Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

THE EVALUATION OF REPLACING SOYBEAN MEAL WITH SESAME MEAL TREATED WITH THYME ON PERFORMANCE AND CARCASS CHARACTERISTICS OF AWASSI LAMBS

NAZDAR M. AHMED

Department of Chemical Engineering. Technical College of Engineering.Duhok Polytechnic University, Duhok, Kurdistan Region of Iraq. Email: nazdar.mohammed@dpu.edu.kdr

VAHEL J. TAHA

Department of Animal Production, College of Agricultural Engineering Science, University of Duhok, Duhok, Kurdistan Region of Iraq. Corresponding author Email: vahel.taha@uod.ac

ABSTRACT.

This study aimed to evaluate the effect of replacing soybean meal with sesame meal as a protein source in a concentrate diet treater with thyme on lamb performance and some carcass characteristics. Twenty-four local Awassi male lambs at approximately four months old with an average of 24.6. ± 2.5 kg live body weight was used in this study. After ten days of adaptation, lambs were kept in an individual pen, blocked according to their live body weight, and then randomly divided into four experimental groups (6 lambs/group). The four experimental diet groups created were: soybean meal as a protein source (BC), soybean meal supplemented with 30 g/kg DM thyme (BT). Sesame meal as a protein source (SC). And sesame meal as a protein source supplemented with 30 g/kg DM thyme (ST). Lambs were randomly allocated to receive ad libitum one of the four experimental feeding groups with free access to clean water and wheat straw. Each lamb was slaughtered after it reached 40 kg live weight to study the effects of experimental treatments on slaughter and carcass traits. Data were analysed as Factorial 2 x 2 using GenStat 15 software. The results showed that replacing soybean meal with sesame meal in the diet had a significant effect ($P<0.05$) on reducing daily dry matter intake (1.16, 1.16, 1.13, 1.12 kg/lamb/day), concentrate intake (0.78, 0.71, 0.65, 0.64 kg/ lamb/day) and increased feed conversion ratio (5.7, 6.0, 6.6 and 7.2 kg/kg for BS, BT, SC and ST respectively). However, using sesame meals as a protein source significantly reduced the cost of the diet. Moreover, using sesame meals in the diet reduces glucose concentration in blood plasma, with no significant effect on carcass and slaughter characteristics. Supplemented 3% of thyme did not have any significant effect on most studied parameters. According to the results, sesame meals can be used in lamb nutrition with some possible reduction in daily feed intake costs.

KEYWORDS: protein source, feed cost, antioxidant, growth rate.

INTRODUCTION

Ruminant meat production could be associated with a large production cost compared to other livestock products (Omer et al., 2019), which might be due to the market of feedstuffs suffering from price vicissitudes and quite often availability, especially for conventional feed ingredients, such as soybean meal (SBM), barely and corn which tend to increase animal production costs (Taha et al., 2022; Kak et al., 2020). Hence, replacing these traditional feeds with some alternative home-grown protein source has become a common practice in an attempt to reduce production costs (Taha, 2015; Mahmoud and Ghoneem, 2014). Accordingly, there might be an observed demand for feedstuffs characterized by low prices and decent availability, which can be utilized in livestock rations, without adverse effects on animal health and productivity (Bonos et al., 2017). Some food industries' by-products and residues are now being examined to be used as an alternative feedstuff in the ruminant diet. And rations formulated from these residues might be economically sufficient and offer the same performance obtained from conventional rations (Taha,2015; Dey et al., 2021).

Sesame (*Sesamum indicum*) can be considered a significant oilseeds-producing plant, which has an important role in human nutrition and is cultivated mainly for the production of sesame oil, tahini, and halva in Iraq, Turkey, Egypt and some other Middle East countries. The chemical composition of sesame seeds showed that it contains a high amount of oil (mostly unsaturated fatty acids), crude protein (CP), simple carbohydrates and minerals (580, 250, 135 and 50 g/kg respectively) (El Tinay et al., 1976). In addition, sesame seeds are rich in sesamin, sesamolin, and sesamol glucosides, which are natural antioxidants that are regarded to be good for animal health. The sesame oil is resistant to oxidation since it also includes significant amounts of polyphenolic chemicals (Elleuch et al., 2007; Shahidi et al., 2006). Therefore, the sesame residue (meal) or by-products from food industries might be an important ingredient that could be used as a protein and energy source in animal nutrition.

Using medical plants in domestic animal nutrition has been expanded after the ban on the use of synthetic antioxidants and growth promoters in developed countries (Shaban et al., 2021). supplementation of dietary medicinal plants to livestock has been advocated as an effective strategy for improving production performance (Odhaib et al., 2018). Thymus vulgaris (thyme) is an aromatic plant of the Lamiaceae family and has received major attention as a natural antioxidant across the globe which is largely used in human nutrition (Khattab et al., 2020). The effects of thyme arise from thymol and carvacrol (Shaaban et al., 2021), and the antioxidant activity of thyme and its extracts have been reported to have a significant extent and defended them from oxidative damage (Dauqan & Abdullah, 2017). Thyme also showed to have an excellent antioxidant activity that may be higher than the well-known BHT and -tocopherol antioxidants and have shown effective radical scavenging capacity (Stanner & Weichselbaum, 2012). In addition, it has been reported that rumen fermentation has been enhanced (increasing the volatile fatty acid and reducing ammonia nitrogen concentration in rumen fluid) when the animal is fed acceptable doses of thymol (Castillejos et al., 2006). Recently, a higher researcher's interest was in the use of thyme extraction and its effects on animal performance and/or enhancing the shelf life of animal products. A few studies (Nieto et al., 2012; Khamisabadi et al.,2016; Shaban et al., 2021) were found to study the effects of feeding thyme leaves on animal performance. To our knowledge, there is a lack of studies on using a different source of protein supplemented with thyme leaf powder in lamb's diet. Therefore, the objective of this study was to investigate the effect of replacing SBM with a sesame meal (SM) treated with thyme in the diet on the performance and carcass characteristics of Awassi lambs.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

