Effect of Almond Hull Level in a Finishing Diet on Lamb Growth and Carcass Performance[1]

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Abstract

Thirty-two Hampshire x Suffolk lambs were fed over two years (year 1 n=14; year 2 n=18) to evaluate the effect of feeding almond hulls (AH) in finishing diets on lamb growth performance and carcass characteristics. Lambs were fed a base ration that was 35% roughage and 65% concentrate. Almond hulls replaced a portion of the alfalfa at 0%, 5%, and 10% of the diet. Data were analyzed as a randomized block design, blocking on year. Addition of almond hulls to the ration did not affect daily gain, feed intake and feed efficiency (P>0.40). Addition of almond hulls did not affect (P>0.19) carcass weight, yield grade or quality grade. Replacing chopped alfalfa with up to 10% almond hulls in lamb finishing diets did not adversely affect growth or carcass performance.

Key Words: lambs, almond hulls, carcass, growth

1. Introduction

Feed costs have escalated over the past several years and have a direct impact on profitability of animal enterprises. Utilizing by-product feeds for livestock production has been a common practice to reduce feed costs and improve profitability (DePeters et al., 2000; Grasser, Fadel, Garnett &DePeters, 1995; Mowrey & Spain, 1999). Fadel (1999) reviewed global usage of plant by-product feeds and determined that for every 100 kg of commodities processed for human food and fiber yields 22 kg of by-product feedstuffs in the USA and 40 kg, globally. California is an agriculturally diverse state, and numerous research projects describe the utilization of by-product feedstuffs in ruminant diets, predominately dairy cattle (Arosemena, DePeters, & Fadel, 1995; Grasser et al., 1995). Almond hulls are a readily available by-product feedstuff in California that can vary in nutrient content (DePeters et al., 2000). The California Department of Food and Agriculture requires that almond hulls shall not contain more than 13% moisture, nor more than 15% CF and 9% ash (DePeters et al., 2000).

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Feed prices have increased drastically over the past couple of decades. This forces producers to evaluate alternative feeds for incorporation into ruminant diets as a method to reduce feed costs (St-Pierre & Knapp, 2008). Many of the by-product feeds evaluated are as replacements for concentrates in ruminant diets (Bamipidis& Robinson, 2005; Bradford & Mullins, 2012; Grasser et al., 1995). Hartwell, Iniquez, Knaus, and Madsen (2010) evaluated the effectiveness and economic benefits of locally available feed resources on lamb growth and carcass traits. It was concluded that the use of locally available feed resources have the potential to reduce and/or stabilize feed costs during times of high grain prices. There is limited data on the use of almond hulls as a potential roughage replacement in sheep diets. The objective of this study was to determine the effects of feeding different levels of almond hulls on finishing lamb growth performance and carcass characteristics.

2. Materials and Methods

Thirty-two Suffolk x Hampshire spring born lambs were assigned to one of three diets with varying levels of almond hulls (0%, 5%, and 10% almond hull) over two years. Animals were handled and managed according to Institutional Animal Care and Use Committee of California State University, Chico. Prior to trial initiation each year, lambs were vaccinated for *Clostridial* diseases, dewormed, and evaluated for hoof problems. During year one, 14 lambs were fed and during year two, 18 lambs were fed. Sex (wethers, n = 17; ewes, n = 15) was balanced across dietary treatments during both years. Lambs were fed a base diet of 35% roughage (chopped alfalfa) and 65% concentrate (18% CP bulk grain mix). Almond hulls replaced a portion of the roughage at 0%, 5%, or 10% of the total diet. Individual feed ingredient samples (chopped alfalfa, bulk grain, and almond hulls) were sent to an analytical laboratory for determination of nutrient concentrations (Dairy One, Ithaca NY). These values were used to calculate diets to meet the minimum requirements for growing lambs (Table 1). Lambs were fed for 63d each year, during the fall (mid-September through mid-November). Lambs were housed in-group pens that were 3.7 m by 18.6 m with one end of each pen sheltered. At 0600 h and 1730h each day, lambs were placed in individual feeding stalls (0.6 m by 1.2 m)for approximately 45-60 minutes for feeding.

