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Harleigh Johnson
Kansas State University

Sarah A. Sexton-Bowser
Kansas State University, sarahann@k-state.edu

Jaymelynn K. Farney
Kansas State University, jkj@ksu.edu

See next page for additional authors

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Authors

Harleigh Johnson, Sarah A. Sexton-Bowser, Jaymelynn K. Farney, and James S. Drouillard

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KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

Evaluating Ground Grain Sorghum as an Alternative to Dry-Rolled Corn in Finishing Cattle Diets

H.A. Johnson, S.A. Sexton-Bowser, J.K. Farney, and J.S. Drouillard

Abstract

Grain sorghum has limited adoption in cattle finishing diets due to the perception of inferior performance relative to corn in cattle finishing diets. However, with the rapid decline of the Ogallala Aquifer there is a need to adopt feed grains like grain sorghum, which grow reliably under water stress. This study evaluated ground sorghum (unknown variety) as a substitute for dry-rolled corn in finishing beef cattle fed for 182 days. Metabolizable energy content of sorghum was determined to be 94% that of corn, with values of 1.39 Mcal/lb and 1.42 Mcal/lb, respectively. Dry matter intakes of cattle fed sorghum were greater than those of cattle fed corn, but average daily gains were less, leading to a reduced feed conversion for cattle fed sorghum. Carcasses of steers fed corn were 32 lb heavier than those of steers fed sorghum, and percentages of Prime and premium Choice carcasses favored cattle fed corn resulting in a carcass value premium for corn fed cattle of $112 relative to sorghum fed cattle (based on average U.S. Department of Agriculture pricing for the week of harvest). This study supports that dry processed sorghum is inferior to dry processed corn as a feedstuff for finishing cattle. Future efforts need to focus on superior hybrids and alternative methods of grain processing, such as steam flaking, to improve the competitiveness of sorghum as a feedstuff for finishing cattle.

Introduction

Crop production in the semi-arid climate of the Southern Great Plains is heavily dependent on irrigation water provided by the Ogallala aquifer. The High Plains region, from Nebraska to Texas, utilizes this groundwater to grow crops such as corn, wheat, alfalfa, and sorghum. Over-withdrawal of irrigation water from the aquifer threatens to leave farmers without sufficient water for future production of irrigated crops. It is estimated that by 2100, 24% of irrigated lands utilizing water from the aquifer will be unable to support irrigated crops, and 13% of those affected areas will be unsuitable even for dryland crops. To sustain production capacity for future generations, farmers in this region need to adopt cropping systems that require less water.

Corn has long been the industry-preferred energy source in cattle finishing diets because of its wide availability and suitable effects on animal growth. The High Plains region has one of the highest concentrations of feedlot cattle in the world, with approximately 2.32 million cattle on feed in Kansas as of June 2024, with the vast majority feeding on corn as the primary energy source. Kansas is also the leading producer of grain sorghum

(*Sorghum bicolor* L.) in the United States, with a total planted acreage of 3.3 million acres. Grain sorghum is more drought tolerant and hardy than corn, thus presenting as an alternative feed crop that could effectively reduce a farmer's water usage. There is a significant geographical overlap of feedlot cattle and grain sorghum production in the High Plains, yet sorghum is seldom utilized in feedlot operations.

Sorghum generally is regarded as being inferior to corn as cattle feed, but variations in grain processing methods and improved genetics may help overcome these differences, leading to increased use of grain sorghum and less overall water use for feed grain production. The variability in grain sorghum, including kernel size, genetic variety, and nutrient composition, requires research to evaluate these cumulative effects on beef cattle growth and carcass merit when compared to corn. Demonstrating the viability of grain sorghum as an alternative energy source for finishing cattle may increase acceptance and use by cattle feeders.

Experimental Procedures

A randomized complete block design (15 blocks of two treatments) study was conducted at the Kansas State University Southeast Research and Extension Center between March and September of 2024. Black-hided, yearling steers (n = 300; 763.5 ± 14.3 lb initial body weight) were procured from a rye grazing operation in Lyons, Kansas, and transported 201 miles to the research center. At induction, cattle were identified using their existing ranch tags as well as individually numbered radio frequency identification ear tags, treated for internal and external parasites, implanted with long-acting steroidal implants, and weighed. Cattle were randomly allocated to feedlot pens (10 animals/pen) based on order of processing, such that the first 20 animals processed were allocated to block one, the second twenty animals to block two, and so on until all 15 blocks were complete. Cattle were housed in open, earthen-surfaced feedlot pens measuring 50 × 100 ft. Pens within block were then allocated randomly to treatments of diets containing either corn or grain sorghum (Table 1). Both diets were balanced to similar crude protein and starch content. Cattle were fed once daily, *ad libitum*. Feed bunks were scored daily, and dry matter content of ingredients was determined using weekly composites of each ingredient. Unconsumed feed was removed from feed bunks every Monday and Thursday and dried, making it possible to determine actual dry matter intake (DMI) for each 3- or 4-day interval.

