or without 10 g per head daily of ruminally protected lysine.

<sup>b</sup>Limit-fed diets formulated to provide 1.4 IU/lb added vitamin A, .12 ppm added Co, 10 ppm added Cu, .6 ppm added I, 60 ppm added Mn, .25 ppm added Se, 60 ppm added Zn, and 30 g/ton Rumensin<sup>®</sup>.

<sup>c</sup>Full-fed diets formulated to provide 1.2 IU/lb added vitamin A, .10 ppm added Co, 8 ppm added Cu, .5 ppm added I, 50 ppm added Mn, .2 ppm added Se, 50 ppm added Zn, and 25 g/ton Rumensin<sup>®</sup>.

**Table 2. Performance of Heifers Fed Roughage-Based or High-Concentrate Diets with Corn or Corn Gluten Feed**

Treatment	Dry Matter Intake, lb/day	Daily Gain, lb/day	Feed:Gain
Days 0 - 13			
Roughage + Corn	16.23 <sup>a</sup>	4.37 <sup>a</sup>	3.74 <sup>a</sup>
Roughage + CGF	16.90 <sup>a</sup>	5.72 <sup>b</sup>	2.96 <sup>b</sup>
Limit-fed Corn	11.33 <sup>b</sup>	2.43 <sup>c</sup>	4.65 <sup>c</sup>
Limit-fed Corn + Smartamine-ML	11.48 <sup>b</sup>	2.41 <sup>c</sup>	4.76 <sup>c</sup>
Limit-fed CGF	12.04 <sup>b</sup>	2.93 <sup>c</sup>	4.13 <sup>ac</sup>
Limit-fed CGF + Smartamine-ML	12.11 <sup>b</sup>	2.65 <sup>c</sup>	4.56 <sup>c</sup>
SEM	.33	.23	.29
Days 14 - 84			
Roughage + Corn	18.86 <sup>a</sup>	2.28 <sup>a</sup>	8.26 <sup>a</sup>
Roughage + CGF	20.09 <sup>b</sup>	2.32 <sup>a</sup>	8.64 <sup>a</sup>
Limit-fed Corn	12.93 <sup>c</sup>	2.47 <sup>b</sup>	5.22 <sup>b</sup>
Limit-fed Corn + Smartamine-ML	12.81 <sup>c</sup>	2.55 <sup>b</sup>	5.02 <sup>b</sup>
Limit-fed CGF	12.86 <sup>c</sup>	1.99 <sup>c</sup>	6.44 <sup>c</sup>
Limit-fed CGF + Smartamine-ML	12.91 <sup>c</sup>	1.95 <sup>c</sup>	6.60 <sup>c</sup>
SEM	.17	.07	.19
Days 0 -99 <sup>d</sup>			
Roughage + Corn	18.96 <sup>a</sup>	2.52 <sup>a</sup>	7.52 <sup>a</sup>
Roughage + CGF	19.81 <sup>b</sup>	2.57 <sup>a</sup>	7.72 <sup>a</sup>
Limit-fed Corn	13.73 <sup>c</sup>	2.54 <sup>a</sup>	5.42 <sup>b</sup>
Limit-fed Corn + Smartamine-ML	13.64 <sup>c</sup>	2.57 <sup>a</sup>	5.30 <sup>b</sup>
Limit-fed CGF	13.69 <sup>c</sup>	2.27 <sup>b</sup>	6.02 <sup>c</sup>
Limit-fed CGF + Smartamine-ML	13.76 <sup>c</sup>	2.20 <sup>b</sup>	6.25 <sup>c</sup>
SEM	.18	.08	.60

<sup>a,b,c</sup>Means in a column with different superscripts are different (P<.05).

<sup>d</sup>Heifers were fed a common series of step-up rations; includes a 15-days post trial period on common diets.