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EFFECT OF FEEDING CONVENTIONAL OR HIGH-MOISTURE, STEAM-FLAKED CORN TO FINISHING HEIFERS

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Summary

Finishing heifers were fed diets containing either conventional (18% moisture) or high-moisture (36% moisture) steam-flaked corn. Increasing moisture concentration in flakes increased starch availability (P<0.01), but feeding heifers high-moisture flakes decreased (P<0.05) dry matter intake and average daily gain compared to heifers fed conventional flakes. Feeding heifers high-moisture flakes also numerically reduced hot carcass weight and ribeye area, but caused (P<0.01) heifers to deposit more fat over their 12th rib. Extreme levels of moisture in flaked corn improve starch availability but do not appear to increase heifer performance or carcass value. The interaction between moisture and flake density needs further evaluation.

Introduction

Many feedlots equipped with steam-flaking mills apply moisture to corn prior to steaming to aid in the flake manufacturing process. Moisture levels of grain are closely monitored and altered to improve consistency of the final product, reduce fine particles, and decrease equipment maintenance.

Moisture is also an essential component of starch gelatinization. Without adequate moisture, starch gelatinization is incomplete. For complete gelatinization of starch to occur, moisture must accompany starch in a ratio of at least 2:1. Moisture concentration of corn prior to flaking generally ranges from 16 to 24%. Improving the gelatinization of starch by increasing the moisture content of corn prior to flaking may result in improvements in cattle performance. Our objective was to evaluate the performance of heifers fed steam-flaked corn-based diets containing flakes of 18 or 36% moisture.

Experimental Procedures

Crossbred beef heifers (n=96; 859 lb) were used in an 82-day finishing experiment. Heifers were randomly allocated to pens and stratified by pen weight to two treatments (8 heifers per pen, 6 pens per treatment). Heifers were implanted with Revlor-H® on day 1 and adapted to the final finishing diets within 15 days. Final finishing diets provided 300 mg Rumensin®, 90 mg Tylan®, and 0.5 mg MGA® per heifer daily.

Heifers were allowed ad libitum access to diets that contained approximately 73% steam-flaked corn (dry matter basis, Table 1). Dietary treatments consisted of steam-flaked corn that was prepared to contain 18% (conventional) or 36% moisture (high-moisture). The high-moisture steam-flaked corn was made by combining 1000 lb of whole corn (89% dry matter) and 380 lb of water. Corn was mixed periodically and tempered overnight to allow for sufficient uptake of moisture. Both conventional and high-moisture corn were steam conditioned for 45 minutes in a 96-cubic foot steam chest and subsequently flaked to 26 lb/bushel using an 18-inch × 24-inch Ferrel-Ross flaker. Electrical load on the flaker during production of both high-moisture and conventional flakes was measured using an ammeter. Flake samples were analyzed for

enzyme (amyloglucosidase) susceptibility to estimate starch availability.

Average daily gain and feed efficiencies were calculated using final weights estimated as hot carcass weight divided by a common dressing percentage (63%).

Results and Discussion

Electrical load on the flaker was not different for the two sources of corn. The average loads placed on the flaker were 27.6 and 28.2 amps when flaking the high-moisture and conventional corn sources, respectively. We thought that increasing the moisture concentration of corn might reduce the electrical use by the flaker. Because added moisture will increase flake density and both sources of grain were processed to common flake densities, the high-moisture corn was likely processed to a greater extent than the conventional corn. Thus, the roll tension on the flaker was likely tighter when the high-moisture corn was processed, which could mask any advantages that moisture might have on reducing electrical use by the flaker.

