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Effect of Feeding Sesame Hull on Growth Performance, Nutrient Digestibility, and Carcass Characteristics of Black Goat Kids

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ABSTRACT : An experiment was conducted to evaluate the effect of replacing barley and soybean meal in finishing diets with sesame hull (SH) on growth performance, digestibility, and carcass characteristics of Black goat kids. Twenty-one Black goat kids were assigned randomly to 0%, 10%, or 20% SH diets (7/diet). The study lasted for 63 d. Intakes of dry matter (DM), organic matter (OM), and crude protein (CP) of kids fed the 10% diet were greater ($p<0.05$) than for the 0% and 20% SH diets ($p<0.10$). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) intakes were highest ($p<0.05$) for kids fed the 10% SH diet when compared to 0% and 20% SH diets. Ether extract (EE) intake was greater ($p<0.05$) for kids fed 10% and 20% SH diets when compared to 0% SH. Digestibilities of DM, OM, CP, NDF, and ADF were similar among all diets. However, sesame hull inclusion increased ($p<0.05$) EE digestibility. Final body weight, total gain, average daily gain (ADG), and feed conversion ratio were comparable among all diets. Cost of gain was lower ($p<0.05$) in kids fed 20% SH than the 0% SH diet, while there was no difference between the 10% SH diet and the other two diets. Dressing percentage, hot and cold carcass weights, non-carcass components, carcass cut weights, and meat quality parameters were not influenced by SH. Total fat percentage in the leg was greater ($p<0.05$) on 0% SH than on the 10% SH diet. Results of this study demonstrated that inclusion of sesame hull at levels of 10 or 20% did not influence the performance of Black goat kids, but the cost of gain was lower. (**Key Words :** Black Goat Kids, Sesame Hull, Growth, Digestibility, Carcass Characteristics)

INTRODUCTION

The unprecedented jump in feed ingredient prices has directly affected many Jordanian livestock producers because the government has scaled down the subsidy on barley, and market prices of red meat do not compensate for the extra production cost. Therefore, producers are geared to use any available agro-industrial by-products such as acorns (Al Jassim et al., 1998), olive cakes (Alcaide et al., 2003; Ben Salem et al., 2003; Chiofalo et al., 2004), tomato pomace (Denek and Can, 2006), date palm (Mahgoub et al., 2007), mustard cake (Kumar et al., 2002), and *Prosopis juliflora* pods (Abdullah and Abd al hafes, 2004; Obeidat et al., 2008a). However, very few studies have evaluated the effect of using sesame meal or hull in livestock rations. Omar (2002) reported that the addition of sesame oil cake at 10% and 20% improved digestibility of protein and fiber, average daily gain, feed conversion ratio, and cost of feed/kg gain in growing Awassi lambs when compared to a commercially fed ration. Recently, Obeidat and Aloqaily (2010) found that when soybean meal and barley grain were replaced by sesame hull at levels of 12.5% and 25%, finishing performance of Awassi lambs was improved and cost of production diminished without any detrimental effect on carcass characteristics or meat quality.

Sesame hulls are by-products of the sesame seed industry after oil extraction (Herano et al., 2002). Depending on the process, mechanical or solvent extraction, the chemical composition varies and, accordingly, crude protein ranges between 23.0 and 31.0% (MOA, 2007). In Jordan, a total of 1,250 tons of sesame hull and sesame meal are produced annually (MOA, 2007). Thus, the use of such by-products in livestock production will partially help producers to alleviate the effect of globally increasing feed costs, especially if there is no detrimental effect of inclusion on growth performance characteristics.

Black goats contribute around 20-25% of the total red meat production in Jordan (MOA, 2007). No research has been conducted to investigate the use of sesame hull in feeding Black goat kids. Therefore, this study was designed to investigate the effect of sesame hull (SH) feeding on nutrient intake and digestibility, growth performance,

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carcass characteristics and meat quality of Black goat kids.

