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Influence of Inclusion Sunflower (*Helianthus annuus*) Seed Meal in Sheep Rations on Their Digestion Coefficients, Nutritive Values, Nitrogen Balance, Ruminal Fermentation and Some Blood Constituents

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Abstract: This work aimed to study the influence of incorporation sunflower seed meal (SFSM) at (0, 5, 10, 15 and 18%) of total ration for R_1, R_2, R_3, R_4 and R_5, respectively on performance, digestion coefficients, nitrogen balance, ruminal fermentation and blood parameters. Twenty five of growing male Barki lambs aged 5-6 months with average weights (21.960 ± 0.175 kg) randomly allotted into five groups each contains 5 lambs that used in group feeding trial for 112 days. The results cleared that experemental rations were approximately iso-caloric and iso-nitrogenous. Digestibility coefficients significantly affected by incorporation SFSM except for organic matter and cellulose digestibility. Incorporation SFSM at different levels significantly ($P<0.05$) increased the digestibility coefficients of DM, CP, CF, NFE, NDF, ADF, hemicellulose digestibility and values of TDN % and DCP% except for R_4 with DCP comparing to the control (R_1). Dietary treatments caused a significantly ($P<0.05$) increasing in final weight, total body weight gain and average daily gain compared to contol. Dry matter intake was gradually significantly ($P<0.05$) decreased with increasing the level of SFSM. Values of feed conversion (g. intake/g. gain) of DM were significantly ($P<0.05$) improved with incorporation SFSM comparing to control. All tested rations showed positive nitrogen retention (NR) and values of (NR, % of nitrogen intake) or (NR, % of digested nitrogen} were significantly ($P<0.05$) improved with increasing SFSM.. Incorporation SFSM significantly ($P<0.05$) decreased ruminal pH. Ruminal ammonia nitrogen were in-significantly ($P>0.05$) decreased when SFSM used at 5, 10 and 15%, meanwhile, 18% SFSM (R_5) caused significantly ($P<0.05$) decreasing. Dietary treatments cleared significantly ($P<0.05$) decreasing in total volatile fatty acids concentrations. Incorporated SFSM at 10, 15 and 18% caused significantly ($P<0.05$) decreasing in acetic and propionic acids %, meanwhile it significantly ($P<0.05$) increasing butyric, valeric and iso-valeric acids. Inclusion SFSM significantly ($P<0.05$) increased blood glucose, hemoglobin, white blood cell count, total protein and albumin contents. Meanwhile, it significantly ($P<0.05$) decreased blood contents of total cholesterol, total lipids, triglycerides, GPT, urea and creatinine. It can be concluded that SFSM is a good source of protein and can be successfully used as conventional source of protein without occurring any adverse effect on performance, digestion, nutritive values, nitrogen balance, fermentation with improving liver and kidney functions throughout decreasing the values of total cholesterol, triglycerides, total lipids, GPT, GOT, urea, creatinine and alkaline phosphatase.

Key words: Sunflower seed meal · Sheep · Performance · Digestion · Nitrogen balance · Fermentation · Blood parameters

INTRODUCTION

The feedstuff market is suffering from price fluctuations and quite often availability problems [1-3]. These detrimental situations are usually observed for high-protein feed such as soybean meal [4], but they can also be observed for cereals such as maize [5], barley [6] and other feed ingredients. Consequently, farmers have problems with supplying their livestock with good quality feed, while keeping the feed cost at manageable levels.

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Accordingly, nowadays there is an observed increasing demand for novel feedstuffs characterized by low price and decent availability, which can be utilized in livestock feed, without any adverse effect on animal health and productivity. Therefore, many by-products of the food and feed industries are now being examined as alternative feedstuffs [7, 8].

Most concentrates for small ruminants (sheep and goats) are grain based to increase their energy concentration, which typically improves gain efficiency and cost of gain. The use of Soybean Meal (SBM) as a source of protein in animal feed has been well established for many years. However, high prices and fluctuation in production have raised the interest in alternative protein sources for feeding ruminants. The increased world production of sunflower has increased interest in Sunflower Seed Meal (SFM) as a high quality by-products for ruminants [9-11]. The SFM, like SBM, is a high-protein supplement, contains 30-46% crude protein, 13-15% crude fiber, 9-12 MJ ME, Neutral Detergent Fiber (NDF) 47% and Ether Extract (EE) 1.5% [9, 10, 12]. Recently, SFM is becoming available in Egypt for ruminant nutrition and as a by-product of extraction of sunflower oil locally. SFM could be used as a substitute for SBM. As a protein supplement, SFM could replace SBM in rations of small ruminants with similar gain and feed efficiency [12, 13].

Sunflower meal is the by-product of the extraction of oil from sunflower seeds. In terms of production, it is the 4th most important oil meal after soybean meal, rapeseed meal and cottonseed meal [14]. A wide variety of products are available on the market, from low-quality straw-like meals to high-quality flours. Sunflower meals can be made from whole or decorticated seeds and can be mechanically and/or solvent-extracted. The quality of sunflower meal depends on the plant characteristics (seed composition, hulls/kernel ratio, dehulling potential, growth and storage conditions) and on the processing (dehulling, mechanical and/or solvent extraction) as noted by [15]. While solvent-extracted sunflower meal remains the main type of sunflower meal commercially available, oil-rich sunflower meals obtained by mechanical pressure only have become more popular since the 2000s, with the development of organic farming and on-farm oil production.

