

2023

Effects of Almond Hull Inclusion on Growth Performance of Limit-Fed Growing Cattle

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Recommended Citation

Duncan, Z. M.; DeBord, Z. L.; Pflughoeft, M. G.; Suhr, K. J.; Hollenbeck, W. R.; Brazle, F. K.; Titgemeyer, E. C.; Olson, K. C.; and Blasi, D. A. (2023) "Effects of Almond Hull Inclusion on Growth Performance of Limit-Fed Growing Cattle," *Kansas Agricultural Experiment Station Research Reports*: Vol. 9: Iss. 1. <https://doi.org/10.4148/2378-5977.8415>

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Funding Source

Appreciation is expressed to the Almond Board of California for financial support of this study.

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Abstract

Almond hulls contain soluble sugars and could potentially be used as a feed ingredient in beef cattle diets. Three-hundred sixty-four steers [initial body weight (BW) 567 ± 45.7 lb] were blocked by source (4) and assigned to one of four treatments to determine the effects of almond hull inclusion on growth performance of limit-fed beef cattle. The control diet (CON) contained [dry matter (DM) basis] 39.5% dry-rolled corn, 7.5% supplement, 40% wet-corn gluten feed, and 13% prairie hay. Non-processed almond hulls replaced prairie hay and were fed at 13% of dietary DM (13AH) or replaced prairie hay and a proportion of dry-rolled corn and were fed at 26% of dietary DM (26AH). In addition, a subset of almond hulls was processed using a grinder mixer with no screen. Processed almond hulls replaced prairie hay and were fed at 13% of dietary DM (13PAH). Steers were limit-fed at 2.2% of BW daily (DM basis) for a 56-day growing period. Individual BW were measured on days 0, 14, and 56. Body weights following the 56-day feeding period were greater ($P < 0.01$) in 13AH and 13PAH compared with 26AH. In addition, BW on day 56 tended ($P = 0.10$) to be greater in 13PAH compared with CON. Average daily gains and DM intakes from days 0 to 56 were greater ($P \leq 0.05$) in 13PAH, 13AH, and CON compared with 26AH. As a result, gain-to-feed ratio from days 0 to 56 was greater ($P \leq 0.02$) in 13PAH and 13AH compared with 26AH and tended to be greater ($P = 0.10$) in CON compared with 26AH. Overall, replacing proportions of dry-rolled corn with almond hulls reduced growth performance; however, final BW were similar among steers fed prairie hay or almond hulls at 13% of dietary DM.

Introduction

The California almond crop was estimated to produce 2.8 billion pounds of almonds in 2022. Almond hulls are by-product of almond production and contain soluble sugars that make them a suitable ingredient in livestock diets. Currently, almond hulls are primarily marketed to local California dairies. Unfortunately, increased regulations have resulted in a decline in the California dairy inventory. Almond hulls could potentially be incorporated as a feed ingredient in beef cattle diets; however, the current bulk density of almond hulls make transporting them long distances to cattle-feeding areas difficult. In addition, research evaluating almond hull inclusion in beef cattle diets is limited. The objective of this experiment was to evaluate the effects of almond hull inclusion and almond hull processing on growth performance of limit-fed growing beef cattle.

Experimental Procedures

Three-hundred sixty-four steers [initial body weight (BW) 567 ± 45.7 lb] were purchased in Nebraska and Texas and transported to the Kansas State Beef Stocker Unit. Four truckloads were received between February 17, 2022 and February 21, 2022. Upon arrival, steers were held in earth floor pens and fed the control diet at 2.2% of BW daily [dry matter (DM) basis]. A randomized block design was used to determine the effects of almond hull inclusion in limit-fed growing beef cattle diets. Steers were blocked by source (4), stratified by day -1 BW, and randomly assigned to pens containing 7 to 11 steers. Blocks 1 and 2 contained 12 pens per block and blocks 3 and 4 contained 8 pens per block. Within block, pens were randomly assigned to one of four treatments for a total of 40 pens and 10 replications per treatment.