Interim pen weights were recorded at 28-day intervals for DMI, average daily gain (ADG), and feed efficiency calculations. The energy content of diets was calculated using performance measurements and values from the Nutrient Requirements of Beef Cattle (National Academies of Sciences, Engineering, and Medicine, 2016). Feed and fecal samples collected from each pen were analyzed for total digestible nutrients. After 182 days on feed, the cattle were shipped and harvested for carcass data collection. Hot carcass weight and the incidence and severity of abscessed livers were recorded on the day of harvest. After approximately 72 hours of refrigeration, 12th rib subcutaneous fat thickness, marbling score, percent kidney, pelvic, and heart fat (KPH), ribeye area (REA), and U.S. Department of Agriculture (USDA) quality and yield grades were acquired via a camera imaging system.

Data were analyzed as mixed models (SAS, version 9.4) with diet as the fixed effect and initial weight block as the random effect. Incidence and severity of abscessed livers, USDA quality grade, and USDA yield grade were analyzed as multinomial distributions. Least-squares means were separated using the predicted difference function of SAS.

Results and Discussion

The effect of grain sorghum finishing diets on growth performance and carcass characteristics, as well as diet digestibility are shown in Tables 2 and 3, and Figure 1, respectively. Cattle in the sorghum treatment ate more and gained less, leading to poor efficiency of feed conversion ($P < 0.01$). Incidence of abscessed livers did not differ ($P > 0.30$). Percentages of cattle grading Prime and premium Choice were greater ($P < 0.01$) for cattle fed corn compared to those fed sorghum, and percentages of low Choice and Select cattle were greater for cattle fed sorghum. Overall carcass value was calculated using weekly average discounts and premiums reported by USDA and was $112 more for cattle fed corn than for cattle fed sorghum ($P < 0.01$). Metabolizable energy value was calculated from performance data and was 1.42 and 1.39 Mcal/lb for corn and sorghum, respectively ($P < 0.01$).

Implications

The energy value of ground sorghum grain was approximately 94% that of dry-rolled corn, which is higher than previously perceived, but its inferiority is reflected in carcass quality. Future efforts should focus on development of superior sorghum hybrids and processing methods that enhance nutritional value of sorghum.

Acknowledgments

Funding for this project was provided by the National Institute of Food and Agriculture. Appreciation is expressed to the technical crew of the KSU Southeast Research and Extension Center where this study was conducted; fellow graduate students Elizabeth Kiselewski, Stephan Knecht, Ludmila de Souza Montiero, and Firman Nasiu; and undergraduate student employees of Pre-Harvest Food Safety Laboratory for their assistance in completing this study.

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National Academies of Sciences, Engineering, and Medicine. 2016. Nutrient requirements of beef cattle: Eighth revised edition. Washington, DC: The National Academies Press. *https://doi.org/10.17226/19014*

Table 1. Composition of diets (dry matter basis)

Item	Control	Sorghum
Corn silage	12.00	12.00
Dry-rolled corn	79.37	---
Ground grain sorghum	---	79.37
Supplement[1]	8.63	8.63
Nutrient composition, analyzed		
Crude protein, %	11.6	11.5
Neutral detergent fiber, %	13.8	12.5
Starch, %	68.9	68.5

[1]Supplement contained soybean meal, urea, minerals, vitamins, and feed additives and was formulated to provide (total diet dry matter basis) 0.7% calcium, 0.7% potassium, 0.3% salt, 33 g/ton monensin, 8 g/ton tylosin, and the following added amounts of trace elements and vitamins: 1,000 IU/lb vitamin A, 15 IU/lb vitamin E, 0.1 ppm cobalt, 10 ppm copper, 0.5 ppm iodine, 40 ppm manganese, 0.1 ppm selenium, and 40 ppm zinc. Ractopamine hydrochloride was included at 25 g/ton of the diet dry matter for the final 42 days on feed.