Sunflower meal is available worldwide. World production was estimated to 21.8.5 million tons in 2019 [16, 17]. Ukraine and Russian federation are the main producers with respectively 6.3 and 5.1 million tons produced in 2019. The European Union (EU-27) is the 3rd producer with 4.8 million ton in 2019 [16, 17]. EU-27 also imported 3.4 million ton sunflower meal in 2019 [16, 17].

On the other hand [18-20] indicated that sunflower meal was equally good in performance, yet the cost of sunflower meal based rations was the lowest. The nutritional quality of sunflower meal is dependent on the processing method of oil extraction [21]. Furthermore, Abbas and Yagoub [22] concluded that sunflower cake can replace up to 100% of groundnut cake in broiler chicks. In Its annual report, CBS [23] mentioned that sunflower grain output reached 12 thousand tons in, 2004/05 seasons compared with 7 thousand tons in the previous season.

Un-decorticated sunflower meal has high fiber content because varieties of sunflower seeds have 25 to 30% hulls [24] (Van Waalwijk and Van Doorn, 1982). Sunflower meal is used extensively in Europe which is a net importer of sunflower meal utilizing 59% of the total world imports as noted by FAO [25].

So, the main objective of this work was to investigate the impact of inclusion sunflower seed meal (SFSM) at different levels (0 , 5, 10, 15 and 18%) of complete feed mixture (CFM) fed to growing Barki lambs on their performance, digestion coefficients, nutritive values, nitrogen balance, ruminal fermentation and some of blood parameters.

MATERIALS AND METHODS

This study was investigated in a co-operation work between Animal Production Department, National Research Centre, 33 El-Bohouth Street, P.O: 12622, Dokki, Cairo and Field Crops Research Department, National Research Centre, 33 El-Bohouth Street, P.O: 12622, Dokki, Cairo.

The present work aimed to study the influence of introduce sunflower seed meal (SFSM) as a traditional source rich in their contents of crude protein and energy, plus it chip price in comparison with the soybean meal (SBM).

Animals and Feeds: A total numbers of Twenty five of growing male Barki lambs aged 5-6 months with an average weights (21.960 ± 0.175 kg) were randomly allotted to five equal experimental group lambs each contains 5 animals to established the impact of introduce SFSM at different levels 0, 5, 10, 15 and 18% of total ration formulation, for R_1, R_2, R_3, R_4 and R_5, respectively on lamb performance, digestion coefficients, nutritive values, nitrogen balance, ruminal fermentation and some of blood parameters.

Feeding trials lasted for 112 days, animals were housed in semi-open pens and fed as group feeding and the experimental rations were formulated to cover the requirements of total digestible nutrients and protein for growing sheep according to the NRC [26].

Each group of experimental lambs was received one of the experimental rations that prepared in (Complete Feed Mixture) and considered as follows:

R_1: 1st experimental ration (Complete Feed Mixture) assigned as control and it contained 0% SFSM.
R_2: 2nd experimental ration (Complete Feed Mixture) contained 5% SFSM.
R_3: 3rd experimental ration replace ration (Complete Feed Mixture) contained 10% SFSM.
R_4: 4th experimental ration (Complete Feed Mixture) contained 15% SFSM...
R_5: 5th experimental ration (Complete Feed Mixture) contained 18% SFSM.

Daily amounts of different tested rations were adjusted every 2 weeks according to body weight changes and it were offered twice daily in two equal portions at 800 and 1400 hours, while feed residues were daily collected, sun dried and weekly weighed. Fresh water was always freely available in plastic containers. Individual body weight change was recorded weekly before receiving the morning ration. chemical analysis Composition and chemical analysis (%) of experimental rations are presented in (Table 1).

Digestibility Trials: At the end of feeding trial, twenty digestibility trials were carried out using four animals from each group and housed in individual metabolic cages. Cages allowed catching feces separately from the urine which was collected in attached glass containers containing 50 ml sulphoric acid 10%. A different tested rations (complete fee mixture) were offered at 8.00 a.m. and water was available all times. The digestibility trial consisted of 7 days as a preliminary period followed by 5 days for feces and urine collection. During the collection period, feces and urine were quantitatively collected from each animal once a day at 7.00 a.m. before feeding. Actual quantity of feed intake and water consumption were recorded. A sample of 10% of the collected feces from each animal was sprayed with 10% sulphoric acid and 10% formaldehyde solutions and dried at 60°C for 48 hrs. Samples were mixed and stored for chemical analysis. Composite samples of feeds and feces were finely ground prior to analysis. Also 10% of the daily collected urine from each animal was preserved for nitrogen determination. The nutritive values expressed as the total digestible nutrient (TDN) and digestible crude protein (DCP) of the experimental rations was calculated by classical method that described by Abou-Raya [27].

