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Summary

A finishing trial was conducted to determine the effects of corn moisture and degradable intake protein level on cattle performance. Diets consisted of 65% processed corn, either dry-rolled, high-moisture at 24% or 30% moisture, or reconstituted dry corn at 28% or 35% moisture. Degradable intake protein levels were evaluated by adding 0%, 0.45% or 0.90% urea (DM basis). Supplementing 0.45% urea increased performance and sufficiently met degradable intake protein requirements. Diets containing high-moisture and reconstituted corn improved cattle performance compared to diets containing dry-rolled corn. Increasing the moisture of ensiled corn further enhanced the feeding value of corn by improving cattle performance.

Introduction

Feeding high-moisture corn (HMC) has been shown to be beneficial by improving cattle performance when compared to DRC in feedlot diets when byproducts are included. Previous beef finishing research (*2001 Nebraska Beef Report*, pp. 54-57) showed that intensive corn processing methods, such as high-moisture corn, increased degradable intake protein (DIP) requirements compared to DRC. Other Nebraska research has shown that including byproducts, such as wet corn gluten feed, increases the DIP requirement by increasing ruminal pH. Higher corn moisture and increased ensiling periods also may lead to increased digestion and DIP requirements by increasing the dry matter digestibility. Degradable intake protein is the fraction of crude protein available to the microbial population. A DIP deficiency can lead to limited microbial growth and reduced starch digestion. Therefore, a deficiency in DIP may result in reduced finishing cattle performance. Greater ruminal dry matter and starch digestion increases the DIP requirement. When the increased DIP requirements are met, cattle performance is improved.

The objectives of our research were to evaluate: 1) the feeding value of ensiled, high-moisture and ensiled, reconstituted corn at two moisture levels compared to DRC in a finishing diet, and 2) the effects of DIP concentration and DIP balance with the different corn treatments on cattle performance.

Procedure

Corn Harvest, Processing, and Storage

High-moisture corn was harvested at two times in September at 30% or 24% moisture (30HMC or 24HMC), coarsely rolled and stored in silo bags until feeding. Field-dried corn was harvested in mid-October. In late November, some of the dry corn was coarsely rolled and reconstituted (RECON) to 28% or 35% moisture (28RECON or 35RECON) and then stored in silo bags until feeding. The remaining dry corn was stored dry and coarsely rolled at time of feeding (DRC). The same hybrid was grown under irrigation in two similar fields at the Agriculture Research and Development Center near Mead, Nebraska.

The moisture at which HMC was harvested was lower than expected and that is why there is a difference in moisture between the HMC and RECON treatments. It is hard to meet the selected target for HMC with moisture equipment in the harvest machinery which is not well designed for higher moisture corns.

Feedlot Experiment

Four-hundred-and-eighty crossbred yearling steers (743 lb) were used to compare the feeding value of HMC and RECON at two moisture levels and DRC. At the beginning of the feeding trial, HMC and RECON had been ensiled for at least 168 days. Cattle performance and DIP balance were evaluated. Steers were stratified by weight and assigned randomly to one of 60 pens (8 steers/pen) and the 60 pens were assigned randomly to one of 15 finishing diets (4 pens/diet). The treatment design was a 5 x 3 factorial with factors being corn type (24HMC, 30HMC, 28RECON, 35RECON or DRC) and DIP balance (NEG, ZERO or POS).

The three DIP balances were achieved by adding 0% (NEG), 0.45% (ZERO) or 0.90% (POS) urea

Table 1. Effects of moisture and harvest method on animal performance and carcass characteristics.

	Treatments[a]						
Item	DRC	24HMC	28RECON	30HMC	35RECON	SEM	*P*-value
Pens, n	12	12	12	12	12		
DMI, lb/day	24.4	24.4	24.2	23.9	23.5	0.2	0.06
ADG, lb	3.43[d]	3.53[de]	3.57[de]	3.68[e]	3.65[e]	0.06	0.02
Feed:gain[b]	7.14[d]	6.94[de]	6.77[e]	6.49[f]	6.45[f]		<0.01
Hot carcass, lb	767[d]	775[de]	779[de]	788[e]	786[e]	5	0.03
Marbling score[c]	492	486	491	490	504	6	0.36
Fat thickness, in	0.39[d]	0.44[e]	0.40[de]	0.44[e]	0.43[e]	0.01	0.04

[a]DRC = dry-rolled corn, 24HMC = 24% moisture, high-moisture corn, 28RECON = 28% moisture, reconstituted dry corn, 30HMC = 30% moisture, high-moisture corn, 35RECON = 35% moisture, reconstituted dry corn.
[b]Analyzed as ADG / DMI, reciprocal of feed conversion.
[c]Marbling score: 400 = Slight 0, 450 = Slight 50, 500 = Small 0, etc.
[d,e,f]Means within a row with different superscripts differ ($P < 0.05$).

Table 2. Effects of DIP balance on animal performance and carcass characteristics.

