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THE EFFECT OF DIFFERENT LEVELS OF SESAME WASTES ON PERFORMANCE, MILK COMPOSITION AND BLOOD METABOLITES IN HOLSTEIN LACTATING DAIRY COWS

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ABSTRACT

The objective of this study was to determine the effect of different levels of sesame wastes (SW) on performance, milk composition and blood metabolites in lactating dairy cows. In this order, eight multiparous Holstein dairy cows were used in a replicated 4×4 Latin square design in four periods of 21 days. Treatments were control (no Sesame waste supplementation), and supplemented with 5, 10 and 15 % (dry matter [DM] basis) Sesame wastes respectively. Each period of experiments included 14 days for adaptation to diets and 7days for sampling. Cows were fed as total mix ration (TMR). The results showed that DMI, milk lactose, MUN, BUN and blood Glucose and Cholesterol were not affected by experimental diets ($P>0.05$). Nevertheless, milk yield average, milk fat, protein percentage, milk TS, SNF percentage, blood Ca and TG showed significant differences ($P<0.05$) between treatments and was the highest in control treatment. In addition, dry matter (DM) and organic matter (OM) digestibility were affected by adding Sesame wastes in diets ($P<0.05$) and was the highest in control treatment. Generally, because of SW had not detrimental effects on the cows it could be substitution instead of soybean meal in diets.

KEYWORDS : Lactating Holstein Cow, Sesame Wastes, Digestibility, Blood Metabolites

The unprecedented jump in feed ingredient prices has directly affected many livestock producers because the government has scaled down the subsidy on barley, and market prices of milk do not compensate for the extra production cost. Therefore, producers are geared to use any available agro-industrial by-products such as a corns (Jassim et al., 1998), olive cakes (Jassim et al., 1998; Chiofalo et al., 2004), tomato pomace (Denek and Can, 2006), date palm (Miron et al., 1997), mustard cake and Prosopis juliflora pods (Abdullah and Abdalhafes, 2004). However, very few studies have evaluated the effect of using sesame wastes in livestock rations. Reported that the addition of sesame oil cake at 10% and 20% of diet 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 (Omar, 2002). Recently, (Obeidat, 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% (Khan et al., 1998). Indicated, a total of 1,250 tons of sesame hull and sesame meal are produced annually (Mahgoub et al., 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. Sesame seed is almost free of anti nutritional factors except high amount of oxalate and phytic acid it contains which reduces the physiological value of calcium from the seed. Dehulling reduces the oxalic acid contents of the seed. The sesame seed contains about 50% oil and 20-25% protein (Obeidat et al., 2008). The residue sesame oil cake contains on an average 32% crude protein, 8-10% oil, total oil and albuminoids of 40-42% and rich in essential amino acids namely methionine and cystine (Johri et al, 1988). Hence, the objective this research was to evaluate the feeding value of sesame wastes (SW) on performance and blood metabolites in lactating dairy cow.

MATERIALS AND METHODS

Cows, Diet and Treatments

Eight Holstein lactating dairy cows (60±15days in milk) with an average body weight (BW) of 650 kg were randomly assigned in a replicated 4×4 Latin square design with 21-day periods according to the parity. Each

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experimental period had 14 days of adaptation followed by 7 days for data collection. The experiment was carried out at the dairy farm of Natural Resources and Agricultural Research center of Mazandaran, Iran. Cows were placed in individual pens with concrete floors that were cleaned regularly and fed a total mixed ration ad libitum intake. Diet consisted of 20 % corn silage, 15 % alfalfa hay, 5 % wheat straw and 60 % concentrate mix (dry matter [DM] basis) (Table 1). Treatments were control (no Sesame waste supplementation), and supplemented with 5, 10 and 15 % (dry matter [DM] basis) Sesame wastes respectively. Cows were fed twice daily at 08:00 and 1800:h allowing for 50100 g orts/kg DM offered, which were weighed daily. Water and mineralized salt stone were available for cows through the entire experiment. The diet was formulated to meet or exceed the recommendations of the National Research Council, 2001.