Performance and carcass characteristics are summarized in Table 2. Feeding heifers high-moisture flakes compared to conventional flakes decreased ($P<0.05$) dry matter intake and average daily gain. Feed efficiencies were similar ($P=0.82$) between both groups of heifers, but lower gains resulted in numerically lighter carcasses for heifers fed high-moisture flakes. Increasing the moisture concentration of flakes also increased starch availability (Table 1; $P<0.01$). The high availability of starch may have caused subacute acidosis in the heifers fed the high-moisture flakes and depressed their feed intake. Despite the reduction in average daily gain, heifers fed the high-moisture flakes were fatter over the 12th rib, tended ($P=0.11$) to have more USDA yield grade 3 carcasses, and tended ($P=0.13$) to have smaller ribeye areas than heifers fed conventional flakes. The higher availability of starch for heifers fed the high-moisture flakes may have altered digestion and(or) meal patterns and, thus, changed systemic hormones that regulate glucose clearance in body tissues, resulting in energy partitioning towards adipose accretion rather than muscle deposition.

Again, it should be noted that both the conventional and high-moisture flaked corn were processed to a common flake density (26 lb/bushel). If other processing factors are held constant, increasing the moisture concentration of flaked corn will cause flake density to increase. Therefore, the high-moisture flakes were likely processed to a greater degree than the conventional flakes, and moisture level may be confounded with flake density in our trial. Assuming that only moisture caused the observed differences in this trial may be incorrect due to the impact of moisture on flake density. Further research is necessary regarding the interaction of moisture content and flake density.

Table 1. Experimental Diets (% of Dry Matter)

Ingredient	Conventional Flakes	High-moisture Flakes
Steam-flaked corn, 18% moisture	73.3	-
Steam-flaked corn, 36% moisture	-	72.9
Wet corn gluten feed	9.7	9.8
Alfalfa hay	5.9	6.0
Tallow	3.1	3.1
R-T-MGA premix[1]	2.4	2.6
Soybean meal	2.1	2.1
Limestone	1.7	1.7
Urea	1.0	1.0
Potassium chloride	0.4	0.4
Sodium chloride	0.3	0.3
Vitamin/trace mineral premix[2]	0.1	0.1
Nutrient, analyzed		
Dry matter, %	77.2	65.4
Crude protein, % of dry matter	14.6	14.6
Calcium, % of dry matter	0.8	0.8
Phosphorus, % of dry matter	0.3	0.3
Starch availability of flaked corn	56.8	72.0

[1]Formulated to provide: 300 mg Rumensin, 90 mg Tylan, and 0.5 mg MGA per heifer daily.
[2]Vitamin/trace mineral premix formulated to provide (total diet dry matter): 1000 IU/lb Vitamin A, 0.13 ppm cobalt, 0.63 ppm iodine, 60 ppm manganese, 0.25 ppm selenium, 60 ppm zinc, 10 ppm thiamin, 10 ppm copper, and 2.5 ppm iron.

Table 2. Performance and Carcass Characteristics of Heifers Fed Finishing Diets Based on Steam-flaked Corn Containing 18 or 36% Moisture

Item	Conventional Flakes	High-moisture Flakes	SEM	P-value
No. of heifers	48	48		
No. of pens	6	6		
Initial weight, lb	855	862	14	0.73
Final weight, lb	1172	1154	16	0.45
Dry matter intake, lb/day	18.9	17.6	0.34	0.05
Average daily gain, lb	3.28	3.01	0.08	0.05
Gain:feed	0.173	0.171	0.0050	0.82
Hot carcass wt, lb	711	702	5.3	0.58
Dressing percentage	63.2	63.3	0.23	0.64
Ribeye area, square inches	13.0	12.4	0.26	0.13
Kidney, pelvic, & heart fat, %	2.45	2.49	0.054	0.65
Back fat thickness, inches	0.51	0.57	0.010	<0.01
USDA yield grade 1, %	13	8	3.7	0.45
USDA yield grade 2, %	33	27	4.6	0.36
USDA yield grade 3, %	46	56	4.2	0.11
USDA yield grade 4, %	8	8	3.5	1.00
Marbling score	$Slight^{259}$	$Slight^{262}$	6.8	0.80
USDA Choice, %	23	25	6.2	0.82
USDA Select, %	67	71	5.3	0.59
USDA Standard, %	10	4	4.0	0.30
Liver abscesses, %	2.1	2.1	2.1	1.00