Effects of Almond Hull Inclusion and Processing on Growth Performance of Limit-fed Beef Calves

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Introduction

- The California almond crop was estimated to produce 2.8 billion pounds of almonds in 2022
- Almond hulls are a by-product of almond production
- Almond hulls contain soluble sugars and could potentially be used as a feed ingredient in beef cattle diets
- The bulk density of almond hulls makes transporting them long distances to cattle-feeding areas difficult
- Limited research evaluating almond hull inclusion in beef cattle diets is available

Objective

- Measure particle size and bulk density of almond hulls ground using a hammermill
- Determine the effects of almond hull inclusion on growth performance and ruminal fermentation characteristics of limit-fed growing cattle

Materials and Methods

- Twenty pounds of almond hulls were ground with a laboratory-scale 1.5 HP Bliss Hammermill using a 7/16-inch, 3/4-inch, 1-inch or no screen
- Each screen-size treatment was ground at three separate time points to provide three replications per treatment
- A group of 364 crossbred steers (initial weight 567 ± 46 lb) were blocked by source and assigned to 1 of 4 treatments
- Steers were limit fed experimental diets at 2.2% BW (dry matter basis) for 56-days
- Prairie hay fed at 13% of dietary DM served as the control diet. Almond hulls replaced prairie hay or prairie hay and proportions of dry-rolled corn and were fed at 13% or 26% of dietary DM, respectively
- A portion of almond hulls were processed using a grinder mixer and replaced prairie hay at 13% of dietary DM
- Eight ruminally cannulated heifers were arranged in a 4 × 4 Latin rectangle to evaluate the effects of almond hull inclusion on ruminal fermentation and diet digestibility

Almond Hull Processing

	Hammermill screen hole diameter[1]					
Item	7/16 in	3/4 in	1 in	No screen	SEM	*P*- value
Particle size,[2] µm	1324^{c}	1772^{b}	1777^{b}	2217^{a}	71.2	0.01
Standard deviation	2.5	2.5	2.5	2.2	0.138	0.13
Bulk density,[3] lbs/ft^3	33.9^{y}	30.3^{z}	30.2^{z}	29.7^{z}	1.45	0.07

[1] Almond hulls were ground with a laboratory-scale 1.5 HP Bliss Hammermill using a 7/16-inch, 3/4-inch, 1-inch, or no screen
[2] Particle size and standard deviation determined as described by ASABE 319.4 methods
[3] Bulk density of non-processed almond hulls: 14.1 lbs/ft^3
^{a,b,c} Within row, means with unlike superscripts differ ($P \leq 0.05$)
^{y,z} Within row, means with unlike superscripts tend to differ ($P \leq 0.10$)

Experimental Diets

Ingredient	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	-

[1] Supplement pellet formulated to contain (dry matter basis) 8.5% calcium, 0.64% phosphorus, 0.76% potassium, 5.0% salt, and 307 g/ton monensin (Rumensin; Elanco, Greenfield, IN)
[2] Cargill Corn Milling (Blair, NE)

Growth Performance

	Treatment					
Item	CON	13AH	13PAH	26AH	SEM	*P*-value
No. of pens	10	10	10	10		
No. of animals	91	91	91	91		
Body Weight, lbs						
Day 0	573	578	577	572	3.9	0.22
Day 56	720^{aby}	729^{a}	734^{ax}	703^{bz}	8.4	< 0.01
ADG, lb/d	2.63^{a}	2.69^{a}	2.80^{a}	2.36^{b}	0.133	0.02
DMI, lb/d	13.9^{a}	13.8^{a}	13.9^{a}	13.6^{b}	0.13	0.03
F:G, lb/lb	5.4^{aby}	5.2^{a}	5.2^{a}	5.9^{bz}	0.28	0.03

^{a,b} Within row, means with unlike superscripts differ ($P \leq 0.05$)
^{x,y,z} Within row, means with unlike superscripts tend to differ ($P \leq 0.10$)

Apparent Digestibility

	Treatment					
Item	CON	13AH	13PAH	26AH	SEM	*P*-value
Dry matter	70.1	72.4	73.3	67.8	2.79	0.21
Organic matter	72.8	74.6	75.5	69.8	2.61	0.15
NDF	54.7	51.4	51.2	46.1	4.61	0.31
ADF	38.9	30.0	33.3	24.8	6.77	0.22

Fermentation Characteristics

	Treatment					
Item	CON	13AH	13PAH	26AH	SEM	*P*-value
VFA, m*M*						
Acetate	50.2	49.3	49.1	46.5	1.80	0.16
Propionate	24.2^{c}	28.4^{b}	32.8^{a}	24.0^{c}	1.66	< 0.01
Butyrate	12.7	13.2	11.4	12.5	0.92	0.22
Total VFA	91.5^{bcz}	95.8^{ab}	98.4^{ay}	87.7^{c}	3.80	< 0.01
Ruminal pH	5.96^{ab}	5.84^{bc}	5.83^{c}	5.99^{a}	0.065	0.03

^{a,b,c} Within row, means with unlike superscripts differ ($P \leq 0.05$)
^{x,y,z} Within row, means with unlike superscripts tend to differ ($P \leq 0.10$)

Conclusions

- Processing almond hulls with a hammermill reduced particle size and increased bulk density
- Apparent dry matter digestibility did not differ among diets
- Replacing proportions of dry-rolled corn with almond hulls reduced growth-performance
- Growth performance was similar between steers fed prairie hay or processed and non-processed almond hulls
- Almond hulls can be considered as an alternative to prairie hay in limit-fed growing diets