Sampling and Chemical Analyses

Individual ingredients (alfalfa hay, corn silage and concentrate mixtures) and the TMRs were sampled daily during the last 7 days of each period and mixed. Orts were sampled daily during the last 7 days of each period. Samples were oven-dried at 55O C for 48 h, ground through a- 1mm screen in a Wiley mill and analyzed for organic matter (OM), crude protein (CP) and neutral detergent fiber (NDF).

Table 1 : Ingredient and Chemical Composition of Diets

Ingredient (% DM)	T_1 (Control)	T_2	T_3	T_4
Alfalfa hay	15	15	15	15
Corn silage	20	20	20	20
Wheat straw	5	5	5	5
Barely	23.6	26.1	26.6	27
Wheat bran	8.6	6.5	6.5	6.5
Cottonseed meal	12.3	8.8	5.3	1.8
Soybean meal	7.8	5.2	2.6	0
Sugar beet pulp	4.9	5.8	6.7	7.6
Sesame waste	0	5	10	15
Calcium-carbonate	0.93	0.69	0.45	0.2
DCP	0.1	0.1	0.05	0.04
Sodium bicarbonate	0.7	0.7	0.7	0.7
Vita/Min premix[1,2]	0.6	0.6	0.6	0.6
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100
Chemical composition				
NEL (Mcal/kg DM)	1.61	1.61	1.61	1.61
Crude protein (%)	15.9	15.9	15.8	15.8
RDP (% DM)	65	65.2	65.2	65.2
UDP (% DM)	35	34.8	34.8	34.7
NDF (% DM)	39	39.4	39.5	39.6
ADF (% DM)	23.1	23.3	23.5	23.8
Effective NDF (% DM)	24	24.2	24.7	25.1
NFC (% DM)	33.7	34.9	35.5	36.1
Calcium (%)	0.76	0.76	0.76	0.75
Phosphor (%)	0.51	0.51	0.51	0.51
DMI (% BW)	3.1	3.1	3.1	3.1

Vitamins and minerals mixture provide per kilogram of diet: vitamin A (as all-trans-retinyl acetate); 12000 IU; vitamin E (tocopheryl acetate); 11 IU; k 29mg; Vit. D , 2200 ICU;riboflavin, 10 mg; Ca pantothenate, 12 mg; niacin, 18 mg;choline chloride, 480 mg; vitamin B12 6, 10mµg; vitamin B, 1.8 mg; thiamine (as thiamine mononitrate); 2.1 mg; folic acid, 1 mg; D-biotin, 50mg. Trace mineral (milligrams per kilogram of diet) : Mn, 52; Zn, 50; Fe, 28; Cu, 9; Se, .1 and Ethoxyquin 4mg.

Analytical DM content of the samples was determined by drying at 110O C (ID 934.01; (Alcaide et al., 2003) and OM content was calculated as the difference between DM and ash contents, with ash determined by combustion at 550^0C for 6 h. Neutral detergent fiber (NDF) without a heat stable amylase and expressed inclusive of residual ash was measured (Tecator, Fibertec System, 1010 heat extractor) according to the methods of a Van Soest. Fat was determined by extraction with ether using a Soxtec system HT apparatus (Tecator, 1043, Denmark) according to the Method 920.39 (AOAC, 2000). Content of N in the samples were determined by Kjeldahl method in an automated Kjelfoss apparatus (Foss Electric, Copenhagen, Denmark). Body weight was measured at the beginning of the trial and the end of each period.

Blood Metabolites

In the end of each experimental period got 10 cc bloods from each cow for consideration of blood parameters and immediately shipped to laboratory for analyze of Glucose, Cholesterol, triglyceride (TG), BUN and calcium.