Table 2. Performance of steers fed diets containing dry-rolled corn or ground grain sorghum throughout a 182-day finishing period

Item	Control	Sorghum	SEM[1]	*P*-value
Average daily gain, lb	3.57	3.21	0.07	<0.01
Feed intake, lb/day	24.14	25.25	0.36	<0.01
Feed:gain	6.77	7.87	0.002	<0.01
Metabolizable energy (calculated from animal performance), Mcal/lb	1.42	1.39	---	---

[1]Standard error of the mean.

Table 3. Carcass characteristics of steers fed diets containing dry-rolled corn or ground grain sorghum throughout a 182-day finishing period

Item	Control	Sorghum	SEM[1]	*P*-value
Hot carcass weight, lb	877.8	845.54	7.11	<0.01
Marbling score[2]	519	467	8.0	<0.01
12th rib fat thickness, in	0.56	0.54	0.019	0.188
Ribeye area, in^2	13.2	12.9	0.10	<0.01
Kidney, pelvic, and heart fat, %	1.8[8]	1.87	0.02	0.677
Prime, %	5.33	0.67	2.25	0.057
Premium Choice, %	47.63	29.33	5.49	<0.01
Low Choice, %	35.55	47.33	5.79	0.061
Select, %	11.48	21.33	4.19	0.034
Sub-Select, %	0.0	0.67	0.67	0.334
Yield Grade 1	1.41	0	0.96	0.165
Yield Grade 2	24.37	30.00	5.64	0.335
Yield Grade 3	52.81	51.00	6.94	0.867
Yield Grade 4	20.07	15.33	4.22	0.280
Yield Grade 5	1.33	0.67	1.13	0.564
Abscessed livers, %	8.74	6.00	2.62	0.31
Total carcass value, $[3]	2491.55	2379.11	22.11	<0.01

[1]Standard error of the mean.
[2]Slight amount of marbling, 300-399; Small amount of marbling, 400-499; Modest amount of marbling, 500-599; Moderate amount of marbling, 600-699.
[3]Based on average price premiums and discounts reported by USDA on Sept 13, 2024.

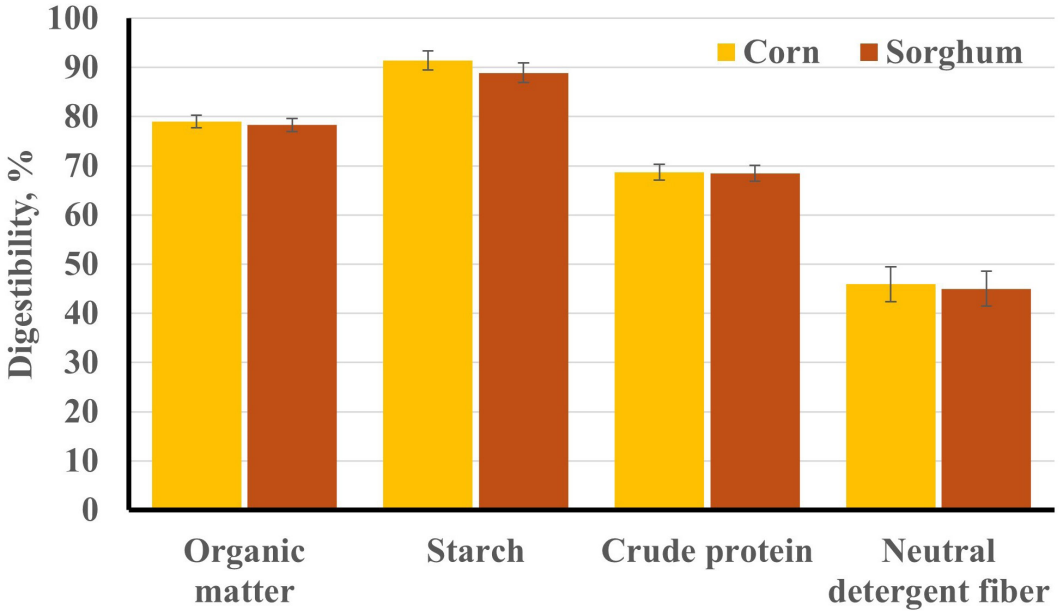

Figure 1. Digestibility of diet components