Rumen Fluid Parameters: Rumen fluid samples were collected from four animals at the end of the digestibility trials at 4 hrs post feeding via stomach tube and strained through four layers of cheesecloth. Samples were separated into two portions, the first portion was used for immediate determination of ruminal pH and ammonia nitrogen (NH_3-N) concentration, while the second portion was stored at-20°C after adding a few drops of toluene and a thin layer of paraffin oil till analyzed for volatile fatty acid's (TVFA's).

Blood Parameters: Blood samples were collected at the end of digestibility trials from 20 animals (four animals from each group) at 4 hours post feeding from the left jugular vein in heparinized test tubes and centrifuged at 5.000 rpm for 15 minutes. Plasma was kept frozen at -20°C for subsequent analysis.

Analytical Procedures: Chemical analysis of the experimental ration samples were analyzed according to AOAC [28] methods. Ruminal pH was immediately determined using a digital pH meter.

Ruminal ammonia nitrogen (NH_3-N) concentrations were determined applying NH_3 diffusion technique using Kjeldahle distillation method according to [28]. Meanwhile, ruminal total volatile fatty acids (TVF'A) concentrations were determined by steam distillation according to Warner [29]. Molar proportion of volatile fatty acids were determined according to Erwin *et al.* [30].

Blood samples were analyzed using commercial diagnostic kits from Biomerieux, France and Quimica Clinica Aplicada (QCA), Amposta, Spain, were used for assay of serum biochemical parameters. Glucose red blood cell count (RBCs) and white blood cell count. of collected blood samples were described by Weiss and Wardrop [31]; hemoglobin as described by [32, 33]; plasma total protein was determined according to [34, 35]; albumin was determined according to [36, 37]; triglycerides were determined according to Fossati and Principe [38]; total lipids were determined according to Postma and Stroes [39]; total cholesterol was determined according to [40, 41]; alkaline phosphates activity was measured according to the method described by Beliefield and Goldberg [42]; urea according to Patton and Crouch [43]; creatinine according to Husdan [44]; plasma glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) activities were determined as described by [45, 46]; while globulin was calculated by difference between total protein and albumin. Albumin: globulin ratio (A: G ratio) was also calculated.

Cell wall constituents includes neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest [47] and Van Soest *et al.* [48]. Meanwhile, hemicellulose and cellulose content were calculated by difference using the following equations:

Hemicellulose = NDF - ADF. Meanwhile, Cellulose =ADF - ADL

Statistical Analysis: Data collected of live weight, average daily gain, daily dry intake (g/h/day), feed conversion, digestion coefficients, nutritive values, nitrogen balance, ruminal fermentation and blood parameters. were subjected to statistical analysis as one-way analysis of variance according to SPSS [49]. Duncan's Multiple Range Test [50] was used to separate means when the dietary treatment effect was significant according to the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

where:

Y_{ij} = observation. μ = overall mean.
T_i = effect of experimental rations for i = 1-5, 1 = {R_1 contained 0% sunflower seed meal (SFSM) and considered as control}, 2 = {R_2 experimental ration contained 5% SFSM}, 3 = {R_3 experimental ration contained 10% SFSM, 4 = {R_4 experimental ration contained 15% SFSM} and 5 = {R_5 experimental ration contained 18% SFSM}.
e_{ij} = the experimental error.

RESULTS AND DISCUSSION

Composition and Chemical Analysis of the Different Experimental Rations: Data illustrated in (Table 1) cleared that all experemental rations were approximately iso-caloric and iso-nitrogenous. The corresponding values of ether extract content (EE) ganged from 2.59 to 2.82%, meanwhile, values of CP contents ganged from 16.09 to 16.34 % among the five tested rations. Inclusion SFSM at different levels occurred a slightly increasing in values of CF, ash, cell wall constituents includes (NDF, ADF and ADL) and cellulose. Meanwhile, it realized a slightly decreasing in values of NFE, hemicellulose and cell soluble-NDF. These results near from those results that found by Paengkoum and Wanapat [11] who showed that when sunflower seed meal (SSM) replaced 0, 25, 50 and 75% of soybean meal (SBM) in basal ration that reach to 0, 7.3, 14.5 and 22% of total ration formulation of growing goats. They recorded that the values of chemical analysis were ranged from (15.2 to 15.3% for CP); (4.8 to 5.8% for ash); (9.7 to 12.8 for CF); (16.2 to 25.1% for NDF). In addition to, Irshaid *et al.* [12] replaced soybean meal (SBM) with sunflower seed meal (SFSM) at 50% or 100% in Awassi lamb rations, they showed that CP cotent ranged from 17.6 to 17.9%; CF from 10.1 to 20.8%; NDF from 31.0 to 63.4%; ADF from 7.3 to 17.0%; ash from 6.4 to 7.1% among three experimental group lambs.