	Treatments[a]				*P*-value[b]	
	NEG	ZERO	POS			
Urea, % of DM	0	0.45	0.90	SEM	Linear	Quadratic
Pens, n	20	20	20			
DMI, lb/day	24.2	24.1	24.0	0.2	0.42	0.93
ADG, lb	3.42	3.64	3.66	0.04	<0.01	0.06
Feed:gain[c]	7.04	6.62	6.54		<0.01	0.02
Hot carcass, lb	766	785	785	4	<0.01	0.05
Marbling score[d]	492	488	498	5	0.40	0.26
Fat thickness, in	0.41	0.43	0.43	0.01	0.17	0.28

[a]NEG = diets formulated to have a negative DIP balance, ZERO = diets formulated to have a zero DIP balance, POS = diets formulated to have a positive DIP balance. DIP balance calculated using Level 1 of the NRC (1996) Model. DIP = degradable intake protein.
[b]Linear=linear response to urea supplementation, Quadratic = quadratic response to urea supplementation.
[c]Analyzed as ADG / DMI, reciprocal of feed conversion.
[d]Marbling score: 400 = Slight 0, 450 = Slight 50, 500 = Small 0, etc.

to the base diet (DM basis). The three DIP balances were calculated using the NRC (1996) model with the assumptions of a 743 lb steer with a DMI of 24 lb/day and an ADG of 4 lb. The final diets contained 65% test corn, 18% corn bran, 5% grass hay, 4% dry-rolled corn, 3% tallow and 5% dry supplement (DM basis). Rumensin® and Tylan® were included at 27 g/ton and 8 g/ton of diet DM, respectively. A commodity DRC was used in all diets at 4% (DM basis) because of limited supply of high-moisture and reconstituted corn.

Steers were weighed initially on two consecutive days after being limit-fed at 2.0% of body weight for five days in order to minimize differences in gut fill. Steers were implanted with Ralgro (Schering-Plough Animal Heath, Union, New Jersey) on day 1, reimplanted with Revalor®-S (Intervet, Millsboro, Delaware) on day 45, and fed for 138 days. Final weights were calculated using hot carcass weights adjusted to a common dress (63%). Steers were harvested at a commercial packing plant where carcass data were collected. Hot carcass weight was collected the day of harvest while fat depth, marbling score, and yield grade data were collected after a 24-hour chill.

Data were analyzed as a 5 x 3 factorial design using the Mixed procedure of SAS. The corn types were analyzed using the Least Significant Difference to separate means. The DIP balances were analyzed using linear or quadratic contrasts.

Results

There were no significant corn type x DIP level interactions for any of the variables observed, therefore, only main effects are presented. Within corn type (Table 1), no differences were detected between early harvested corn at 24% moisture and reconstituted dry corn at 28% moisture. There also were no differences between 30HMC and 35RECON. For both early harvested and reconstituted dry corn, the higher moisture treatment had improved ($P < 0.05$) feed conversion compared to the lower moisture treatment.

There was no difference in DMI ($P = 0.06$) between any of the corn types. There was a tendency for DMI to decrease as corn moisture increased. Steers fed diets containing DRC, 24HMC, and 28RECON had similar ADG and hot carcass weights. Steers fed diets containing 30HMC and 35RECON had a 9.4% improvement ($P < 0.01$) in feed conversion, gained 6.3% faster ($P = 0.02$), and had heavier

($P = 0.03$) hot carcass weights compared to steers fed diets containing DRC. Steers fed diets containing 24HMC and 28RECON had intermediate performance. There were no differences in marbling score among any of the corn types. For fat thickness, DRC and 28RECON were similar and 24HMC, 30HMC, and 35RECON had increased ($P = 0.04$) fat thickness compared to DRC.

Within DIP level (Table 2), no differences ($P > 0.05$) in DMI were observed among the treatments. Steers fed diets supplemented with urea had a 6.6% improvement (quadratic response, $P = 0.02$) in feed conversion, gained 6.1% faster (linear response, $P < 0.01$), and had increased (quadratic response, $P = 0.05$) hot carcass weights compared to steers fed diets with no supplemental urea. There were no differences ($P > 0.05$) among diets for marbling score or fat thickness.

For the DRC diets, the NRC model (1996, Level 1) predicts that the diets containing no urea supplementation had a DIP deficiency of -313 g/day and diets supplemented with 0.45% urea had a DIP balance of -173 g/day. For HMC and RECON diets, the NRC model (1996, Level 1) predicts that the diets containing no urea supplementation had a DIP deficiency of -157 g/day and diets supplemented with 0.45% urea had a balance of 22 g/day. Clearly the diets containing no urea were deficient in DIP. The diets containing 0.45% urea were close to a DIP balance of zero and cattle performance was improved compared to diets containing no urea. The diets that contained 0.90% urea had excess DIP and no improvement in cattle performance was observed compared to the diets with 0.45% urea supplementation.

In conclusion, increasing the moisture of high-moisture and reconstituted dry corn enhanced the feeding value. Increasing the moisture of ensiled corn improved cattle performance; however, higher moistures should only be fed with the inclusion of by-products or other mechanisms to control acidosis. The negative DIP diet with no urea supplementation reduced cattle performance. The zero DIP diet met the DIP requirements of the cattle and the positive DIP diet did not improve cattle performance. Therefore, current prediction models appear to be appropriate and protein (urea supplementation) above cattle requirements is not beneficial.

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