

Effects of 20 or 40 percent forage levels with whole or rolled corn on carcass traits, tenderness and color

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The objective of this study was to evaluate the effects of forage level and corn processing on carcass traits, meat tenderness and retail display to determine if utilizing a high-forage diet is a feasible alternative to a high-concentrate diet for finishing cattle in North Dakota. Replacing high-concentrate diets with higher levels of forage may result in similar carcass traits and tenderness, but it may impact meat color.

Summary

One hundred six steers were fed at the Carrington Research Extension Center and randomly assigned to one of four treatments: 1) 20 percent forage with rolled corn, 2) 40 percent forage with rolled corn, 3) 20 percent forage with whole corn and 4) 40 percent forage with whole corn. After cattle were evaluated visually to have approximately 0.50 inch of back fat at the 12th rib, all steers were shipped to a commercial packing plant for slaughter. Approximately 24 hours after slaughter, carcass traits, including rib-eye area; back fat; and kidney, pelvic, heart (KPH) fat; final U.S. Department of Agriculture (USDA) yield grade; marbling; and USDA quality grade were measured or collected from the grading camera. In addition, the strip loin was collected from each carcass and shipped back to the NDSU meat lab for evaluations of tenderness, cook loss and simulated retail display. Rib-eye area back fat, KPH fat, final yield grade, tenderness and cook loss were not different among treatments. The whole-40 treatment tended to result in lower

hot carcass weights when compared with whole-20 and rolled-40 treatments, and also tended to have higher muscle lightness (L*) than rolled-20. The 40 percent forage groups had lower L* values. Rolled corn increased meat redness and yellowness.

Introduction

Processed corn usually is included in finishing diets to increase digestibility and improve animal performance. Typically, some level of forage also is included in the diet to help maintain rumen function and decrease the incidence of acidosis. Research has shown that when finished to the same time endpoint, cattle fed all forage and no concentrate have lower carcass weights; less back fat, KPH fat and marbling; darker-colored lean; and no differences in tenderness (Mandell, 1998).

We hypothesized that forage level and type of corn processing would not result in differences in carcass traits, tenderness or color measurements. The objectives were to determine if utilizing a high-forage diet is a feasible alternative to a high-concentrate diet for finishing cattle in North Dakota.

Experimental Procedures

All live animal aspects of the project were approved by the NDSU Institutional Animal Care and Use Committee. One hundred six steers were allotted randomly to a pen, and the pen was assigned randomly to one of four treatment groups: 1) 20 percent forage with rolled corn, 2) 40 percent forage with rolled corn, 3) 20 percent forage with whole corn and 4) 40 percent forage with whole corn. (Table 1) Steers were fed for a total of 141 days.

Upon a visual evaluation that the steers had reached approximately 0.50 inch of 12th rib back fat, the steers were slaughtered at a commercial packing plant in Dakota City, Neb. Following a 24-hour chill at approximately 40 F, 12th rib back fat, rib-eye area, KPH fat, and USDA quality and yield grades were measured.

Strip loins (IMPS 180) were collected and transported to the NDSU meat lab, where they were aged at 39 F until 14 days postmortem. After aging, two 1-inch-thick steaks were cut from the cranial end of the strip loins and then were vacuum packaged and frozen for tenderness evaluations or immediately packaged for retail display.

Steaks for Warner-Bratzler shear force determination were thawed at room temperature for 18 hours. Steaks then were weighed and cooked on clamshell-style grills to an internal temperature of 160 F, then reweighed to determine cooking loss. Six 0.5-inch cores were removed parallel to the muscle fibers and sheared using a Warner-Bratzler shear force machine. The average of six cores was used for the statistical analysis.

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Retail display steaks were over-wrapped with polyvinyl chloride, placed on racks under continuous fluorescent lights and rotated daily. Readings were taken daily using a Minolta chromameter. Muscle lightness (L*), redness (a*) and yellowness (b*) were recorded daily for seven days.

Data were analyzed using the general linear model procedure of SAS with animal as the experimental unit for tenderness and color measurements, and pen as the experimental unit for carcass traits.

Least square means were obtained and means were separated using the pdiff option.