MATERIALS AND METHODS

Experimental design, animals, and diets

A total of twenty-one Black goat kids, averaging 6 months of age and 17.9±0.75 kg body weight, were assigned randomly to one of three diets (7 kids/diet). Sesame hull was included in the diets at 0%, 10%, 20% levels to replace soybean meal and part of the barley grain (Table 1). Sesame hull was obtained from a local industry for oil extraction from seed. All diets were iso-nitrogenous and formulated to have 16.3% CP (DM basis) and to meet requirements for fattening Black goat kids. Kids were housed individually in shaded pens (1.5 m×0.75 m), and fed twice daily (two equal meals at 0900 and 1500) for 63 d. Diets were mixed biweekly during the study and were sampled upon mixing to ensure consistency in their chemical composition. A one-week adaptation period was allowed prior to receiving the experimental diet. A total mixed ration was offered *ad libitum* to all animals which had free access to fresh water. Refusals were collected, weighed, and recorded before the next-day feeding to evaluate daily intake of DM and other nutrients, and representative samples were taken to be chemically analyzed. Feeders were managed to allow no more than 10% of feed per animal to remain 1 h prior to feeding on the following day. When feeders were found to be empty, the amount of feed offered was scaled up by 10% on the following day. Kids were weighed before the morning feeding at the beginning of the study and weekly thereafter.

At the end of the fattening period, three animals from each dietary group were selected randomly and housed individually in metabolism crates to evaluate nutrient digestibilities. Animals were allowed a period of 7 days to adapt to the metabolism crates, followed by a 4-day collection period. Feed intake and refusals were recorded and sampled during those 4 days for further analysis. Daily fecal output was collected, weighed, and recorded, and 10% was kept for subsequent analysis. All samples were dried at 55°C in a forced-air oven to constant weight, air equilibrated, then ground to pass a 1 mm screen (Brabender OHG Kulturstrase 51-55, type 880845, Nr 958084, Duisdurg, Germany) and stored for further analysis. Diets, feed refusals, and faeces were analyzed for their DM, OM, CP, NDF, and ADF content following AOAC (1990) procedures. The methods were as follows: DM (100°C in air-forced oven for 24 h; method 967.03), OM (550°C in ashing furnace for 6 h; method 942), CP (Kjeldahl procedure) and EE (Soxtec procedure, SXTEC SYSTEM

Table 1. Ingredients and chemical composition of the diets

Item	Diets[1]			Sesame hull
	0%	10%	20%	
Ingredients (% DM)				
Barley	62.0	59.0	56.0	
Soybean meal	15.0	7.5	0	
Sesame hull	0	10.0	20.0	
Wheat hay	20.0	20.0	20.0	
Urea	0	0.5	1.0	
Salt	1.4	1.4	1.4	
Limestone	1.5	1.5	1.5	
Mineral and vitamins[2]	0.1	0.1	0.1	
Feed cost/ton (US$)	530	461	393	
Nutrient				
Dry matter (%)	92.9	93.5	92.6	93.3
Organic matter (% DM)	88.2	83.9	85.0	80.0
Crude protein (% DM)	16.3	16.3	16.3	25.8
Neutral detergent fiber (% DM)	34.9	33.0	30.5	23.0
Acid detergent fiber (% DM)	16.5	16.0	14.0	15.8
Ether extract (% DM)	2.6	6.1	7.1	17.6
ME (Mcal/kg)[3]	2.7	2.8	2.9	3.92[4]

[1] Diets were: 1) no SH (0%; n = 7), 2) 10% SH (10%; n = 7), and 20% SH (20%; n = 7) of the total mixed diet.
[2] Composition per 1 kg contained (vitamin A, 450,000 IU; vitamin D3, 1,100,000 IU; vitamin E, 3.18 g, Mn, 10.9 g; I, 1.09 g; Zn, 22.73 g; Fe, 22.73 g; Cu, 2.73 g; Co, 0.635; Mg, 100 g; Se, 0.1 g).
[3] ME = Metabolizable energy; calculated using NRC (1985). [4] NRC (1994).

HT 1043 Extraction Unit, TECATOR, Box 70, HOGANAS, SWEDEN). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed according to procedures described by Van Soest et al. (1991) with modifications for use in the $ANKOM^{2000}$ fibre analyzer apparatus (ANKOM Technology Cooperation, Fairport, NY). NDF analyses were conducted using sodium sulfite and alpha amylase (heat stable) and expressed with residual ash content.