Nutrients & Cell Wall Digestibility Coefficients and Nutritive Values of the Experimental Rations: Data of (Table 2) showed that except for organic matter and cellulose digestibility the all other nutrient digestibility were significantly affected by incorporation SFSM in the lamb rations. Second 2nd ration that contained 5% SFSM (R_2) had no significant (P>0.05) effect on DM & CF digestibility and digestible crude protein DCP in comparison with the control one (R_1). However, the incorporation levels of SFSM (R_3, R_4 and R_5) significantly (P<0.05) increased the other nutrient digestibility includes (DM, CP, CF, NFE, NDF, ADF, hemicellulose digestibility and values of TDN % and DCP%, except for R_4 with DCP comparing to the control (R_1). These results disagreement with those found by Omer *et al.* [8] who noted that replaced 50 or 100 % of soybean meal (SBM) by sesame meal (SM) had no significant effect on all digestibility and TDN value but, DCP was significantly (P<0.05) reduced with complete replacement of SBM by SM while the DCP in the control and that replaced 50% of SBM with SM was similar (P>0.05). On the other hand, Eweedah *et al.* [51] found no differences in digestibility of CP, CF and ADF. However, digestibility of DM, OM, NDF and NFE was lowest with the sheep fed SFM-based diet. Different protein sources have varying effects on nutrient digestibility in animals. Khan *et al.* [52] reported significant effects of canola meal (CM) , cotton seed meal (CSM) and soybean meal (SBM) on DM, CP and fiber digestibility in growing Afghani lambs. However, in other study carried by Paterson *et al.* [53] noted that different protein sources had no effect on NDF digestibility. Sunflower meal contains more NDF, which would contribute to lower digestibility [54].

Table 1: Composition and chemical analysis of the different experimental rations

	Experimental rations				
Item	R_1	R_2	R_3	R_4	R_5
Level of sunflower seem meal	0% SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM
Composition (kg/ ton)					
Yellow corn	380	360	340	330	320
Soybean meal	140	110	80	40	20
Sunflower seed meal	-	50	100	150	180
Wheat bran	150	150	150	150	150
Berseem hay	300	300	300	300	300
Lime stone	18	18	18	18	18
Sodium chloride	7	7	7	7	7
Anti toxic	4	4	4	4	4
Vitamin and mineral mixture[1]	1	1	1	1	1
Moisture	8.42	8.39	8.34	8.32	8.30
Chemical analysis on DM basis (%)					
Organic matter (OM)	91.66	91.56	91.45	91.38	91.33
Crude protein (CP)	16.15	16.24	16.34	16.09	16.09
Crude fiber (CF)	11.05	12.07	13.06	14.07	14.67
Ether extract (EE)	2.59	2.65	2.7	2.78	2.82
Nitrogen free extrct (NFE)	61.87	60.60	59.35	58.44	57.75
Ash	8.34	8.44	8.55	8.62	8.67
Cell wall constituents (%)					
Neutral detergent fiber (NDF)	36.18	36.85	37.50	38.17	38.56
Acid detergent fiber (ADF)	19.51	20.44	21.34	22.26	22.81
Acid detergent lignin (ADL)	3.39	3.57	3.73	3.90	4.01
Hemicellulose[2]	16.67	16.41	16.16	15.91	15.75
Cellulose[3]	16.12	16.87	17.61	18.36	18.80
Cell soluble-NDF[4]	63.82	63.15	62.50	61.83	61.44

[1]Vitamin & Mineral mixture: Each kilogram of Vit. & Min. mixture contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 g Vit. K, 0.33 g Vit. B_1, 1.0 g Vit. B_2, 0.33g Vit. B_6, 8.33 g Vit.B_5, 1.7 mg Vit. $B1_2$, 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 g Mn.

[2]Hemicellulos = NDF – ADF. [3]Cellulose = ADF – ADL.

[4]Cell soluble – NDF = 100 – NDF.

Table 2: Nutrients & cell wall digestibility coefficients and nutritive values of the experimental rations

	Experimental rations					
Item	R_1	R_2	R_3	R_4	R_5	
Level of sunflower seem meal	0 % SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM	SEM
Nutrient digestibility (%) of						
Dry matter (DM)	71.12^{b}	71.25^{b}	71.81^{a}	71.98^{a}	72.09^{a}	0.117
Organic matter (OM)	71.35	71.52	71.93	72.11	72.37	0.164
Crude protein (CP)	76.11^{d}	76.88^{c}	77.02^{c}	77.56^{b}	77.95^{a}	0.174
Crude fiber (CF)	61.43^{c}	61.92^{bc}	62.36^{ab}	62.94^{a}	63.12^{a}	0.199
Ether extract (EE)	79.13^{d}	79.89^{c}	80.16^{c}	80.85^{b}	81.64^{a}	0.242
Nitrogen-free extract (NFE)	75.16^{c}	75.93^{b}	76.17^{b}	76.81^{a}	77.32^{a}	0.208
Cell wall constituents digestibility of						
Neutral detergent fiber (NDF)	67.11^{d}	68.25^{c}	69.08^{bc}	69.93^{ab}	70.26^{a}	0.331
Acid detergent fiber (ADF)	69.16^{d}	70.31^{c}	71.87^{b}	72.36^{b}	72.88^{a}	0.373
Hemicellulose	62.85^{e}	63.26^{d}	63.98^{c}	64.37^{b}	64.81^{a}	0.196
Cellulose	73.71	74.37	75.12	75.88	76.30	0.588
Nutritive values (%)						
Total digestible nutrient (TDN)	70.19^{d}	70.74^{c}	70.81^{bc}	71.28^{ab}	71.63^{a}	0.144
Digestible crude protein (DCP)	12.29^{b}	12.49^{ab}	12.59^{a}	12.48^{ab}	12.54^{a}	0.041

a, b, c, d and e: Means in the same row having different superscripts differ significantly ($P<0.05$).