MATERIALS AND METHODS

The lamb growth study was conducted at the Animal Production Project at the College of Agricultural Engineering Science, University of Duhok, Kurdistan Region of Iraq. All laboratory analyses were completed at the Laboratory of Animal Production Department. The experiment and all experimental protocols were approved by the Ethics Committee of Animal Production (no. 201/2022).

Twenty-four male Awassi lambs at four months old with an average of 24.6. ± 2.5 kg live body were used in this experiment. Lambs were kept in one group for ten days to accumulate under experimental conditions and diet. During the adaptation period, lambs were treated against internal and external parasites. After the adaptation period has finished the lambs were reweighted and blocked according to their live weight into four blocks. Blocks were then randomly allocated to receive one of the four experimental concentrated diets with six lambs per treatment. The concentrate diet consists of two different protein sources (soybean meal and/or sesame meal) that were used in the diet of the current experiment. Then each of these two groups was sub-divided into two other groups one of them was left without any additives and the other group was supplemented with 30 g/kg thyme leaf powder. Hence the four experimental groups were: soybean meal as a protein source (BC), soybean meal as a protein source supplemented with 30 g/kg DM thyme (BT), sesame meal as a protein source (SC) sesame meal as a protein source supplemented with 30 g/kg DM thyme (ST). The ingredients used in the diet and chemical analysis of the four experimental diets are presented in Table 1.

Lambs were kept in individual pens (1.5 m^2) two days before starting the experiment and received one of four experimental diets in two equal meals at 9:00 and 17:00 every day at the rate of approximately 0.75 kg/ meal, with free access to clean water and offered *ad libitum* wheat straw. The diet was formulated to meet the requirements of Awassi lambs at the live weight (25-40 kg) gaining approximately 200 g/day according to AFRC, 1993.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

Table 1: Composition and chemical analysis of the four experimental diets.

Ingredient	Soybean meal		Sesame meal	
g/kg DM	BC	BT	SC	ST
Barely	300	300	300	300
Wheat bran	300	300	300	300
Corn	250	220	170	140
Soybean	150	150	60	60
Thyme	0	30	0	30
Sesame meal	0	0	170	170
Total	1000	1000	1000	1000
Dray matter	866	865	867	869
Organic matter	955	950	953	953
Crude protein	165	166	165	166
NDF*	249	265	255	280
NFE*	496	472	453	425
Ether extract	45	47	80	82
MP*	121	120	124	123
ME*	12.6	12.5	12.7	12.6

NDF: neutral detergent fibre, NFE: nitrogen-free extract, MP: metabolizable protein g/kg DM, ME: metabolizable energy M jol/kg DM, *: estimated according to McDonald et al. (2011).

Refusal diet (concentrate and straw) were collected every three days and weighed in order to calculate daily dry matter intake (DMI). Lambs were weighed every week in order to measure lamb gain during the experimental period. Samples of different concentrate diets and straws were taken every week throughout the experiment and frozen at –20 º C for chemical analysis. Concentrate, wheat straw and faecal samples were analysed chemically according to AOAC (2000) for dry matter (DM), organic matter (OM), crude protein (CP), and ether extract (EE). In addition, the natural detergent fibre (NDF), acid detergent fibre (ADF), metabolizable energy (ME) and metabolizable protein (MP) of the diet samples were estimated and calculated according to McDonald et al. (2011). The average daily dry matter intake (t-DMI) was calculated by measuring the total concentrated intake and total wheat straw intake and dividing by days to reach the slaughter weight for each lamb. The average daily weight gain (g/day) was calculated by dividing the lamb's final weight by the days to reach the slaughter weight. And feed conversion ratio was calculated by dividing the total feed intake by gaining weight (kg/kg). Diet DM and OM digestibility was measured using acid insoluble ash (AIA) according to Van Keulen and Young (1977).

Ten ml of blood samples were taken from each lamb 30 minutes prior to slaughtering via jugular venepuncture into a lithium heparin vacutainers tube, the blood plasma was extracted from the blood using a centrifuge at 3000 rmp for 10 mint and kept at -20 º C. The frozen plasma samples were defrosted in the fridge and the blood plasma was analysed by (Cobas 6000) in a local commercial laboratory for total protein, glucose, uric acid, triglyceride and cholesterol. When each lamb reached 40 kg live weight, the lamb was slaughtered at the Animal Production Project. The lambs were weighed after

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

12h of fasting with free access to water, slaughtering was done according to the Islamic method. then the carcass was partially skinned. Immediately after that evisceration, the carcass and non-carcass components were weighed. Hot carcass includes kidney and kidney fat only. The dressing percentage was calculated by dividing the hot carcass weight by the slaughter weight. The carcasses were then washed using tap water and was transported to the meat laboratory and chilled in the refrigerator for 24 h at 4º C. After chilling the carcasses for 24hr at 4 ºC, the child carcasses' weight was recorded, and then the kidney and kidney fat were separated and weighed separately. The shrinkage percentage was calculated as the difference between hot and chilled carcass weight. The subcutaneous fat thickness (at rib 12) was measured using a set of metal callipers, and the eye muscle area was obtained by tracing the eye muscle at rib 12 on acetate paper. The area was measured using a Placom digital planimeter apparatus (PLANIX7, TAMAYA digital planimeter, Japan).