At the conclusion of each feeding time, refusal was weighed, bunk scores (Table 2) and fecal scores (Table 3) were assigned and appropriate changes to feed allocation were made. All lambs had ad libitum access to water and a trace mineral salt. Lambs were adapted to the individual feeding system for 14d prior to initiation of the trial. Lambs were weighed at 1300 h for two consecutive days upon trial initiation and conclusion. An average of the two weights was used for determination of beginning and ending weights. All pens were cleaned weekly (Fridays between 1300 h and 1500 h) throughout the 63d feeding period. Upon the conclusion of the trial, lambs were harvested at the California State University, Chico's Agriculture and Teaching Research Center. Following evisceration, hot carcass weights were determined and dressing percentages were calculated. Carcasses were chilled for 48 h at 3°C prior to determination of yield and quality grades as per United States Department of Agriculture (1992) lamb grading standards. Growth and carcass data were analyzed as a randomized block design using PROC MIXED (SAS Inst. Inc., Cary, NC). Data were blocked by year, and the model included the fixed effect of dietary treatment. Individual lamb was the experimental unit. Least square means of significant effects were separated using least squares difference.

3. Results and Discussion

Beginning weights of the lambs did not differ (40.0 kg; $P = 0.90$) among treatment groups. Additionally, level of almond hull in the diet did not impact ending weights (Table 4; $P = 0.83$), total feed intake (Table 4; $P = 0.81$) and ADG (Table 4; $P =0.46$). Feed efficiency (expressed as gain: feed) was not impacted by level of almond hull (Table 4; $P = 0.46$). Hot carcass weights, yield grade and quality grade were not impacted by level of almond hull in the diet of finishing lambs (Table 5; $P> 0.20$). Dressing percent tended to differ ($P = 0.07$) among treatments, with the 0% AH diet dressing at 63.7%, 5% AH diet dressing at 59.8% and 10% AH diet dressing at 60.2%. By-product ingredients have been evaluated as alternative feed ingredients for ruminants. Bradford and Mullins (2012) reviewed the use of non-forage fiber sources (NFFS) in the dairy industry. Non-forage fiber sources were defined as greater than 30% NDF and includes feeds such as brans, spent grains, fruit/vegetable pomace, and hulls.

Bradford and Mullins (2012) concluded that judicious use of NFFS can maintain health and production in dairy cattle, while possibly controlling feed costs. In sheep, the majority of NFFS alternative feeds have been evaluated as replacements for concentrates in diets (Ferreira et al., 2014; Mahgoub et al., 2005).

Christodoulou et al.(2008) replaced alfalfa meal with various levels of fermented olive wastes in growing lamb rations. Increasing level (up to approximately 15% of the ration, as fed) of fermented olive waste did not impact lamb growth or carcass parameters. Citrus pulp has been evaluated as a possible replacement for roughage (Scerra, Caparra, Foti, Lanza, & Priolo, 2001) and concentrates (Caparra, Foti, Scerra, Sinatra, &Scerra, 2007) in growing lamb diets. By-product feeds have had minimal impact on carcass traits when replacing various components of the ration.

Scerra et al. (2001) determined that citrus pulp and wheat straw silage could be economically beneficially without affecting carcass and meat quality in growing. Tufarelli, Introna, Cazzato, Mazzei, and Ladadio (2013) reported no impact on carcass fat when partly destined exhausted olive cake was used to replace part of the roughage component in finishing lamb diets. Almond hulls are a NFFS (Bradford & Mullins, 2012 that has limited data published regarding use in small ruminants. Yalchi (2011) determined that almond hulls were higher in sugars than alfalfa hay and had greater DM digestibility in lambs, than alfalfa hay. Vonghia, Ciruzzi, Vicenti, and Pinto (1989) evaluated the impact of almond hulls at 15% and 30% of lamb finishing diets. Similar to the current study, these researchers observed no difference in ending weight, however, they observed improved feed efficiency with the addition of almond hulls. However, and almond hulls have been successfully substituted for alfalfa in dairy rations without reducing performance (Aguilar, Smith, & Baldwin, 1984; Reed & Brown, 1989). Researchers have determined that almond hulls can be reasonable energy sources in lamb diets (Alibes, Maiestre, Munoz, Combellas, & Rodriquez (1983) and in equine diets (Clutter &Rodiek, 1992). Furthermore, Clutter and Rodiek (1992) concluded that the energy value of almond hulls is comparable to mid bloom alfalfa, and although almond hulls are low in protein, they can complement alfalfa-based rations.