SEM: Standard error of mean.

R_1: 1st experimental ration assigned as control and it contained 0% SFSM.

R_2: 2nd experimental ration contained 5% SFSM.

R_3: 3rd experimental ration replace ration contained 10% SFSM.

R_4: 4th experimental ration contained 15% SFSM.

R_5: 5th experimental ration contained 18% SFSM.

Likewise, decreased DM and OM digestibility were noted in sheep when fed cotton seed cake, which might be the result of gossypol contents [55] that caused depression in nutrient digestibility due to its adverse effect on the digestive enzymes as mentioned by Chase *et al*. [56]. In addition to, Milis *et al*. [57] reported that SBM or corn gluten meal (CGM) had no effect on nutrient digestibility. Irshaid *et al.* [12] has also reported no effect of SFM or SBM on digestibility of DM, OM, CP, crude fiber (CF), NDF or ADF in Awassi lambs. Also, Phillips and Rao [58] observed no difference in DM digestibility in lambs fed diets containing pigeon pea, CSM or alfalfa as protein sources. Although lambs fed pigeon pea showed a lower protein digestibility (65.7%) compared to those fed alfalfa diet (72.7%). The CP intakes were 869, 894, 812 and 944 g/d by lambs fed diets containing SBM, heated SBM, menhaden FM and combination of protein supplements, respectively. Bacterial CP flow remained unchanged in cows fed diets supplemented with CGM and extruded soybeans at 2.7% of body weight [59, 60]. On the other hand, Bowman and Paterson [61] reported similar digestibility in lambs fed corn plus urea, corn plus SBM or 50% dry, wet or ensiled corn gluten feed in high concentrate diets. Also, Khan *et al*. [52] observed no difference in DM and CP digestibility in Afghani lambs fed diets containing SBM and CM, however, differed significantly when fed CSM as the major protein source. Apparent digestion of OM in the reticulo-rumen was lower in steers fed diets supplemented with heated SBM, menhaden FM and combination of protein supplement [62]. Abou-Ward *et al*. [63] reported that un-decorticated CSM supplemented with ferrous sulphate significantly improved the nutrient digestibility in growing Barki male lambs compared to those lambs fed un-decorticated CSM or SBM without the addition of ferrous sulphate. Hussein and Jordan [64] reported 78, 52 and 57% degradability of CP from SBM, fish meal (FM) and corn, respectively. Protein efficiency ratios were unaffected across all the diets. Karsli *et al.* [65] reported that no difference in the NDF and ADF digestibility due to changing protein source. Also, Merchen *et al.* [66] found higher DM and OM digestibility and lower N digestibility in lambs fed urea, SBM and CGM as protein supplements in corn silage diet. Similarly, Swanson *et al.* [67] observed better digestibility of DM, OM and CP with protein supplementation in sheep fed grass hay: straw mixture. Jaster *et al.* [68] reported that DM digestibility was higher (76.6%) in heifers fed wet corn gluten feed compared with alfalfa haylage (60.67%). In the same study, the digestibility of CP, NDF and ADF was increased in wet corn gluten feed compared with other feeds. Also, Bernard *et al.* [69] reported higher apparent DM digestibility when wet or dry corn gluten feed was fed. However, Drackley *et al.* [70] reported decreased fiber digestion in steers fed diets containing sunflower seeds whereas, Nelson and Watkins [71] found non-significant differences in DM (55.5 versus 55.6), protein (39.1 and 40.5) and fiber (54.1 and 54.3) digestibility in lambs offered diets containing CSM given after every 6 days as compared to daily supplementation. Similar results were obtained by Zinn [72]. In addition to, Leupp *et al.* [73] reported higher apparent CP digestibility in steers given feed supplemented with CM compared to the control. Whereas, Richardson *et al.* [13] substituted CSM with SFM in a growing finishing feedlot diet at levels of 0, 5.5, 11 and 22% and found no difference in digestibility which indicated that solvent processed CSM was similar to solvent extracted SFM when fed on an equal CP and fiber basis. Ahmed and Abdalla [74] noticed that replacing 50% of cotton seed cake by sesame seed cake in yearling sheep had no effect on digestibility and TDN value. Also, Mahmoud and Ghoneem [75] noted that there were no significant (P>0.05) difference in the digestibility of DM, CF, NFE, NDF, cellulose and hemicellulose among rations that contained 50% *Nigella sataiva* meal, 50% sesame seed meal, or 25% *Nigella sataiva* meal + 25% sesame seed meal, in comparison with the control. While there were insignificant decreases in digestibility of OM, CP and ADF for lactating buffaloes that received 50% *Nigella sataiva meal* or 50% sesame seed meal. However, the previous values decreased (P<0.05) for lactating buffaloes fed 25% *Nigella sataiva meal* + 25% sesame seed meal containing rations. Also, [75] noted that buffaloes which received concentrate feed mixture contained 50% sesame meal insignificantly decreased DCP content comparing with those fed control ration. On the other hand, Fitwi and Tadesse [76] noticed that feeding growing sheep diets containing 0, 150, 200, 250 and 300 g day^{-1} feed ingredient did not affect DM, OM, CP and CF digestibility of rations and in their TDN. Also, digestibility of DM was not affected by the inclusion of sesame oil cake in Awassi lamb diets as reported by [77]. In addition, similar results were observed in bull calves when fed rations containing sesame oil cake as noted by [78] and in goats as reported by [79]. Meanwhile, CP and crude fiber digestibility was