Slaughtering procedures and meat quality measurements

At the end of the experiment all the animals were slaughtered to evaluate carcass characteristics and meat quality. After fasting for around 18 h all animals were processed by trained personnel using standard slaughter procedures (Abdullah et al., 1998). Fasted live weight was recorded immediately before slaughter and hot carcass weight was recorded after slaughter. Cold carcass weight was recorded after chilling the carcass at 4°C for 24 h. Empty live weight was calculated by subtracting rumen contents from the fasted live weight. Non-edible carcass components (lungs and trachea, heart, liver, spleen, kidney, kidney fat, mesenteric fat and testes) were removed and weighed directly after slaughter. On the next day, following the procedure described by Abdullah et al. (1998) linear dimensions such as tissue depth (GR), rib fat depth (J), eye muscle width (A), eye muscle depth (B), eye muscle area, fat depth (C), and shoulder fat depth (S2) were taken on the chilled carcass and *longissimus* muscle. Carcasses were then cut into four parts (shoulder, rack, loin and leg cuts). Upon cutting, the loin cut was dissected and *longissimus* muscle was excised and vacuum-packed immediately and stored at -20°C for 2 weeks until assessment of meat quality.

Meat quality parameters measured were pH, color (CIE *L*a*b** coordinates), cooking loss, water holding capacity (WHC) and shear force values. Frozen *longissimus* muscles were thawed in a chiller at 4°C overnight while still in plastic bags. Each muscle was divided into slices of specific thickness and each slice was used for specified meat quality measurement as described by Abdullah and Musallam (2007) and Obeidat et al. (2008b). Color was measured on 15 mm thick slices. Muscle slices were weighed before cooking, placed in plastic bags and cooked in a water bath at 75°C for 90 minutes and cooking loss was measured as a percent of the pre-cooked weight. Shear force values of cooked meat were measured using a Warner-Bratzler shear device to determine the maximum force required to cut through each core in a perpendicular direction to the muscle fibers (Warner-Bratzler meat shear, G-R Manufacteuring Co. 1317 Collins LN, Manhattan, KS, USA). Muscle pH was measured using a pH spear after thawing and homogenizing 2 g of raw meat in 10 ml of neutralized 5-mM iodoacetate reagent (pH Spear, Large screen, waterproof pH/Temperature Tester, double injection, model 35634-40, Eurotech instruments, Malaysia). Water-holding capacity was measured using the procedure described by Grau and Hamm (1953).

Statistical methods

The data obtained were analyzed using the MIXED procedure of SAS (version 8.1, 2000, SAS Inst. Inc., Cary, NC). For all data, the fixed effect included only treatment. Initial body weight was used as a covariant for analysis. Least square means were separated using appropriate pair-wise t-tests if the fixed effects were significant ($p<0.05$).

RESULTS

Nutrient intakes, digestibility, live weight gain, and feed conversion ratio

Nutrient composition of the three diets was similar except for the EE content due to the high level of EE in the sesame hull when compared to barley grain and soybean meal. All animals completed the study without any health problems, demonstrating that sesame hull could partially replace barley and soybean meal feed ingredients in diets of finishing Black goat kids.

Nutrient intake, digestibility coefficients and performance data of Black goat kids fed finishing diets containing SH are presented in Table 2. Kids fed a diet containing 10% SH had higher intakes ($p<0.05$) of DM, OM, and CP than those fed a 0% or 20% SH diet ($p<0.10$). Also, NDF and ADF intake was highest ($p<0.05$) in kids fed the 10% SH diet compared to 0% or 20% SH diets. EE intake was greater ($p<0.05$) in kids fed 10% and 20% SH diets when compared to 0% SH. Although EE digestibility of diets containing SH was higher ($p<0.05$) compared to 0% SH, the digestibilities of DM, OM, CP, NDF, and ADF were similar among all dietary groups (Table 2).