Statistical analysis.

Data collected in the following experiment were analysed in an ANOVA procedure of GenStat (GenStat version 15, VSN International Ltd, UK). Data were analysed as factorial 2 x 2 (protein source and feed additives). Lamb's average daily weight gain (ADG) was measured using linear regression in Microsoft Excel.

RESULTS AND DISCUSSION.

Animal performance

Results obtained from the following experiment showed that replacing a soybean meal with a sesame meal as a protein source by approximately 60% had a negative effect ($P<0.05$) on daily total dry matter and concentrate intake (Table 2). While the data showed that lambs offered a diet containing sesame meal consumed higher wheat straw compared to lambs offered a diet containing soybean meal, which was probably due to the negative effect of SM on DMI, hence the lambs tried to cover their hunger and requirement by consuming higher straw as it was offered *ad libitum*. The negative impact on the daily DMI and concentrated intake when SM was used in the diet of the lambs in both SC and ST groups might be due to the high oil contained in the structure of sesame seeds (~ 300 g/kg), which led to an increase in oil inside the whole diet in SC and ST groups by approximately 70% compared to BC and BT groups (Table 1). The current experiment has been conducted between March and June, and the ambient temperature was relatively high (25-40 º C), therefore, the effect of EE content was higher, and it might be the reason for reducing the DMI. dos Santos et al. (2016) suggested that increased EE content may depress the diet palatability of lambs.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

Table 2: Effect of using soybean meal or sesame meal as a protein source in the diet treated with thyme on lamb performance.

Trait	SBM		SM		Probability (P-value)		
	BC	BT	SC	ST	PS	A	PS x A
Initial weight kg	24.5	24.7	24.4	25.2	0.85	0.64	0.77
Final Weight kg	39.8	40.0	40.0	39.7	0.90	0.90	0.18
Average daily gain g/d	203.0	191.0	172.0	156.0	0.04	0.19	0.86
Daily T-DMI kg	1.16	1.16	1.13	1.12	<0.01	0.48	0.78
Daily C-DMI kg	0.78	0.74	0.65	0.64	0.01	0.08	0.13
Daily S-DMI kg	0.38	0.45	0.48	0.48	0.05	0.08	0.11
Total feed intake kg	87.1	93.5	102.8	104.8	<.01	0.19	0.48
Toal concentrate intake kg	58.3	56.9	59.4	60.2	0.27	0.88	0.59
Total straw intake kg	28.9	36.5	43.4	44.6	<.001	0.06	0.15
FCR total kg/kg	5.7	6.0	6.6	7.2	0.02	0.21	0.91
Feed cost $/ton	423	412	362	350			
T- daily cost intake $/day	0.431	0.414	0.366	0.356	<.001	0.01	0.18
C-daily cost intake $/day	0.331	0.292	0.236	0.226	<.001	0.001	0.21
S- daily cost intake $/day	0.10	0.12	0.13	0.13	<.001	0.09	0.09
Time to reach 40 kg day	75.0	80.5	91.0	93.3	<001	0.166	0.568

SBM: soybean meal, SM: sesame meal, BC: soybean meal with no additive, BT: soybean supplemented 30/kg DM thyme, SC: sesame meal with no additive, ST: sesame meal supplemented 30/kg DM thyme, FCR: feed conversion ratio. DMI: dry matter intake, T: total, C: concentrate, S: wheat straw.

These results were similar to the results obtained by Omar (2002) as he reported that DMI decreased numerically when SM replaced was with SBM in Awassi lambs' diet at levels of 10% and 20%. In contrast, Obeidat and Gharaybeh (2011) found that increasing the use of sesame seeds hull (0, 10, and 20 %) in the diet of Awassi lambs has led to an increasing the DMI (657, 963 and 768 g/day respectively) of the lambs. While Ghorbani et al. (2018) reported that using different levels of SM (0, 2.59, 5.26, 7.87 or 10.55%) instead of SBM in Zel lamb ration had no effect on DMI, daily weight gains nor FCR during the whole experimental period. Similarly, Obeidat et al., (2019) also reported that replacing SBM with SM had no significant effect on DMI, CP intake, or OMI in Awassi lambs, they only found that increasing the use of SM level led to an increase ($P<0.05$) in the ether extract consumption (0, 7.5 and 15 % SM level 78.0, 86.9 and 92.9 g/day respectively). The difference between studies on the effect of SM on DMI might be attributed to modified palatability, digestibility and/ or lower dustiness, due to the increased crude fat in the ruminant's diet (Abdullah et al., 2011; Obeidat & Aloqaily, 2010).