Milk Yield and Samples

Cows milked three times per day at 04:00, 12:00 and 20:00 h. Daily milk yields were recorded throughout the experiment. Milk samples were collect on last 2 days of each experimental period for determining milk composition and analyzed for fat, protein, lactose, SNF and TS using Milko-Scan (133B Foss Electric). Milk urea nitrogen (MUN) was measured by official method of analysis (ID 967.07 (Alcaide et al., 2003). The daily yield per cow of 4% FCM was calculated according to the NRC (2001) equation:4% FCM (kg) = 0.4.milk (kg) + 15.0. milk fat (kg).

Digestibility Measuring

In this experiment Cr_2O_3, as an unabsorbed marker for dry and organic matter digestibility determination, was mixed with TMR components. The Cr_2O_3 concentration in the TMR was designed to reach the level of 10 g of Cr_2O_3/cow per d(14). Estimation of daily fecal excretion was based on marker concentrations in feces and in TMR. Fecal grab samples were taken twice daily for 6 d, at 12-h intervals, each day 2 h later than the preceding day.

Feed Conversion Rate

Feed conversion rate was calculated as the amounts of dry matter intake required to produce 1 kg 4% FCM.

Statistical Analysis

Data were analyzed using the GLM procedure of SAS® (21). Duncan's New Multiple Range Test (Duncan, 1955) was used to test mean differences at ($P<0.05$). The experimental data were analyzed as a 4×4 replicated Latin square design using the following model:

$Yijk(l)=\mu +Sk + Ri(k) + Cj(k) +T(l) +eijk(l)$

where Yijk(l) was the amount each observation, μ is the overall mean, Sk is the effect of square, Ri(k) is the effect of row, Cj(k) is the effect of column, Ti is the effect of the treatments (i=1, 2 and 3) and eijk(l) is the experimental error. Effects of the treatments were declared significant at ($P<0.05$).

RESULTS

In this study, no significant differences were observed among the treatments regarding DMI, and FCM, but the MYN, MYN, MYA, total milk yield and FCR were affected by SW significantly ($p<0.05$) (Table 2), and the highest means were belong to control group.

Moreover, the SW had a significant effect on the milk fat (%), milk protein (%), TS (kg/day) and SNF ($p<0.05$), but had no significant effect on the Lactose and MUN by SW consumption ($p>0.05$) (Tables 3). In This study, sesame wastes (SW) decreased the TS and SNF and increased the milk fat in cows.

On the other hand, some of the blood metabolites (calcium and TG) were affected by SW supplementation in diets ($p<0.05$), and the highest calcium (11.42 mg/dl) and the lowest TG (15.25 mg/dl) were belong to control, but there was no significant different for BUN, Glucose and cholesterol ($p>0.05$) (Table 4).

Furthermore, the different levels of SW induced a significant effect on dry and organic matter digestibility in cows ($p<0.05$) (Table 5). As showed the highest and lowest dry and organic matter digestibilities were belong to control and 15% SW treatments respectively.

Table 2 : Effect of Sesame Wastes on Dry Matter Intake, Milk Yield and FCR of Dairy Cow

Studied Characteristics	Treatments				
	Control	T_2	T_3	T_4	SE
Dry matter intake	20.88 ± 1.69	21.18 ± 2.14	21.78 ± 1.24	21.30 ± 1.03	1.143
MYM (kg/day)	11.38^{a} ± 2.48	10.50^{ab} ± 0.58	10.88^{ab} ± 1.13	10.38^{b} ± 1.18	0.265
MYN (kg/day)	10.50^{a} ± 1.91	10.13^{ab} ± 1.06	9.75^{b} ± 0.87	9.63^{a} ± 0.95	0.125
MYA (kg/day)	9.35^{ab} ± 1.25	10.25^{a} ± 1.19	9.50^{ab} ± 1.08	9.25^{b} ± 1.71	0.265
Total milk yield	31.25^{a} ± 1.85	30.88^{ab} ± 2.75	30.13^{ab} ± 1.80	29.25^{b} ± 0.87	1.1454 %
FCM	29.60 ± 1.22	29.71 ± 3.26	29.13 ± 1.77	28.72 ± 1.09	2.490
FCR	0.67^{b}	0.69^{b}	0.72^{ab}	0.73^{a}	0.001