Initial body weight was similar among treatment groups. However, final body weight, total weight gain and ADG tended to be greater ($p<0.10$) for kids fed the 10% SH diet compared to 0% SH. All groups reported similar feed conversion ratios; nevertheless cost of production was lower ($p<0.05$) for kids fed the 20% SH diet compared to 0% SH. Kids fed the 10% SH diet had a similar cost of production to both 0% and 20% SH diets.

Carcass and non-carcass characteristics and meat quality

Fasted live weights, empty live weights, hot and cold carcass weights, dressing percentages, non-carcass components and weights of carcass cuts are shown in Table 3. No significant differences were observed among the different treatment groups with respect to these parameters.

Table 2. Least squares means for nutrient intake and performance of Black goat kids fed finishing diets containing sesame hull

Item	Diets[1]			SE
	0%	10%	20%	
Nutrient intake (g/d)				
Dry matter	657[a]	963[bc]	768[ad]	71.4
Organic matter	580[a]	808[bc]	653[ad]	61.2
Crude protein	107[a]	157[bc]	125[ad]	11.7
Neutral detergent fiber	230[a]	318[b]	235[a]	23.5
Acid detergent fiber	108[a]	154[b]	108[a]	11.1
Ether extract	16[a]	55[b]	55[b]	4.3
Digestibility coefficients (%)				
Dry matter	74.2	71.0	67.8	4.83
Organic matter	74.1	70.3	67.2	5.01
Crude protein	64.4	61.5	63.7	7.30
Neutral detergent fiber	53.3	47.6	38.8	9.27
Acid detergent fiber	53.2	47.4	34.5	9.51
Ether extract	69.8[a]	89.1[b]	85.5[b]	4.16
Initial body weight (kg)	18.3	17.9	17.4	0.75
Final body weight (kg)	24.2[c]	27.0[d]	26.1[cd]	1.81
Total gain (kg)	6.3[c]	9.2[d]	8.2[cd]	0.98
ADG (g)[2]	100.1[c]	145.2[d]	130.8[cd]	15.62
FCR[3]	7.54	7.31	6.24	1.05
Cost/kg gain (US$)	4.01[a]	3.37[ab]	2.49[b]	0.525

[1] Diets were: 1) no SH (0%; n = 7), 2) 10% SH (10%; n = 7), and 20% SH (20%; n = 7) of the total mixed diet.
[2] ADG = Average daily gain ((final weight-initial weight)/63 days). [3] FCR (g DM intake/g ADG) = Feed conversion ratio.
[a,b] Within a row, means without a common superscript letter differ ($p<0.05$).
[c, d] Within a row, means without a common superscript letter differ ($p<0.10$).

Table 3. Least-squares means for liveweights, carcass weights, dressing percentages, weights of carcass cuts and non-carcass components of Black goat kids fed finishing diets containing sesame hull

Item	Diets[1]			SE
	0%	10%	20%	
Fasting live weight (kg)	23.9	25.6	25.1	1.2
Empty live weight (kg)[2]	22.5	23.8	23.4	1.1
Hot carcass weight (kg)	11.92	12.18	12.22	0.7
Cold carcass weight (kg)	11.13	11.71	11.86	0.7
Dressing percentage[3]	52.8	50.8	52.1	1.8
Non-carcass components (g)				
Heart	99	105	98	7
Liver	453	512	494	26
Spleen	37	48	98	30
Kidney	67	75	69	4
Kidney fat	270	275	370	42
Mesenteric fat	664	644	638	69
Testes	174	183	221	27
Lungs and trachea	304	372	306	24
Carcass cut weights (kg)				
Shoulders	4.98	4.97	5.33	0.4
Racks	1.03	1.01	1.17	0.1
Loins	0.92	1.00	0.98	0.1
Legs	3.56	3.68	3.81	0.3

[1] Diets were: 1) no SH (0%; n = 7), 2) 10% SH (10%; n = 7), and 20% SH (20%; n = 7) of the total mixed diet.
[2] Empty live weight equal fasted live weight minus rumen content.
[3] Dressing percentage = (Hot carcass weight/empty live weight)×100.