In the current study, the results of the feed conversion ratio were noticed to be higher in both groups of lambs fed a diet containing SM compared to lambs consuming a diet containing SBM only. Lambs ate more than 6.5 kg of feed to gain 1 kg of meat in both experimental groups which offered a diet containing sesame meal, while in the other

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

two experimental groups (BS and BT), the lambs need to consume less than 6 kg to gain 1 kg of meat. The higher FCR in both SC and ST groups is probably due to the negative impact of SM on DM and OM digestibility (Table 3). Similar results have been reported by Abdullah et al. (2011), they found that feeding lambs diet containing three different levels of SM linearly increase FCR (7.8, 7.9, 8.6 kg/kg for 10, 15 o4 20% of SM in the diet respectively). In constant Omer et al. (2019) found that the FCR linearly improved when they increased the used level of SM in Bakri male lamb's diet (6.55, 5.32 and 5.13 kg diet/ kg gain for a diet containing 0, 8 or 16% SM respectively). Fitwi and Tadesse (2013) reported that using SM in the sheep's diet increases the nutrient concentration of the diet and as consequence increases the weight gain of the sheep.

Supplementation of thyme at a rate of 30 g/kg DM on two experimental diets (BT or ST) did not have any significant effect on most of the studied lamb performance parameters (ADG, total gain final weight, daily DMI, concentrated daily intake, and straw intake) (Table 2). In a study published by Shaaban et al. (2021), they found that supplementing 15g of thyme to Barki lamb's diet has led to improve animal performance (DMI, 1428.9 g/d), this difference in the results obtained in the current study and previous studies might be due to the rate of supplementation and/or the type and thyme breed used. (Kulisic et al., 2005; Aljabeili et al., 2018; Jabri-Karoui et al., 2012) Matloup et al. (2017) hypothesised that thyme contains bioactive compounds and a pleasant aroma and flavour. These compounds stimulate the animal brain to increase their feed intake by stimulating saliva secretion and therefore, adding thyme to a ruminant's diet has an impact to improve DMI and animal performance.

As the cost of sesame meal was lower than the cost of SBM in the local market, hence replacing SBM with sesame meal led to reducing the cost of the concentrated diet used in the current experiment. The diet cost was 423, 412, 362 and 350 $/ton for BC, BT, SC and ST respectively. Such differences in the cost of ration formulation led to find some differences in average total daily intake diet cost among experimental treatments (0.43, 0.41, 0.36 and 0.35 $/d/lamb for BC, BT, SC, ST respectively $P < 0.01$). In addition, when 30 g/kg DM of thyme were added to two experimental groups in the current study, this amount was replaced by corn (Table 1) as it has approximately similar CP content (90 g/kg DM) and because the price of corn was higher than the price of thyme in the local market, hence this had an effect by reducing the concentrated diet cost per lamb per day for lambs consumed diet supplements with thyme (0.331, 0.292, 0.236 and 0.226 $/day/lamb for BC, BT, SC, and ST respectively, $P=0.01$). Using SM in the Awassi lambs' diets had economically advantageous by reducing the price of diet per metric ton and the daily cost of feed intake per lamb compared to a diet without SM. These differences in the cost of each experimental feed were probably due to the differences between the price of SBM and SM in the local market (Table 2). Sesame seeds are considered a home-grown legume crop compared to SBM which is imported feed staff to the local market in Iraq. And due to the high global demand for SBM recently, their price has increased dramatically in the last

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

decades (Taha, 2015). Several studies (Obeidat et al., 2009; Obeidat & Aloqaily, 2010) also reported a reduction in the cost of a ruminant diet when they replace SBM with SM.

Lambs were slaughtered when their live weight reached 40 kg, and because the DMI and ADG were significantly higher in both groups consumed a diet containing SBM as a protein source, therefore, these lambs (BC and BT groups) reached 40 kg significantly in less time compared to lambs fed diet contained SM (SC and ST groups) as a protein source (75, 80.5, 91 and 93.3 days to reach 40 kg live weight for BC, BT, SC, and ST respectively, Figure 1). While adding 3 % of thyme to a concentrated diet had no significant effect on time to reach 40 kg live weight in all experimental groups.

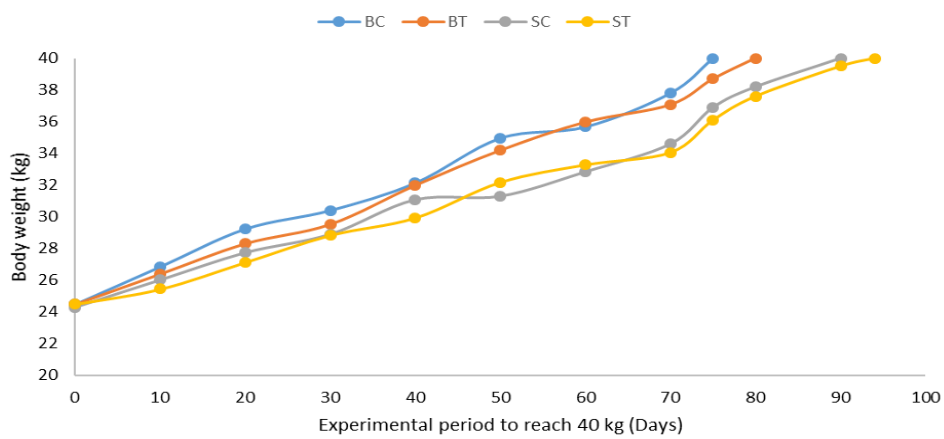

Figure 1: Lamb growth rate during the experimental period until the live weight of the lambs reached slaughter weight (40 kg). BC: soybean meal with no additive, BT: soybean supplemented 30/kg DM thyme, SC: sesame meal with no additive, ST: sesame meal supplemented 30/kg DM thyme.