Results and Discussion

Rib-eye area, back fat, KPH fat, yield grade, marbling, tenderness and cook loss were similar for all treatments ($P > 0.05$; Table 2). Cattle finished at the same time typically have similar rib-eye area, KPH fat, tenderness and cook loss. Hot carcass weights and yield grade tended to be lower for the whole corn, 40 percent forage treatment, compared

with the 20 percent treatments ($P \geq 0.10$).

Increasing the energy in the diet by processing corn or reducing the amount of forage has been shown to increase carcass weights, as well as back fat and yield grade. However, in this study, only carcass weight increased. This may be due to a more moderate difference in the amount of forage. Although hot carcass weights differed, yield grade was only slightly different. Yield grade also is dependent upon rib-eye area, back fat and KPH fat.

Other research by LaBrune et al. (2008) comparing dry-rolled and steam-flaked corn found that feeding steam-flaked corn resulted in heavier carcass weights. In a different study conducted by Mandell et al. (1998) comparing 95 percent alfalfa silage with 15 percent alfalfa silage, the 15 percent alfalfa silage treatment also resulted in heavier carcass weights.

During retail display, the higher-forage groups had lower L* values, indicating that the steaks were darker in color during the seven-day display period. Steak redness and yellowness were significantly higher for the rolled-corn treatment groups (higher a* and b*). Duckett et al.

Table 1. Formulation and nutrient composition of diets for yearling steers fed whole or dry-rolled corn and 20 or 40 percent grass hay.

Ingredients, Dry-matter Basis	40% Forage Whole Corn	40% Forage Rolled Corn	20% Forage Whole Corn	20% Forage Rolled Corn
Corn, %	32.54	33.48	51.47	52.39
MDGS, %	25.67	25.27	25.65	25.07
Hay, %	39.75	39.15	20.73	20.32
Supplement, %	2.04	2.1	2.2	2.21
Nutrient Composition				
CP, %	14.29	14.07	14.51	14.17
NEg, Mcal/lb	0.47	0.48	0.56	0.56
DM, %	74.1	73.02	72.91	74.59
Diet concentrate, %	60.25	60.85	79.27	79.68
Diet forage, %	39.75	39.15	20.73	20.32

Table 2. Influence of corn processing and forage level on carcass characteristics, shear force and cook loss.

Corn Treatment Forage Treatment	Rolled		Whole		SEM	P-value
	20	40	20	40		
n	3	3	3	3		
Hot Carcass Weight, lbs.	902	911	915	861	14.73	0.1
Rib-eye area, sq. in.	12.2	12.4	12.2	12.1	0.252	0.86
Back fat, in.	0.52	0.53	0.54	0.48	0.026	0.43
KPH, %	1.70	1.78	1.79	1.77	0.033	0.25
USDA yield grade	3.84	3.77	3.90	3.53	0.098	0.12
Marbling score	449	466	433	447	9.753	0.197
n	25	27	27	27		
Shear force, lbs.	5.21±.094	5.17±.087	5.41±.103	5.54±.087		0.52
Cook loss, %	21.1±.016	20.2±.015	20.5±.018	21.4±.015		0.095

^aYield grade was determined using the yield grade equation of $2.50 + (2.5 \times \text{adjusted fat thickness in inches}) + (0.2 \times \text{percent KPH fat}) + (0.0038 \times \text{hot carcass weight}) - (0.32 \times \text{rib-eye area in square inches})$

^b400 = small 0, 500 = modest 0

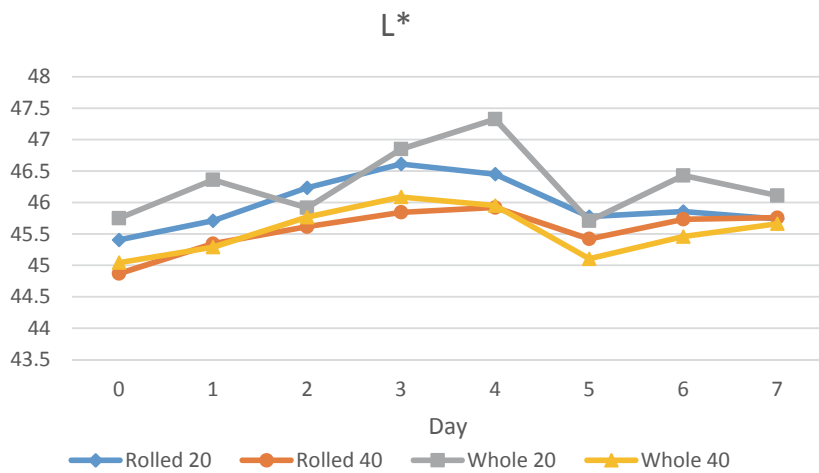


Figure 1. L* measurements during a seven-day period for steaks from steers fed whole or dry-rolled corn and 20 or 40 percent forage.