MYM: Milk yield in morning; MYN: Milk yield in noon; MYA: Milk yield in afternoon; FCR: Feed conversion rate. Means with different superscript within a row are different significantly ($P<0.05$)

Table 3 : Effect of Sesame Wastes on Milk Composition in Dairy Cow

Studied Characteristics	Treatments				
	Control	T_2	T_3	T_4	SE
Milk fat (%)	3.65^{c} ± 0.15	3.75^{b} ± 0.28	3.78^{b} ± 0.14	3.88^{a} ± 0.14	0.011
Milk fat (kg/day)	1.14 ± 0.04	1.16 ± 0.15	1.14 ± 0.08	1.13 ± 0.05	0.008
Milk protein (%)	3.08^{ab} ± 0.08	3.25^{a} ± 0.45	2.88^{ab} ± 0.11	2.83^{b} ± 0.14	0.046
Milk protein (kg/day)	0.96^{a} ± 0.06	1.00^{a}± 0.10	0.87^{b} ± 0.04	0.83^{b}± 0.03	0.003
TS[1] (%)	11.87 ± 0.33	11.70 ± 0.24	11.22 ± 0.31	11.24 ± 0.48	0.182
TS (kg/day)	3.71^{a} ± 0.14	7.61^{ab} ± 0.22	7.38^{bc} ± 0.11	7.29^{c} ± 0.09	0.027
SNF[2] (%)	8.22^{a} ± 0.22	7.96^{ab} ± 0.31	7.43^{b} ± 0.28	7.36^{b} ± 0.39	0.086
SNF (kg/day)	2.57^{a} ± 0.14	2.46^{a} ± 0.22	2.24^{b} ± 0.11	2.15^{b} ± 0.09	0.010
Lactose (%)	4.25 ± 0.10	4.27 ± 0.10	4.24 ± 0.15	4.23 ± 0.21	0.030
Lactose (kg/day)	1.33 ± 0.09	1.32 ± 0.15	1.28 ± 0.07	1.24 ± 0.05	0.005
MUN (mg/dl)	14.95 ± 1.17	14.30 ± 2.84	14.21 ± 2.41	13.68 ± 3.27	0.511

1- Total solid. 2- Solid non-fat. Means with different superscript within a row are different significantly ($P<0.05$)

DISCUSSION

Performance

The achieved data from investigation of effect of substitution of the sesame wastes (SW) in diet on performance of dairy cows represents in (Table 2). The cows fed with control diet to 20.88 kg/day and cows fed with 10 % SW to 21.78 kg/day had the lowest and highest DMI, respectively. Although the null hypotheses for performance parameters held true, substitution of barley grain and soybean meal with sesame wastes reduced the unit production cost of the diets and thus improved profitability. This was due to the low cost of sesame wastes compared to the current price of barley grain and soybean meal. Therefore, this study has shown the economic advantages of using sesame wastes in the diets of lactating dairy cow. Obeidat et al. (2010) reported a reduction in cost when sesame hull was included at levels of 12.5% and 25% in diets of Awassi lambs is also one of the obtained similar results. In (Table 2) showed that there are a significant different in FCR and milk yield between treatments ($P<0.05$). The cow fed with control diet and 10% SW had the lowest (20.88 kg/day) and highest (21.78) dry matter

Table 4 : Effect of Sesame Wastes on Blood Metabolites in Dairy Cow

Studied Characteristics	Treatments				SE
	Control	T_2	T_3	T_4	
BUN (mg/dl)	16.48 ± 1.51	16.10 ± 0.98	15.93 ± 2.94	15.58 ± 2.83	0.481
Glucose (mg/dl)	52.50 ± 5.69	53.75 ± 6.50	54.50 ± 5.00	55.00 ± 7.48	17.145
Cholesterol (mg/dl)	198.75 ± 15.76	199.00 ± 11.75	200.75 ± 11.94	199.25 ± 13.50	31.137
TG (mg/dl)	15.25^{a} ± 1.26	16.00^{ab} ± 0.98	16.75^{bc} ± 1.26	17.75^{c} ± 1.50	0.645
Calcium (mg/dl)	11.42^{a} ± 0.97	11.14^{a} ± 0.58	11.01^{a} ± 0.68	10.66^{a} ± 1.11	0.629