Supplementation of thyme at a rate of 30 g/kg DM did not show any significant effect on the lamb performance which might be due to that in the current study a low level of thyme has been used. In addition, thyme's effect can be clearly shown when it is consumed by monogastric farm animals (pig and poultry) and its effect would be reduced in ruminant animals due to rumen microorganisms. In addition, it has been known that the main role of thyme is formatting free radicals in the animal's body to decrease the oxidation process, especially for meat. Hence, it might have an effect on meat quality, especially during the storage period.

Digestibility

Table 3 showed that although lambs on both BC and BT diet groups consumed higher DMI, the faecal DM out was significantly lower than lambs on group diet SC and ST (0.37, 0.35, 0.39 and 0.38 kg/day for BC, BT, SC, and ST respectively). The higher DMI and lower faecal output led to increasing (P=0.04) DM digestibility when SBM was used as a protein source in both experimental groups (BC or BT 0.68 and 0.70 respectively) compared to both experimental diet groups containing SM (SC or ST 0.65 and 0.66

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

respectively). The results obtained in the current study disagree with the results reported by El-Nomeary et al. (2021) as they found that feeding sheep a diet containing SM significantly increases DM digestibility compared to a diet containing SBM. Similarly, Obeidat et al. (2009) reported that the inclusion of the ruminant diets with sesame meal improved nutrient digestibility. Abdullah et al. (2011) also reported that feeding goat kids a diet containing sesame hulls (20%) numerically improved nutrient intake, digestibility and growth performance. While Obeidat and Aloqaily (2010) noticed that the inclusion of sesame hulls in kids' and lambs' diets did not affect DM, OM, and CP digestibility and had adverse effects on feed intake due to EE digestibility as found to be greater for goat kids and lambs fed diets contained SM. The variation between the results obtained from the different studies regarding the effect of using SM in the diet on DM digestibility could be related to the method of sesame meal preparation (oil extraction), ambience temperature during the experimental period as sesame by-products could have a high amount of oil (similar to SM used in the current study ~ 300 g/kg DM) which might lead to increase EE in the ration, and therefore, slow down the degradability in the rumen due to encapsulation and inhibition the microorganism's activity, hence had an effect on DMI, faecal output, and digestibility.

Table 3: Effect of using soybean meal or sesame meal as a protein source in the diet treated with thyme on lamb diet intake, faecal output and digestibility component.

Trait	**SBM**		**SM**		**Probability (P-value)**		
	BC	BT	SC	ST	PS	A	PS x A
Total DM intake kg	1.16	1.16	1.13	1.12	<001	0.48	0.78
Faecal DM output kg	0.37	0.35	0.39	0.38	0.04	0.08	0.12
DM digestibility	0.68	0.70	0.65	0.66	<.001	0.11	0.13
Total OM intake kg	1.10	1.10	1.07	1.06	<001	0.48	0.78
Faecal OM output kg	0.35	0.33	0.37	0.36	0.04	0.08	0.12
OM digestibility	0.74	0.70	0.65	0.65	<.001	0.14	0.25

SBM: soybean meal, SM: sesame meal, BC: soybean meal with no additive, BT: soybean supplemented 30/kg DM thyme, SC: sesame meal with no additive, ST: sesame meal supplemented 30/kg DM thyme, DM: dry matter, OM: organic matter.

Blood parameters:

Data for blood plasma parameters are presented in Table 4. Neither protein source (soybean meal or sesame meal) nor additional thyme had a significant effect on the concentration of triglyceride, total protein, uric acid or cholesterol in blood plasma at the slaughter of Awassi lambs (Table 4). However, the data for blood plasma parameters showed that relapsing 60% of SBM with SM significantly ($P<0.01$) reduced glucose concentration by approximately 17%, this is due to the effect of daily concentrate intake as the data from the current study revealed that using sesame meal as a main protein source in the diet reduced DMI and DM digestibility which might be decreased the formation of volatile fatty acid in the rumen compared to using SBM only in the lamb's

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

ration. The dry matter intake, feed degradability, and formation of volatile fatty acids would be the main factors affecting blood plasma glucose. And this was probably the main reason that blood glucose concentration was significantly lower (17%) when SBM was replaced with SM. VanSuest and colleagues (1994) hypothesized that the reduction in glucose levels in ruminant blood plasma might be due to rumen development in young ruminants, and a reduction in blood glucose that occurs when the operation is preventing quid. Contrary Qussay et al. (2015) indicated that total protein, cholesterol and triglyceride were significantly (P≤0.05) linearly reduced when sesame meal was used in the diet of Friesian cows (10% and 20%) as compared to the control treatment (0%). However, they found that blood glucose and blood urea were not affected by the experimental rations, whereas blood cholesterol and triglyceride values were decreased linearly (P≤0.05) with increasing sesame seed meal percentages while total protein values increased. Al-Dain (2012) indicated that the concentration of total protein increased significantly. and the concentration of triglycerides and cholesterol were decreased significantly by increasing the percentage of sesame by-product in the ratio of Awasi lambs.

The results in the current study showed that supplemented 30 g/kg thyme to either SBM or SM diets had no effect on all blood plasma studied parameters. Similarly Shaaban et al. (2021), also reported that supplemented 30 g/kg of thyme did not have any effect on (triglyceride, total protein, uric acid or cholesterol glucose concentration in the blood plasma. In addition, Delavar (2014) indicated that sesame waste had no significant effect on blood metabolites.