4. Implications

Replacing chopped alfalfa hay with almond hulls (up to 10%) did not impact lamb growth, feed efficiency or carcass traits. Lambs fed a diet that is approximately 65% concentrate and 35% roughage (from either alfalfa or almond hulls) gained 290 g/d, consumed 4.2% of their BW in DM/d and averaged about 0.188 gain:feed. During times of high feed prices, almond hulls are a potential cost-controlling feed source in growing lamb diets.

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Table 1: Nutrient composition of diets containing 0%, 5%, and 10% almond hull in replacement of the roughage component of the diet

	---Percentage of Almond Hull in Diet---		
	0%	5%	10%
---Ingredients in Diet, % as fed---			
Alfalfa, chopped	35	30	25
Almond hulls	0	5	10
Commercial grain mix	65	65	65
Average cost ($/kg feed)	$0.421	$0.410	$0.400
---Calculated Composition---*			
DM, % as fed	90.20	90.10	90.00
TDN, % DM (68%)	67.91	68.02	68.14
CP, % DM (16%)	18.18	17.54	16.90
CF, % DM	16.03	15.37	14.71
ADF, % DM	17.79	17.33	16.86
NDF, % DM	24.64	24.07	23.05
Ca, % DM (0.50%)	0.83	0.78	0.73
P, % DM (0.30%)	0.46	0.45	0.44
*Average nutrient requirements for growing lambs in parenthesis (NRC, 1985)			

Table 2: Bunk scoring system used for feed allocation, adapted from Loy (1997)

Score	Description
0*	No remaining feed
½*	Scattered feed present, crumbs, most of the bottom of bunk is exposed
1	Thin, uniform layer of feed, approximately one kernel deep
2**	Approximately 25-50% of offered feed remaining
3**	Crown of feed disturbed, >50% of offered feed remaining
4**	Feed virtually untouched

*Animals receiving a score of ½ or less for 4 consecutive feedings had feed allocation increased by 10%.
**Animals receiving a score of 2 or greater for 4 consecutive feedings had feed allocation decreased by 5%.

Table 3: Fecal scoring system used to monitor animal digestive system health

Score	Description
1	Pelleted feces, considered normal, no treatment
2	Soft, non-pelleted feces, considered normal, no treatment
3	Loose feces, considered abnormal, animals treated for digestive upset
4	Diarrhea, off odor, considered abnormal, animals treated for digestive upset

Table 4: Effect of almond hull level in finishing lamb diets on growth and feed efficiency

	---Percentage of Almond Hull in Diet---				
	0%	5%	10%	SEM	P-value
Number of animals	10	11	11	---	---
Beginning wt, kg	39.90	40.55	39.52	5.11	0.91
Ending wt, kg	57.14	58.79	58.71	3.67	0.83
Total feed intake, kg	101.84	99.65	103.82	15.59	0.81
ADFI, % of BW	4.33	4.08	4.21	0.57	0.22
ADFI, kg/d	1.62	1.58	1.65	0.25	0.81
ADG, g/d	275.3	290.4	305.4	30.31	0.46
Feed efficiency, gain: feed	0.177	0.193	0.194	0.048	0.46

Table 5: Effect of almond hull level in finishing lamb diets on carcass characteristics

	---Percentage of Almond Hull in Diet---				
	0%	5%	10%	SEM	P-value
Hot carcass wt, kg	36.04	35.08	35.24	1.91	0.84
Yield grade	2.80	3.03	2.64	0.22	0.19
Quality grade*	2.80	2.36	2.36	0.35	0.58
Dressing percentage	63.67	59.84	60.25	1.27	0.07

*A quality grade score of 2.0 is the equivalent of high Choice and a score of 3.0 is the equivalent of average Choice.