Table 4. Least-squares means for weights and percentages of dissected loins and legs of Black goat kids fed finishing diets containing sesame hull

Item	Diets[1]			SE
	0%	10%	20%	
Loin weight (g)	443.7	493.3	491.7	24.2
Longissimus muscle (g)	114.3	124.0	124.9	10.6
Intermuscular fat (%)	15.9	13.5	16.2	1.4
Subcutaneous fat (%)	2.5	2.8	2.4	0.4
Total fat (%)	18.4	16.4	18.9	1.3
Total lean (%)	46.1	45.5	45.6	2.2
Total bone (%)	29.6	31.9	29.9	1.8
Meat to bone ratio	1.62	1.45	1.57	0.15
Meat to fat ratio	2.52	3.19	2.43	0.35
Leg weight (g)	1,713.2	1,893.3	1,829.0	106.4
Intermuscular fat (%)	6.0	4.9	5.9	0.4
Subcutaneous fat (%)	5.4	4.3	4.4	0.5
Total fat (%)	11.3[a]	9.1[b]	10.3[ab]	0.6
Total lean (%)	56.6	56.7	58.1	1.0
Total bone (%)	26.2[c]	28.0[d]	26.0[c]	0.8
Meat to bone ratio	2.17	2.04	2.26	0.09
Meat to fat ratio	5.12	6.52	5.72	0.44

[1] Diets were: 1) no SH (0%; n = 7), 2) 10% SH (10%; n = 7), and 20% SH (20%; n = 7) of the total mixed diet.
[a, b] Within a row, means without a common superscript letter differ ($p<0.05$).
[c, d] Within a row, means without a common superscript letter differ ($p<0.10$).

No differences were observed for dissected loins and legs except for total fat (%) and total bone (%) in legs (Table 4). Total fat percentage in the leg was greater ($p<0.05$) in the 0% SH group than in the 10% SH group. Total bone percentage tended to be greater ($p<0.10$) in kids fed the 10% SH diet when compared to the 0% and 20% SH diets.

No differences were observed in carcass and *longissimus* muscle linear dimensions and fat measurements among the treatment groups (Table 5).

Least square means for average meat quality characteristics measured in *longissimus* muscle are presented in Table 6. No differences were observed between treatment groups in pH, cooking loss, water holding capacity, and shear force values. No differences were observed in brightness (L*), redness (a*), and yellowness (b*) of the carcass.

DISCUSSION

Nutrient intakes and digestibility, live weight gain, and feed conversion ratio

Although the null hypotheses for performance parameters held true, substitution of barley grain and soybean meal with sesame hull reduced the unit production cost of the diets and thus improved profitability. This was due to the low cost of sesame hull compared to the current price of barley grain and soybean meal. Barely grain and

Table 5. Least-squares means for carcass and *M. longissimus* linear dimensions and fat measurements of Black goat kids fed finishing diets containing sesame hull

Item	Diets[1]			SE
	0%	10%	20%	
Tissue depth (GR) (mm)	3.41	3.86	3.23	0.3
Rib fat depth (J) (mm)	2.73	3.67	2.71	0.4
Eye muscle width (A)(mm)	37.1	49.7	41.9	3.9
Eye muscle depth (B)(mm)	21.0	23.9	22.4	2.5
Eye muscle area (cm^2)	12.53	12.95	13.31	1.2
Fat depth (*C*) (mm)	1.35	1.50	1.50	0.4
Shoulder fat depth (S2) (mm)	2.47	2.53	2.61	0.2

[1] Diets were: 1) no SH (%; n = 7), 2) 10% SH (10%; n =7), and 20% SH (20%; n = 7) of the total mixed diet.

Table 6. Least square means for a range of meat quality characteristics of Black goat kids fed finishing diets containing sesame hull

Item	Diets[1]			SE
	0%	10%	20%	
pH[2]	6.05	6.08	6.07	0.02
Cooking loss (%)	31.7	29.3	32.0	1.3
Water holding capacity (%)	29.3	31.3	29.0	1.4
Shear force (kg/cm^2)	2.53	2.44	2.59	0.17
Color coordinates				
*L** (brightness)	38.16	37.06	39.81	1.4
*a** (redness)	2.11	1.52	1.65	0.2
*b** (yellowness)	17.51	15.82	17.37	1.4

[1] Diets were: 1) no SH (0%; n = 7), 2) 10% SH (10%; n = 7), and 20% SH (20%; n = 7) of the total mixed diet.
[2] pH measured after thawing.

soybean meal replacement by SH in the diet at 10% and 20% levels reduced the cost by 13% and 26%, respectively, compared to the 0% SH diet. Therefore, this study has shown the economic advantages of using sesame hull in the finishing diets of Black goat kids. Similar results were also obtained by Obeidat and Aloqaily (2010) who reported a reduction in cost when sesame hull was included at levels of 12.5% and 25% in diets of Awassi lambs.