Table 4: Effect of using soybean meal or sesame meal as a protein source in the diet treated with thyme on lamb blood plasma parameters at slaughter.

Trait	SBM		SM		Probability (P-value)		
Blood parameters	**BC**	**BT**	**SC**	**ST**	**PS**	**A**	**PS x A**
Glucose g/l	73.3	79.7	61.7	64.3	0.01	0.14	0.52
Triglycerides g/l	25.1	31.7	27.1	36.1	0.23	0.35	0.16
Total protein g/l	6.5	7.1	6.6	7.4	0.28	0.32	0.33
Uric acid g/l	0.06	0.07	0.07	0.06	0.71	0.55	0.91
Cholesterol g/l	60.3	58.7	59.9	51.7	0.63	0.61	0.74

SBM: soybean meal, SM: sesame meal, BC: soybean meal with no additive, BT: soybean supplemented 30/kg DM thyme, SC: sesame meal with no additive, ST: sesame meal supplemented 30/kg DM thyme.

Slaughter parameters:

As all lambs were slaughtered when they reached 40 kg live weight, hence there were no significant differences between treatments on all studied slaughter parameters (Table 5). No differences were observed between diets SM, SBM and thyme additives in slaughter weight, hot carcass weight, dressing percentage, child carcass weight and shrinkage percentage. Several studies (Obeidat & Aloqaily, 2010; Obeidat et al., 2009)

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

found that using SM in ruminant ration had no effect on slaughter characteristics. No substantial influences in carcass characteristics have been found in Awassi lambs fed fattening diets containing sesame meal at levels of 17%. In addition, all results of carcass characteristics were within the range of acceptable values when compared to results obtained by Obeidat et al. (2009) when soybean meal was replaced by sesame meal. Overall, the results of the current study confirmed that the use of sesame meal in Awassi lambs fed fattening diets had limited or no effect on the carcass and slaughter characteristics.

Table 5: Effect of using soybean meal or sesame meal as a protein source in the diet treated with thyme at slaughter parameters.

Trait	SBM		SM		Probability (P-value)		
	BC	BT	SC	ST	PS	A	PS x A
Slaughter W kg	39.8	40.0	40.0	39.7	0.90	0.90	0.181
Hot carcass W kg	17.58	18.15	17.43	17.50	0.30	0.14	0.642
Dressing %	44.17	45.37	43.57	44.08	0.24	0.08	0.587
Child Carcass W kg	16.97	17.52	16.71	16.85	0.57	0.74	0.758
Shrinkage %	3.55	3.55	4.11	3.66	0.77	0.48	0.486
Reb eye area cm^2	2.50	2.65	2.58	2.33	0.61	0.83	0.42
Fat thickness mm	1.9	2.4	2.1	2.3	0.87	0.28	0.31
Kidney kg	0.1	0.1	0.11	0.11	0.09	0.31	0.13
Kidney pelvic fat kg	0.10	0.12	0.2	0.19	0.33	0.51	0.66

SBM: soybean meal, SM: sesame meal, BC: soybean meal with no additive, BT: soybean supplemented 30/kg DM thyme, SC: sesame meal with no additive, ST: sesame meal supplemented 30/kg DM thyme.

CONCLUSION

It can be concluded that replacing SMB with SM reduced animal performance, and this can be seen by reducing the feed consumption (total and concentrate DMI), average daily gain, and DM and OM digestibility. In addition, the time to reach slaughter weight and feed conversion ratio has been increased. However, using SM as a protein source in the ration formulation of Awassi lambs has led to reducing the cost by approximately 17% of the diet per metric ton and the daily feed intake cost by approximately 28%. Therefore, it is worth to using SM in ruminant ration but with a lower rate of inclusion (~10%). The researchers suggest that additional research should be conducted with different diet formulations to enable the determination of the optimum supplementation levels in ruminant diets for increased performance and determining the effect on carcass and slaughter characteristics. Supplementation of thyme at a rate of 30 g/kg DM did not show any significant effect on the lamb performance due to that in the current study a low level of thyme has been used.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

References.