Composition of experimental diets is presented in Table 1. The control diet (CON) contained (DM basis) 39.5% dry-rolled corn, 7.5% supplement, 40% wet-corn gluten feed, and 13% prairie hay. Non-processed almond hulls replaced prairie hay and were fed at 13% of dietary DM (13AH) or prairie hay and dry-rolled corn and were fed at 26% (26AH) of dietary DM. In addition, a subset of almond hulls was processed using a grinder mixer (Gehl 100 Mix-All, Gehl, West Bend, WI) with no screen. Processed almond hulls replaced prairie hay and were fed at 13% of DM (13PAH).

On March 6, 2022 steers were individually weighed and a visual identification tag was applied. The following morning (day 0), steers were weighed individually, vaccinated against viral respiratory and clostridial pathogens, and treated for external parasites. On day 14, calves were revaccinated against viral respiratory pathogens. Beginning on day 0, steers were limit-fed their respective treatment diets at 2.2% of BW daily (DM basis) for a 56-day period. Feed was mixed and delivered once daily beginning at 7:00 a.m. using a Roto-Mix feed wagon. Individual BW were measured on days 0, 14, and 56 and pen weights were measured weekly to determine feed offered the following week.

Results and Discussion

Body weights on day 0 did not differ ($P = 0.22$; Table 2) among treatments; however, BW on day 14 tended ($P = 0.09$) to be greater in 13PAH compared with 26AH. Body weights at the completion of the 56-day period were greater ($P < 0.01$) in steers fed 13PAH and 13AH compared with calves fed 26AH. In addition, day 56 BW tended to be greater ($P = 0.10$) in 13PAH compared with CON and tended to be greater ($P = 0.06$) in CON compared with 26AH. Average daily gains (ADG) from day 0 to 56 were greater ($P \leq 0.05$) in 13PAH, 13AH, and CON compared with 26AH. Although overall ADG were similar for steers fed 13PAH, 13AH, and CON, differences in ADG from days 14 to 56 were observed. Average daily gains from days 14 to 56 were greater ($P = 0.03$) in 13PAH compared with CON and tended to be greater ($P = 0.09$) in 13AH compared with CON. These data were interpreted to suggest that once steers were adapted to almond hulls in the diet, ADG were improved when almond hulls replaced prairie hay at 13% of dietary DM. The adaptation in the initial 14 days likely reflected differences among treatments in gut fill.

Dry matter intakes from days 14 to 56 and days 0 to 56 were greater ($P \leq 0.05$) in 13PAH, 13AH, and CON compared with 26AH. Differences in DM intake were associated with improved weight gains in steers fed 13PAH, 13AH, and 26AH. Feed

delivery was calculated each week by multiplying weekly average pen weight by 2.2% of BW (DM basis); therefore, greater ADG in steers fed 13PAH, 13AH, and CON resulted in greater average pen weights and ultimately more feed delivered compared with steers fed 26AH. Similarly, gain-to-feed ratio from days 0 to 56 was greater ($P \leq 0.02$) in steers fed 13PAH and 13AH compared with steers fed 26AH. In addition, gain-to-feed ratio from days 0 to 56 tended to be greater ($P = 0.10$) in CON compared with 26AH.

Replacing prairie hay with almond hulls at 13% of dietary DM resulted in similar final BW in limit-fed growing calves; however, improved ADG from days 14 to 56 in calves fed 13AH and 13PAH were interpreted to suggest almond hull inclusion may result in improved growth performance compared with prairie hay inclusion when cattle have adapted to almond hulls in the diet. Conversely, replacing proportions of dry-rolled corn with almond hulls reduced BW gains and feed efficiency.

Implications

These data were interpreted to suggest almond hulls can be utilized as an alternative to prairie hay in limit-fed growing beef cattle diets while maintaining or slightly improving growth performance.