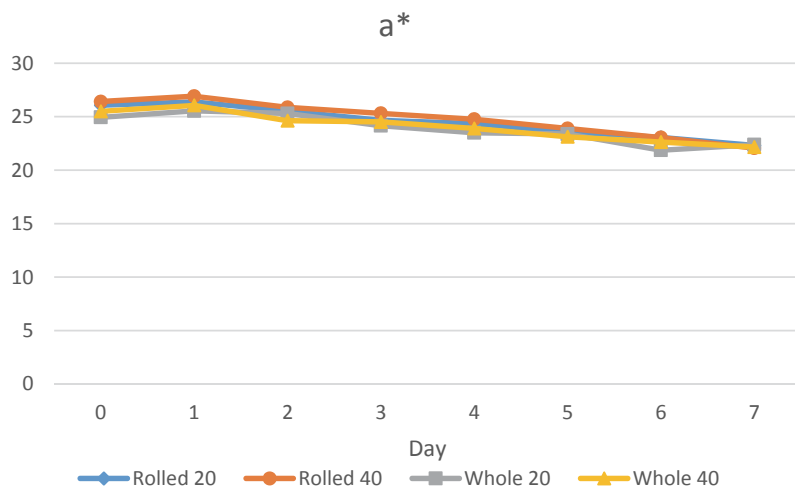


Figure 2. a* measurements during a seven-day period for steaks from steers fed whole or dry-rolled corn and 20 or 40 percent forage.

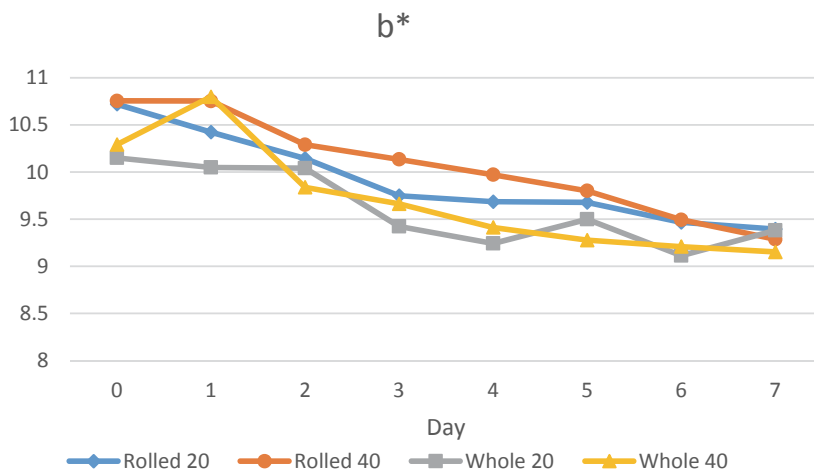


Figure 3. b* measurements during a seven-day period for steaks from steers fed whole or dry-rolled corn and 20 or 40 percent forage.

(2007) found concentrate finishing systems to have steaks with lighter color, and more redness and yellowness, when compared with pasture finishing systems. They state that the increased yellowness of steaks from concentrate systems may be due to an increase in marbling.

Starch from rolled corn is digested in the rumen more easily and possibly would result in an increase in the glycogen in the muscle at the time of slaughter, which results in decreased pH. Decreasing the pH of meat results in increased lightness and redness by increasing the amount of light that is reflected from the surface of the steak. Decreasing the pH increases the amount of free water in the meat, which more easily reflects light than bound water. However, we did not measure pH in this research

This research found that feeding of forage at 20 or 40 percent of the diet and corn processing will result in similar rib-eye areas, KPH fat, back fat, yield grade, tenderness and cook loss. However, hot carcass weight and color may be impacted negatively by feeding certain combinations of the two.

Literature Cited

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