Table 3: Performance of the experimental groups

Item	Experimental rations					
	R_1	R_2	R_3	R_4	R_5	
	0 % SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM	SEM
Initial weight (kg)	21.900	22.200	21.500	22.500	21.700	0.175
Final weight (FW, kg)	41.500^{c}	42.920^{b}	43.340^{ab}	43.780^{ab}	44.100^{a}	0.269
Total body weight gain (TBWG, kg)	19.600^{d}	20.720^{c}	21.840^{ab}	21.280^{bc}	22.400^{a}	0.287
Experimental duration period			112 days			
Average daily gain (ADG, g)	175^{d}	185^{c}	195^{ab}	190^{bc}	200^{a}	2.565
Daily dry matter intake (DMI), g	1250^{a}	1200^{b}	1150^{c}	1125^{cd}	1100^{d}	14.78
Feed conversion expressed as g. intake / g. gain of dry matter	7.14^{d}	6.49^{c}	5.90^{b}	5.92^{b}	5.50^{a}	0.155

a, b, c and d : Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean.

R_1: 1st experimental ration assigned as control and it contained 0% SFSM.

R_2: 2nd experimental ration contained 5% SFSM.

R_3: 3rd experimental ration replace ration contained 10% SFSM.

R_4: 4th experimental ration contained 15% SFSM.

R_5: 5th experimental ration contained 18% SFSM.

highest (P<0.05) for the diet containing 20% sesame oil cake [77]. On the other hand, El-Nomeary *et al.* [80] reported that apparent digestibility of all nutrients OM, CP, CF, EE and NFE all were increased (P<0.05) with sesame seed meals in rabbits compared with the control diet

Lambs Performance of the Experimental Groups: Data of lamb performance presented in (Table 3) showed that introduced SFSM in lamb rations at different levels caused a significantly (P<0.05) increasing in final weight (FW), total body weight gain (TBWG) and average daily gain (ADG) comparing to contol group lambs that received ration that not cotaining SFSM. Furthermore, these parameters that mentioned above were gradally increase with increasing the level of incorporation of SFSM in lamb rations.

Dry matter intake (DMI) was gradually significantly (P<0.05) decreased with increasing the level of SFSM in lamb rations. Thecorresponding value of DMI were 1250, 1200, 1150, 1125 and 1100 g/h/day for R_1, R_2, R_3 R_4 and R_5, respectively. Meanwhile values of feed conversion that expressed as (g. intake / g. gain) of DM was significantly (P<0.05) improved with incorporation SFSM in lamb rations in comparison with that not contained SFSM (control one).

These results were in agreement with those obtained by Omer *et al.* [8] who replaced 50% or complele replacement (100%) of SBM by sesame meal (SM) in sheep rations and they noted that replaceing 50% or complele replacement of SBM by (SM) significantly (P<0.05) increased FW, TBWG and ADG comparing to contol group lambs that received ration that not cotaining SM. They also, observed that values of feed converion were significantly (P<0.05) improved, meanwhile DMI were not affected (P>0.05) by replacing SBM by SM. Dry matter intake (DMI) may be affected by the dietary protein source as they affect the ability of the rumen to hold ruminal contents [81]. Higher intakes were observed in Dorper lambs fed maize stovers as basal diet supplemented with maize meal and cotton seed meal (CSM) as noted by Chakeredza [82]. Whereas, wether lambs fed wheat forage as a control diet supplemented with CSM, corn gluten meal (CGM) and blood meal (BM) had no effect on forage intake but it resulted in increasing in digestible DMI [83]. On the other hand, Ponnampalam, *et al.* [84] observed that DMI was the highest in lambs fed fish meal (FM), moderate fed soybean meal (SBM) and canola meal (CM) and was the lowest in lambs fed basal feed (lucern and oat hay with a ratio of (20: 80), respectively. Higher intakes were observed in crossbred wether lambs fed diets supplemented with sunflower meal (SFM) than those fed rape seed meal (RSM) as noted by Coombe [85]. Protein intake was higher in finishing lambs fed diets containing varying protein sources than those fed a basal diet having protein in excess of NRC [26] recommendations for fattening lambs. Also Khalid *et al.* [86] reported significantly higher dry matter intake for growing Kajli male lambs fed diets containing CM comparing with the lambs fed CSM, FSM or CGM based diets. Total DMI was higher in lambs fed a CM diet because of its rapid ingestion and reduced rumen filling effects [87]. Another reason for increased DMI might be because of enhanced microbial biomass resulting in higher digestion rate and more post ruminal flow of amino acids [88]. However, Suliman and Babiker [89] observed no difference in feed intake ranging from (1011 to 1018 g//h/day) in fattening lambs fed different protein sources like ground nut cake, sesame cake, cotton seed cake and sunflower seed cake. Also, Irshaid *et al*. [12] recorded slightly higher daily feed intake in Awassi lambs fed SFM (1094 kg) in comparison with those fed SBM (1088 g/h/day) but overall difference was not significant. In addition to, Kandylis *et al*. [90] noticed no difference in feed intake by growing lambs fed CSM substituted for SFM at 0, 10 and 100% of supplemental protein. Contrary to this, Walz *et al.* [91] who observed an increasing in DMI in Suffolk lambs fed FM diets when compared to those fed SBM diets. In addition to, Krysl *et al*. [92] showed that the intake of prairie hay was increased from 23.7 to 28.3 g/kg BW, when supplemented with CSM. However, CSM supplementation did not influence ruminal and caecal fermentation and its higher intake may be attributed to a positive relationship between DM and CP intake [93]. Furthermore, Rule *et al*. [94] found not significant differences in DMI when CM and SBM diets were fed to steers. Abou-Ward *et al*. [63] reported unchanged DMI by Barki lambs fed diets containing SBM, CSM and CSM supplemented with ferrous sulphate although slightly lower DMI was observed in lambs fed SBM diets. Whereas, Yagoub and Talha [95] found significant effect on feed intake by lambs fed diets replaced groundnut meal by decorticated SFM. Similarly, Karsli *et al*. [65] reported slightly higher DMI in sheep raised on hazelnut meal diets compared with those fed SBM diet. Wiese *et al*. [96] observed an improvement in DMI of lambs fed CM diets compared with lupine and urea diets (1660, 1570 and 1380 g/d/ day, respectively). They further stated that higher DMI in lambs fed CM diet might be attributed to better availability of nutrients in diverse forms and their readily digestion by rumen microbes than those fed lupine and urea diets. Also, Baile and Forbes [97] concluded higher DMI due to better digestibility. Another plausible explanation for higher DMI in lambs fed CM diet might be the less gut fill effect on reticulo-rumen [87].