Sesame hull inclusion in the diet of kids improved intake in 10% SH fed groups compared to 0% and 20% SH groups. Thus, it is safe to conclude that the presence of SH at a 10% level in the diet did not affect palatability. Obeidat et al. (2009) reported similar results when sesame meal was fed to Awassi lambs at 8% of the diet. Recently, Obeidat and Aloqaily (2010) investigated the effect of feeding sesame hull in Awassi lambs and found that intake improved when included at levels of 12.5 and 25%.

In the current study, results indicated that the digestibilities of DM, OM, CP, NDF and ADF were not affected by inclusion of sesame hull in diets of Black goat kids. Omar (2002) reported that the digestibilities of CP and CF were greater in lambs fed diets containing sesame oil cake, whereas DM digestibility was not affected. Khan et al. (1998) found that the DM and nitrogen-free extract digestibilities were not affected when til oil cake was replaced by poultry excreta, but CP and CF digestibilities were higher in the group supplemented with til oil cake. In addition, digestibilities of DM, OM, CP, and EE were not affected when Awassi lambs were fed with sesame meal (Obeidat et al., 2009). Hossain et al. (1989) found that DM digestibility was higher when goat kids were fed sesame oil cake supplemented with mineral mixture. Thus, it is clear that using sesame hull as an alternative feed ingredient is applicable in feeding Black goat kids without affecting nutrient digestibility.

The current study reported similar growth rates to those obtained by Abdullah and Musallam (2007) using the same breed. Farran et al. (2000) found that weight gain and feed conversion ratio of starter broiler chicks was reduced when the level of sesame hull in their diets increased to 12%. Similarly, when sesame hull was fed to laying birds at up to 28% of the diet, body weight and egg production decreased and feed conversion ratio increased. Khan et al. (1998) evaluated the effect of replacing til (sesame) oil cake with poultry excreta on growth and nutrient utilization at levels of 50 and 100% in growing bull calves. They found that animals fed with til oil cake gained more live weight than those fed the control diet. Herano et al. (2002) found that body weight change was similar when sesame meal was fed at a level of 200 g/d in goats.

This study has shown the economic advantage of using sesame hull in the diets of fattening Black goat kids. Obeidat et al. (2009) reported similar results when sesame meal replaced soybean meal at 8 and 16% levels of the diet fed to fattening Awassi lambs. Obeidat and Aloqaily (2010) reported similar results when sesame hull was fed at levels of 12.5% and 25% to Awassi lambs.

Omar (2002) reported that sesame meal addition at 10% and 20% levels improved digestibility of crude protein and fiber, average daily gain, feed conversion ratio, and cost of feed/kg gain in growing Awassi lambs when compared to a commercially fed ration. However, dry matter digestibility was not affected by the inclusion of sesame oil cake (Omar, 2002). Similarly, Lanza et al. (2001) reported that final live weight, ADG, DM intake and feed efficiency improved, and feed cost decreased when lambs were fed diets containing carob and orange pulp when compared to a control diet.

Carcass and non-carcass characteristics and meat quality parameters

In the current study, results for carcass characteristics and meat quality were comparable to those reported by Abdullah and Musallam (2007) for Black goat kids. In the current study, fasting live weight, empty live weight, hot and cold carcass weight, dressing percentage, non-carcass components, and weight of carcass cuts were similar for all treatment groups. No differences were observed for dissected loins and legs except for total fat (%) and total bone (%) in legs. No differences were observed in linear dimensions and fat measurements of carcass and *longissimus* muscle among the treatment groups. Meat quality parameters and loin tissue percentages and ratios were comparable among the treatment groups.