Means with different superscript within a row are different significantly (P<0.05).

intake respectively, that was not significant (P>0.05). Sesame wastes inclusion in the diet of dairy cow improved dry matter intake in 10% SW fed groups compared to 0% and 15% SW groups.Thus, it is safe to conclude that the presence of SW at a 10% level in the diet did not affect palatability. A research (Obeidat et al., 2009) reported similar results when sesame meal was fed to Awassi lambs at 8% of the diet. Obeidat et al., (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 addition, the groups fed with control diet have shown the highest milk production and the best FCR significantly (P<0.05) and the groups fed with 15 % SW diet have shown the lowest milk yield and the worst FCR significantly (P<0.05). Indicated the main cause in milk yield reduction with increase of SW replicating in diets thus, it seems that be because of dry matter intake reduction in animals. 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 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. Furthermore, found that body weight change was similar when sesame meal was fed at a level of 200 g/d in goats (Herano et al., 2002). Omar et al., (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 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 (Ministry of Agriculture, 2007).

Milk Composition

The achieved data from investigation of effect of substitution of the sesame wastes in diet on milk composition of dairy cow presents in (Table 3). There were a significant variation in milk fat, milk protein, TS and SNF among various treatment groups during the experiment period (P<0.05). The cows fed diet containing15 % SW with 3.88 percent highest and cow fed control diet with 3.65 percent had the lowest milk fat.Grain in dairy cow diet could be effective premier source on digestible energy requirement for maintenance of great milk production. Overfed grain in spite of milk production stimulate reduce the milk fat percentage and outcome changes in milk fatty acids. However, in this study the grain amount in was equal. About of 60 % long chain fatty acids milk fat generated from diets and SW contain high level these fatty acids that this fatty acids in sesame wastes can arise the milk fat (Omar, 2002).

This study showed no significant variation in lactose among various treatment groups during the experiment period (P>0.05). MUN is one of the milk normal ingredients and constitute about of 20 to 70 % the milk NPN.

Table 5 : Effect of Sesame Wastes on Digestibility in Dairy Cow

Studied Characteristics	Treatments Control	T_2	T_3	T_4	SE
Dry matter Digestibility (g/kg DM)	$68.35^{a} \pm 4.35$	$66.12^{b} \pm 3.98$	$64.23^{c} \pm 3.26$	$61.15^{d} \pm 4.89$	0.947
Organic matter Digestibility (g/kg DM)	$70.52^{a} \pm 2.89$	$68.42^{ab} \pm 3.56$	$67.11^{b} \pm 3.11$	$62.46^{c} \pm 3.76$	2.504

Means with different superscript within a row are different significantly (P<0.05).

Indicated that the MUN concentrations can influence by the nutrient density of diet and available of nutrient for rumen microorganisms. However, in present experiment the MUN not affected by sesame wastes substitution in diets (P>0.05). The cow received 5 % SW and 15 % SW had the highest and lowest milk protein percent as significantly (P<0.05). Decrease of milk protein density in this study could be related to great fat intake that to induce an insulin resistance influences the amino acids absorption. According to Table 5, probably reduce of total solid (TS) in supplemented diets with SW were because of milk calcium decrease. Cows fed diets containing 15% SW and control had the highest and lowest SNF (P<0.05) respectively. Of the effective factors in this case is forage : concentrate ratio and season influences. Because of the season for all groups in this study was similar, this factor cannot be effective.