Acknowledgments

Appreciation is expressed to the Almond Board of California for financial support of this study.

Table 1. Composition of experimental diets

| Ingredient, % dry matter | Diet | | | |
|--------------------------|---------|------|-------|------|
| | Control | 13AH | 13PAH | 26AH |
| Dry-rolled corn | 39.5 | 39.5 | 39.5 | 26.5 |
| Supplement ¹ | 7.5 | 7.5 | 7.5 | 7.5 |
| Sweet Bran ² | 40.0 | 40.0 | 40.0 | 40.0 |
| Prairie hay | 13.0 | --- | --- | --- |
| Almond hulls | --- | 13.0 | --- | 26.0 |
| Processed almond hulls | --- | --- | 13.0 | --- |

¹Supplement pellet formulated to contain (DM basis) 8.5% calcium, 0.64% phosphorus, 0.76% potassium, 5.0% salt, and 307 g/ton monensin (Rumensin; Elanco, Greenfield, IN).

²Cargill Corn Milling (Blair, NE).

Table 2. Effects of almond hull inclusion on growth performance of limit-fed growing steers

| Item | Diet ¹ | | | | SEM ² | Treatment |
|----------------------------|----------------------|---------------------|--------------------|---------------------|------------------|-----------|
| | CON | 13AH | 13PAH | 26AH | | P-value |
| Number of pens | 10 | 10 | 10 | 10 | | |
| Number of animals | 91 | 91 | 91 | 91 | | |
| Body weight, lb | | | | | | |
| Day 0 | 573 | 578 | 577 | 572 | 3.9 | 0.22 |
| Day 14 | 595 ^{yz} | 595 ^{yz} | 598 ^y | 586 ^z | 4.9 | 0.09 |
| Day 56 | 720 ^{aby} | 729 ^a | 734 ^{ax} | 703 ^{bz} | 8.4 | < 0.01 |
| Average daily gain, lb/day | | | | | | |
| Days 14 to 56 | 2.97 ^{bcz} | 3.18 ^{aby} | 3.24 ^a | 2.80 ^c | 0.115 | < 0.01 |
| Days 0 to 56 | 2.63 ^a | 2.69 ^a | 2.80 ^a | 2.36 ^b | 0.133 | 0.02 |
| Dry matter intake, lb/day | | | | | | |
| Days 14 to 56 | 14.64 ^a | 14.59 ^a | 14.69 ^a | 14.25 ^b | 0.159 | 0.04 |
| Days 0 to 56 | 13.88 ^a | 13.82 ^a | 13.93 ^a | 13.55 ^b | 0.131 | 0.03 |
| Gain-to-feed, lb/lb | | | | | | |
| Days 14 to 56 | 0.205 ^b | 0.222 ^a | 0.222 ^a | 0.205 ^b | 0.008 | < 0.01 |
| Days 0 to 56 | 0.191 ^{aby} | 0.198 ^a | 0.202 ^a | 0.176 ^{bz} | 0.010 | 0.04 |
| Feed-to-gain, lb/lb | | | | | | |
| Days 14 to 56 | 5.05 ^b | 4.65 ^a | 4.64 ^a | 5.23 ^b | 0.188 | < 0.01 |
| Days 0 to 56 | 5.44 ^{aby} | 5.18 ^a | 5.15 ^a | 5.93 ^{bz} | 0.275 | 0.03 |

¹CON = prairie hay fed at 13% of dietary dry matter (DM); 13AH = almond hulls fed at 13% of dietary DM; 13PAH = processed almond hulls fed at 13% of dietary DM; 26AH = almond hulls fed at 26% of dietary DM.

²Standard error of the mean.

^{a,b,c} Within row, means with unlike superscripts differ ($P \leq 0.05$).

^{x,y,z} Within row, means with unlike superscripts tended to differ ($P \leq 0.10$).