Nitrogen Utilization by the Experimental Groups: Data of (Table 4) showed that inclusion SFSM at 10, 15 and 18% in lamb rations formulation significantly decreased nitrogen intake (NI), meanwhile, lambs that received 5% SFSM in significantly (P>0.05) decreased their NI in comparison with the control (not received SFSM). Dietary treatments significantly (P<0.05) decreased fecal nitrogen (FN), urinary nitrogen (UN) and total nitrogen extraction (TNE). Furthermore, it treatments significantly (P<0.05) increased digested nitrogen (DN), nitrogen retention (NR), NR, % of NI and NR, % of DN. All tested rations were positive in their NR and values that calculated as (NR, % of NI) or (NR, % of DN) were significantly (P<0.05) improved with increasing the level SFSM incorporation in the lamb rations. The corresponding values of the improvement of (NR, % of NI) reach to 23.98, 27.67, 31.63 and 42.93%. Meanwhile, values of improving when calculated as (NR, % of DN) reach to 8.64, 9.64, 9.69 and 13.76% for R_2, R_3, R_4 and R_5, respectively in comparison with the control one. Nitrogen intake, fecal and urinary N are determinants of nitrogen balance (N-balance), whereas N intake depends upon DM and CP intake. Feeding high CP diets may also result in greater fecal and urinary N excretion [98, 58]. Increased urinary N may be the result of increased post-ruminal amino acids absorption that is surplus to the tissue needs or ruminal or post-ruminal absorption of ammonia [99]. A positive N-balance ranging between 4.1 to 6.4 g/h/d was recorded in lambs fed diets supplemented with protein source. Lambs fed Soybean meal (SBM) and cotton seed meal (CSM) (supplemented with ferrous sulphate) diets retained the higher N compared to those lambs fed CSM (un-supplemented with ferrous sulphate) based diet [63]. Paengkoum and Wanapat [11] studied the impact of replacing soybean meal (SBM) by sunflower seed meal (SSM) in growing goats at different levels (0, 25, 50 and 75%) that equals (0, 7.3, 14.5 and 22% of total concentrate feed mixture formulation on their nitrogen balance. They noted that there were no effects of dietary treatment on Nitrogen intake (NI) and faces N (FN). However, N absorption (g/day) and N retention (g/day, %) increased (p<0.05) with the addition of SSM in concentrate up to 14.5% in concentrate, thereafter decreased (p<0.05) in goats fed 22.0% SSM. However, urine N (UN) of goats fed 14.5% SSM was lower (p<0.05) than goats fed 22.0% SSM. On the other hand, [100-103, 12, 10] noted that SSM could replacing SBM as a protein source for ruminant feeding. Furthermore, [104-106] reported that nitrogen excretions, particularly urine N increased with incorporated SSM in the rations. they also, suggested that high urine N excretion has a higher adverse impact on environmental pollution. Merchen *et al.* [66] fed corn based diets supplemented with urea, SBM and corn gluten meal (CGM) as protein source in lamb diet and found that protein source had no effect on N-retention indicating that supplementing diets with un-degradable protein had no added advantage. The N-retention or balance may be