- AFRC. (1993) Agricultural Food and Research Council. Energy and Protein Requirements of Ruminants. An Advisory Manual Prepared by the Agricultural Food and Research Council Technical Committee on Responses to Nutrients. . CAB International, Wallingford, UK.
- Al-Dain, Q. Z. (2012). Effect of sesame by-product feeding on some hematological and biochemical parameters of awassi lambs. Mesopotamia Journal of Agriculture, 40, 24-32.
- Abdullah, A. Y., Obeidat, B. S., Muwalla, M. M., Matarneh, S. K., & Abu Ishmais, M. A. (2011). Growth performance, carcass and meat characteristics of black goat kids fed sesame hulls and Prosopis juliflora pods. Asian-Australasian Journal of Animal Sciences, 24(9), 1217–1226.
- https://doi.org/10.5713/ajas.2011.11061
- Aljabeili, H. S., Barakat, H., & Abdel-Rahman, H. A. (2018). Chemical composition, antibacterial and antioxidant activities of thyme essential oil. Food and Nutrition Sciences, 09(05), 433–446.
- https://doi.org/10.4236/fns.2018.95034.
- Bonos, E., Kargopoulos, A., Basdagianni, Z., Mpantis, D., Taskopoulou, E., Tsilofiti, B., & Nikolakakis, I. (2017). Dietary sesame seed hulls utilization on lamb performance, lipid oxidation and fatty acids composition of the meat. Animal Husbandry, Dairy and Veterinary Science, 1(1) 1-5.
- https://doi.org/10.15761/ahdvs.1000101.
- Castillejos, L., Calsamiglia, S., & Ferret, A. (2006). Effect of essential oil active compounds on rumen microbial fermentation and nutrient flow in in vitro systems.Journal of Dairy Science, 89(7), 2649-2658.
- Dauqan, E. M. A., & Abdullah, A. (2017). Medicinal and functional values of thyme (Thymus vulgaris L.) Herb. Journal of Applied Biology & Biotechnology, 5(02), 17–22. https://doi.org/10.7324/jabb.2017.50203.
- Dey, D., Richter, J.K., Ek, P. Gu, B.J. & Ganjyal, G.M. (2021) Utilization of food processing by-products in extrucsion processing: A review. Frontiers in Sustainable Food Systems. (4),1-18.
- https://doi.org/10.3389/fsufs.2020.603751
- dos Santos A.B., Pereira M.L.A., de Oliveira Silva H.G., de Carvalho G.G.P., de Jesus Pereira T.C., Ribeiro L.S.O., Azevedo, J.A.G., das Gracas C., Parada Costa, S. M., Sousa L.B. & Sousa L.B. (2016) Intake, digestibility and performance of lambs fed diets containing peach palm meal. Tropical Animal Health Prodduction (48) 509–515.
- Delavar, M. H. A. (2014). The effect of different levels of sesame wastes on performance and blood metabolites in zel fattening lamb.Journal of Applied Science and Agriculture,9(9), 9-13.
- El-Nomeary, Y. A. A., Abd El-Rahman, H. H. H., Shoukry, M. M., Abedo, A. A., Salman, F. M., & Mohamed, M. I. (2021). Effect of different dietary protein sources on digestibility and growth performance parameters in lambs. Bulletin of the National Research Centre, 45(1) 1–11.
- https://doi.org/10.1186/s42269-021-00486-1
- Elleuch, M., Besbes, S., Roiseux, O., Blecker, C., & Attia, H. (2007). Quality characteristics of sesame seeds and by-products. Food Chemistry, 103(2), 641–650. https://doi.org/10.1016/j.foodchem.2006.09.008.
- El Tinay, A. H., Khattab, A. H., & Khidir, M. O. (1976). Protein and oil compositions of sesame seed.

Journal of the American Oil Chemists' Society,53(10), 648-653.

- Fitwi, M., & Tadesse, G. (2013). Effect of sesame cake supplementation on feed intake, body weight gain, feed conversion efficiency and carcass parameters in the ration of sheep fed on wheat bran and teff (Eragrostis teff) straw. Momona Ethiopian Journal of Science, 5(1), 89. https://doi.org/10.4314/mejs.v5i1.85333.
- Ghorbani, B., Yansari, A. T., & Sayyadi, A. J. (2018). Effects of sesame meal on intake, digestibility, rumen characteristics, chewing activity and growth of lambs.South African journal of animal science,48(1), 151-161.
- Jabri-Karoui, I., Bettaieb, I., Msaada, K., Hammami, M., & Marzouk, B. (2012). Research on the phenolic compounds and antioxidant activities of Tunisian Thymus capitatus. Journal of Functional Foods, 4(3), 661–669. https://doi.org/10.1016/j.jff.2012.04.007.
- Kak, H.F., Al-Doski, S.H. & Taha, V.J. (2020) Effect of implanting zeranol on growth and carcass characteristics of Awassi lambs and goat kids raised under commercial condition. Iraqi Journal of Agricultural Science 51(5):1321-1328. https://doi.org/10.36103/ijas.v51i5.1141
- Khamisabadi, H., Kafilzadeh, F., & Charaien, B. (2016). Effect of thyme (Thymus vulgaris) or peppermint (Mentha piperita) on performance, digestibility and blood metabolites of fattening Sanjabi lambs. Biharean Biologist, 10(2), 118–122.
- Khattab, M. S. A., Kholif, A. E., Abd El Tawab, A. M., Shaaban, M. M., Hadhoud, F. I., El-Fouly, H. A., & Olafadehan, O. A. (2020). Effect of replacement of antibiotics with thyme and celery seed mixture on the feed intake and digestion, ruminal fermentation, blood chemistry, and milk lactation of lactating Barki ewes. Food & function,11(8), 6889-6898.
- Kulisic, T., Radonic, A., & Milos, M. (2005). Antioxidant properties of thyme (Thymus vulgaris L.) and wild thyme (Thymus serpyllum L.) essential oils. Italian Journal of Food Science, 17(3), 315–324.
- Mahmoud, A. E. M., & Ghoneem, W. M. A. (2014). Effect of partial substitution of dietary protein by nigella sativa meal and sesame seed meal on performance of Egyptian lactating buffalo. Asian Journal of Animal and Veterinary Advances, 9(8), 489–498. https://doi.org/10.3923/ajava.2014.489.498.
- Matloup, O.H., El, Abd, Tawab, A.M., Hassan, A.A., Hadhoud, F.I., Khattab, M.S.A., Khalel, M.S., Sallam, S.M.A., Kholif, A.E., (2017). Performance of lactating Friesian cows fed a diet supplemented with coriander oil: feed intake, nutrient digestibility, ruminal fermentation, blood chemistry, and milk production. Anim. Feed Sci. Technol. 226, 88–97. https://doi.org/10.1016/j.anifeedsci.2017.02.012.
- McDonald P, Edwards RA, Greenhalgh JFD, Morgan CA, Sinclair LA and Wilkinson RG (2011). Animal Nutrition. 7th edn. Harlow, England, Pearson.
- Nieto, G., Bañón, S., & Garrido, M. D. (2012). Administration of distillate thyme leaves into the diet of Segureña ewes: Effect on lamb meat quality. Animal, 6(12), 2048–2056.
- https://doi.org/10.1017/S1751731112001012
- Obeidat, B. S., Abdullah, A. Y., Mahmoud, K. Z., Awawdeh, M. S., Al-beitawi, N. Z., & Al-Lataifeh, F. A. (2009). Effects of feeding sesame meal on growth performance, nutrient digestibility, and carcass characteristics of Awassi lambs. Small Ruminant Research, 82(1), 13–17.
- https://doi.org/10.1016/j.smallrumres.2009.01.002
- Obeidat, B. S., & Aloqaily, B. H. (2010). Using sesame hulls in Awassi lambs diets: Its effect on growth performance and carcass characteristics and meat quality. Small Ruminant Research, 91(2–3), 225–230. https://doi.org/10.1016/j.smallrumres.2010.03.004.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication Online Open Access
Vol: 41 Issue: 11-2022
DOI 10.17605/OSF.IO/W739H