Blood Metabolites

The achieved data from investigation of effect of substitution of the sesame wastes in diet on blood metabolites of dairy cow presents in (Table 4). This study showed no significant variation in blood Glucose, Cholesterol and BUN among various treatment groups during the experiment period (P>0.05). According to Table 3, the highest blood urea nitrogen (BUN) mean was produced by 15 % SW and the lowest was belong to control diet and the lowest Glucose and Cholesterol was produced by control diet. Can indicate that fats pose a disorder in rumen functions and inducement a decrease in protein digestion and ammonia density in rumen and lastly occur reduce of BUN. The cause of increase TG in this study could be related to fat great amount in sesame wastes (P<0.05).

Furthermore, the highest and lowest calcium were belong to control and 15 % SW (P<0.05) respectively. The reasons of this decrease is probably for unnutritional effects of oxalic acid and phytic acid in sesame wastes that inducement a complex to calcium and as a result reduced the calcium absorption. Dry and organic matter digestibility In the current study, results indicated (Table 5) that the digestibilities of DM, OM were affected by inclusion of sesame wastes in diets of lactating dairy cow. The lowest and highest dray and organic matters digestibility were observated by15 % sesame wastes and control diets (P>0.05) respectively. Omar et al., (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 when til oil cake was replaced by poultry excreta, the DM and nitrogen-free extract digestibilities were not affected, but CP and CF digestibility's 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). Moreover, 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 (Hossain and Jauncey, 1989). In our study, seems that unnutritional factors (such as oxalic acid and phytic acid) in sesame wastes are main reason in decrease of organic and dry matters digestibility.

CONCLUSION

From the results of the present study, it can be conclude that inclusion of sesame wastes in diet of dairy cow not affecting on the DMI, BUN, MUN, Glucose, and Cholesterol. But, induced a significant different on the milk yield average, milk fat, protein percentage, milk TS, SNF percentage, blood Ca and TG ($P<0.05$). Furthermore, the milk fat percent, milk protein percent, milk production average, TS and SNF in control diet were higher than supplemented diets. Thus, because of SW had not obviously negative effects on dairy cows, it could be substitution instead of soybean meal in diets.

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REFERENCES

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

Alcaide M. E., Y. D. R. Ruiz, Moumen A. and Garc M. A. I., 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.

AOAC, 2000. Official Methods of Analysis, 17th ed. Association of Official Analysis Chemists, Washington, DC, p: 2044.

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

Denek N. and Can A., 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., Uwayjan A. M., Miski A., Akhdar N. M. and Ashkarian V. M., 2000. Performance of roilers and layers fed graded levels of sesame hull. Poult. Sci., **9**:453-459.

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

Hossain MA.and K. Jauncey ;1989. Studies on the protein, energy and amino acid digestibility of fish meal, mustard oil cake, linseed and sesame meal for common carp (*Cyprinus carpio* L.). Aqua, **83**: 59-72.

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

Johri T. S., Agrawal R. and Sadagoban V. R., 1988. Available lysine an methionine contents of some proteinous feedstuffs. Indian Journal of Animal Nutrition, **5**: 228 - 229.

Khan M. J., Shahjalal M. and Rashid M. M., 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.

Mahgoub O., Kdim I. T., Al-Busaidi M. H., Annamalai K. and Al-Saqri N. M., 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.

Miron J., Solomon R., and D. Ben-Ghedalia, 1997. Digestibility by dairy cows of monosaccharide components in diets containing either ground sorghum or sorghum grain treated with sodium hydroxide. J. Dairy Sci. **80**:144-151.

National Research Council, 2001. Nutrient Requirements of Dairy Cattle, 7th rev. ed. Natl. Acad. Sci., Washington, DC.

Obeidat B. S. and Aloqaily B. H., 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., Abdullah A. Y. and Al-Lataifeh F. A., 2008. 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., Abdullah A. Y., Mahmoud K. Z., Awawdeh M. S., AL- Beitawi N. Z. and AL-Lataifeh F. A., 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.

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

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

Van Soest P.J., Robertson J. B. and Lewis B.A., 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition.J. Dairy Sci., **74** :3583-3597.