On the whole, the purpose of using alternative feed in livestock diets is to reduce the cost while improving, or at least not affecting, carcass characteristics and meat quality. In the current study, using an alternative feed ingredient did not impact on carcass characteristics. In agreement with the current study, Obeidat and Aloqaily (2010) reported that the use of sesame hull in Awassi lambs fed fattening diets had limited or no effect on carcass characteristics and meat quality. Similarly, Obeidat et al. (2008) studied the effect of replacing barley grain with *Prosopis juliflora* pods on carcass characteristics of Awassi lambs and found that dressing percentage, non-carcass components, weights of carcass cuts, and percentages of loin cut tissues were similar among all experimental groups. Lanza et al. (2003) studied the effect of feeding peas to lambs and found the meat quality (i.e., ultimate pH, meat color, and cooking loss) was similar to lambs fed diets containing soybean meal. Obeidat et al. (2008) found that water-holding capacity improved when Awassi lambs were fed with *Prosopis juliflora* pods (20%) compared to commercial diets. Both the current and previous studies have shown the possibility of using alternative or unconventional feed ingredients without causing problems to carcass characteristics and meat quality.

CONCLUSION

The objective of the current study was to evaluate the effect of replacing soybean meal and grains with sesame hull in finishing diets on nutrient intake, growth performance, nutrient digestibility and carcass characteristics of Black goat kids. The results showed that sesame hull has a good nutrient content allowing the possibility of using it at up to 20% in livestock diets to replace soybean meal and barley grain. As a result of this replacement the cost of gain is reduced in Black goat kids fed with sesame hull when compared to the control diet (no SH).

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REFERENCES

Abdullah, A. Y. and B. Y. Abd al hafes. 2004. Inclusion of *Prosopis juliflora* pods in finishing Awassi lamb diets. Proc. 11th AAAP Animal Science Congress. 2:373-375.

Abdullah, A. Y. and H. S. Musallam. 2007. Effect of different levels of energy on carcass composition and meat quality of male Black goats kids. Livest. Sci. 107:70-80.

Abdullah, A. Y., R. W. Purchas and A. S. Davies. 1998. Patterns of change with growth for muscularity and other composition characteristics of Southdown rams selected for high and low back depth. New Zealand J. Agric. Res. 41:367-376.

Alcaide, M. E., Y. D. R. Ruiz, A. Moumen and M. A. I. García. 2003. Ruminal degradability and *in vitro* intestinal digestibility of sunflower meal and *in vitro* digestibility of olive by-products supplemented with urea or sunflower meal: Comparison between goats and sheep. Anim. Feed Sci. Technol. 110:3-15.

Al Jassim, R. A. M., K. I. Ereifej, R. A. Shipli and A. Abudabos. 1998. Utilization of concentrate diets containing acorns (*Quercus aegilops* and *Quercus coccifera*) and urea by growing Awassi lambs. Small Rumin. Res. 29:289-293.

AOAC. 1990. Offical methods of Analysis. 15th ed. Assoc. Anal. Chem., Arlington, VA.

Ben Salem, H., I. Ben Salem, Nefzaoui and M. S. Ben Said. 2003. Effect of PEG and olive cake feed blocks supply on feed intake, digestion, and health of goats given kermes oak (*Quercus coccifera* L.) foliage. Anim. Feed Sci. Technol. 96:15-30.

Chiofalo, B., L. Liotta, A. Zumbo and V. Chiofalo. 2004. Administration of olive cake for ewe feeding: effect on milk yield and composition. Small Rumin. Res. 55:169-176.

Denek, N. and A. Can. 2006. Feeding value of wet tomato pomace ensiled with wheat straw and wheat grain for Awassi sheep. Small Rumin. Res. 65:260-265.

Farran. M. T. M. G., A. M. Uwayjan, A. Miski, N. M. Akhdar and V. M. Ashkarian. 2000. Performance of broilers and layers fed graded levels of sesame hull. Poult. Sci. 9:453-459.