- Obeidat BS, Gharaybeh FF (2011) Effect of feeding sesame hull on growth performance, nutrient digestibility, and carcass characteristics of black goat kids. Asian-Australasian Journal of Animal Sciences 24: 206-213.
- Obeidat, Belal S., Kridli, R. T., Mahmoud, K. Z., Obeidat, M. D., Haddad, S. G., Subih, H. S., Ata, M., Al-Jamal, A. E., Abu Ghazal, T., & Al-Khazáleh, J. M. (2019). Replacing soybean meal with sesame meal in the diets of lactating awassi ewes suckling single lambs: nutrient digestibility, milk production, and lamb growth. Animals, 9(4), 157. https://doi.org/10.3390/ani9040157
- Odhaib, K. J., Adeyemi, K. D., & Sazili, A. Q. (2018). Carcass traits, fatty acid composition, gene expression, oxidative stability and quality attributes of different muscles in Dorper lambs fed Nigella sativa seeds, Rosmarinus officinalis leaves and their combination. Asian-Australasian Journal of Animal Sciences, 31(8), 1345–1357. https://doi.org/10.5713/ajas.17.0468.
- Omar, J. M. A. (2002). Effects of feeding different levels of sesame oil cake on performance and digestibility of Awassi lambs. Small Ruminant Research, 46(2–3), 187–190. https://doi.org/10.1016/S0921-4488(02)00173-6
- Omer, H. A. A., Ahmed, S. M., Abdel-Magid, S. S., Bakry, B. A., El-Karamany, M. F., & El-Sabaawy, E. H. (2019). Nutritional impact of partial or complete replacement of soybean meal by sesame (Sesamum indicum) meal in lambs rations. Bulletin of the National Research Centre, 43(1). https://doi.org/10.1186/s42269-019-0140-8
- Qussay, Z. S. A., Essam, A. J., Hussain, A. S., & Younis, I. H. (2015). Milk production, composition and economic efficiency and some blood parameters of local Friesian dairy cows fed Sesame seed meal. Journal For Veterinary Medical Sciences, 6(2).
- Shaaban, M. M., Kholif, A. E., Abd El Tawab, A. M., Radwan, M. A., Hadhoud, F. I., Khattab, M. S. A., Saleh, H. M., & Anele, U. Y. (2021). Thyme and celery as potential alternatives to ionophores use in livestock production: their effects on feed utilization, growth performance and meat quality of Barki lambs. Small Ruminant Research, 200(May), 106400. https://doi.org/10.1016/j.smallrumres.2021.106400
- Shahidi, F., Liyana-Pathirana, C. M., & Wall, D. S. (2006). Antioxidant activity of white and black sesame seeds and their hull fractions. Food Chemistry, 99(3), 478–483.
- https://doi.org/10.1016/j.foodchem.2005.08.009
- Stanner, S., & Weichselbaum, E. (2012). Antioxidants. Encyclopedia of Human Nutrition, 1–4, 88–99. https://doi.org/10.1016/B978-0-12-375083-9.00013-1
- Taha, V.J (2015) Effect of supplemental chestnut tannins on silage quality and animal performance. PhD thesis to Harper Adams University, Newport, Shropshire, UK.
- https://hau.repository.guildhe.ac.uk/id/eprint/17318/1/Vahel%20Taha.pdf
- Taha, V.J., Huntington, J.A, Wilkinson, R.G. & Davies, D. (2022) The effect of supplemented chestnut tannin to grass silage either at ensiling or at feeding on lamb performance, carcass characteristics and meat quality. Agricultural and Food Science, 31: 175–186. https://doi.org/10.23986/afsci.115275
- Van Keulen, J., and B. A. Young. 1977. Evaluation of Acid-Insoluble Ash as a Natural Marker in Ruminant Digestibility Studies. J. Anim. Sci. 44:282– 287.
- Vansoest, P.J., G.B. Robertson and B.A. Lewis, 1994. Method for dietary fiber, natural detergent fiber and non starch polysaccharides in relation to animal nutrition.Journal of Animal Science.