Grau, W. R. and R. Hamm. 1953. Muscle as food. In: Food Science and Technology (Ed. P. J. Bechtel). A Series of Monographs, 1985. Academic Press, New York.

Herano, Y., T. Kashima, N. Inagaki, K. Uesaka, H. Yokota and K. Kita. 2002. Dietary sesame meal increase plasma HDL-cholesterol concentration in goats. Asian-Aust. J. Anim. Sci. 15:1564-1567.

Herano, Y., H. Yokota and K. Kita. 2003. Increase in plasma HDL-cholesterol in goat fed sesame meal is related to ether extract fraction included in the meal. Asian-Aust. J. Anim. Sci. 16:511-514.

Hossain, M. M., M. A. Huq, M. Saadulah and S. Akhter. 1989. Effect of supplementation of rice straw diets with sesame oil cake, fish meal and mineral mixture on dry matter digestibility in goats. Ind. J. Anim. Sci. 6:44-47.

Khan, M. J., M. Shahjalal and M. M. Rashid. 1998. Effect of replacing Til oil cake by poultry excreta on growth and nutrient utilization in growing bull calves. Asian-Aust. J. Anim. Sci. 11(4):385-390.

Kumar, A. G. K., V. S. Panwar, K. R. Yadav and S. Sihag. 2002. Mustard cake, as a source of dietary protein for growing lambs. Small Rumin. Res. 44:47-51.

Lanza, M., M. Bella, A. Priolo and V. Fasone. 2003. Peas (*Pisum sativum* L.) as an alternative protein source in lamb diets: growth performances, and carcass and meat quality. Small Rumin. Res. 47:63-68.

Lanza, M., A. Priolo, L. Biondi, M. Bella and H. Ben Salem. 2001. Replacement of cereal grains by orange pulp and carob pulp in faba bean-based diets fed to lambs: effects on growth performance and meat quality. Anim. Res. 50:21-30.

Mahgoub, O., I. T. Kdim, M. H. Al-Busaidi, K. Annamalai and N. M. Al-Saqri. 2007. Effects of feeding ensiled date palm fronds and by-product concentrate on performance and meat quality of Omani sheep. Anim. Feed Sci. Technol. 135:210-221.

Ministry of Agriculture. 2007. The Annual Report of the Animal Production Department. Amman, Jordan.

NRC. Nutrient requirement of sheep and goats. 1985. 6th Edition, National Academy of Sciences, Washington, DC, USA.

NRC. Nutrient Requirements of Domestic Animals. 1994. 9th Rev. Edition. National Academy of Sciences, Washington, DC, USA.

Obeidat, B. S., A. Y. Abdullah and F. A. Al-Lataifeh. 2008a. The effect of partial replacement of barley grains by *Prosopis juliflora* pods on growth performance, nutrient intake, digestibility, and carcass characteristics of Awassi lambs fed finishing diets. Anim. Feed Sci. Technol. 146:42-54.

Obeidat, B. S., A. Y. Abdullah, M. S. Awawdeh, R. T. Kridli, H. H. Titi and R. I. Qudsieh. 2008b. Effect of methionine supplementation on performance and carcass characteristics of Awassi ram lambs fed finishing diets. Asian-Aust. J. Anim. Sci. 21:831-837.

Obeidat, B. S. and B. H. Aloqaily. 2010. Using sesame hull in Awassi lambs diets: Its effect on growth performance and carcass characteristics and meat quality. Small Rumin. Res. 91: 225-230.

Obeidat, B. S., A. Y. Abdullah, K. Z. Mahmoud, M. S. Awawdeh, N. Z. AL-Beitawi and F. A. AL-Lataifeh. 2009. Effects of feeding sesame meal on growth performance, nutrient digestibility, and carcass characteristics of Awassi lambs. Small Rumin. Res. 82:13-17.

Omar, A. J. M. 2002. Effect of feeding different levels of sesame oil cake on performance and digestibility of Awassi lambs. Small Rumin. Res. 46:187-190.

SAS Institute Inc., 2000. SAS/STAT User's Guide: version 8.1st ed. SAS Institute Inc., Cary, NC.

Van Soest, P. J., J. B. Robertson and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:473-481.