Table 4: Nitrogen utilization by the experimental groups

	Experimental rations					
Item	R_1	R_2	R_3	R_4	R_5	
Level of sunflower seem meal	0 % SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM	SEM
Nitrogen intake (NI)	32.32^{a}	31.20^{ab}	30.08^{bc}	28.98^{cd}	28.32^{d}	0.42
Fecal nitrogen (FN)	10.60^{a}	7.27^{b}	6.54^{c}	5.61^{d}	4.41^{e}	0.56
Digested nitrogen (DN)	21.72^{b}	23.93^{a}	23.54^{a}	23.37^{a}	23.91^{a}	0.25
Urinary nitrogen (UN)	9.08^{a}	8.80^{ab}	8.52^{b}	8.45^{bc}	8.08^{c}	0.10
Total nitrogen extraction (TNE)	19.68^{a}	16.07^{b}	15.06^{c}	14.06^{d}	12.49^{e}	0.65
Nitrogen retention (NR)	12.64^{b}	15.13^{a}	15.02^{a}	14.92^{a}	15.83^{a}	0.31
NR, % of NI	39.11^{d}	48.49^{c}	49.93^{bc}	51.48^{b}	55.90^{a}	1.50
NR, % of DN	58.20^{c}	63.23^{b}	63.81^{b}	63.84^{b}	66.21^{a}	0.74

a, b, c, d and e: Means in the same row having different superscripts differ significantly (P<0.05).
SEM: Standard error of mean.
R_1: 1st experimental ration assigned as control and it contained 0% SFSM.
R_2: 2nd experimental ration contained 5% SFSM.
R_3: 3rd experimental ration replace ration contained 10% SFSM.
R_4: 4th experimental ration contained 15% SFSM.
R_5: 5th experimental ration contained 18% SFSM.

Table 5: Ruminal fluid parameters of the experimental groups

	Experimental rations					
Item	R_1	R_2	R_3	R_4	R_5	
Level of sunflower seem meal	0 % SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM	SEM
pH	6.45^{a}	6.40^{ab}	6.35^{bc}	6.30^{cd}	6.25^{d}	0.02
NH_3-N (mg/dl)	19.52^{a}	19.36^{ab}	19.18^{ab}	18.95^{ab}	18.83^{b}	0.10
TVFA's (meq/dl)	8.52^{a}	8.33^{b}	8.19^{c}	8.00^{d}	7.93^{d}	0.06
Molar proportion of volatile fatty acids						
Acetic acid %	61.10^{a}	60.83^{ab}	60.56^{bc}	60.35^{cd}	60.10^{d}	0.10
Propionic acid %	23.21^{a}	23.03^{ab}	22.92^{bc}	22.81^{cd}	22.65^{d}	0.06
Butyric acid %	10.43^{b}	10.69^{ab}	10.86^{a}	10.93^{a}	11.04^{a}	0.07
Iso-Butyric acid %	1.38^{d}	1.46^{c}	1.52^{c}	1.66^{b}	1.82^{a}	0.04
Valeric acid %	2.26^{c}	2.33^{c}	2.41^{b}	2.46^{b}	2.54^{a}	0.03
Iso-Valeric acid %	1.62^{c}	1.66^{c}	1.73^{b}	1.79^{ab}	1.85^{a}	0.02
Acetic acid: Propionic acid ratio	2.63	2.64	2.64	2.65	2.65	0.05

a, b, c and d: Means in the same row having different superscripts differ significantly (P<0.05).
SEM: Standard error of mean.
NH_3-N: Ammonia nitrogen concentration.
TVFA's: Total volatile fatty acids concentration
R_1: 1st experimental ration assigned as control and it contained 0% SFSM.
R_2: 2nd experimental ration contained 5% SFSM.
R_3: 3rd experimental ration replace ration contained 10% SFSM.
R_4: 4th experimental ration contained 15% SFSM.
R_5: 5th experimental ration contained 18% SFSM.

related to normal CP synthesis [98]. Protein supplements tended to increase N-retention (g/d) in lambs [83]. Knowlton *et al*. [107] reported no difference in fecal, urinary and total N excretion in cows fed diets supplemented with SBM or a blend of SBM and blood meal (BM) as protein source to meet the 16.2% CP requirements. Khalid *et al.* [108] concluded that organic N sources with high un degradable protein (RUP) are more efficient in improving the N-balance when compared to lower RUP or inorganic N sources.

Ruminal Fluid Parameters of the Experimental Groups: Data of ruminal fluid parameters presented in (Table 5) showed that incorporated SFSM at levels of 10, 15 and 18% in lamb rations (R_3, R_4 and R_5) occurred significantly (P<0.05) decreasing in their values of ruminal pH, meanwhile that received ration for that containing 5% SFSM (R_2) caused in-significant (P>0.05) decreasing in comparison with the control (R_1). Values of ruminal ammonia nitrogen (NH_3-N) concentration were in-significantly (P>0.05) decreased with inclusion SFSM in the ration at 5, 10 and 15% (R_2, R_3 and R_4), meanwhile, when SFSM incorporated at 18%, value NH_3-N was significantly (P<0.05) decreased comparing to control that not contained SFSM (R_1). Also, dietary treatments realized a significantly (P<0.05) decreasing in values of total volatile fatty acids (TVFA's) concentrations. Values of molar proportion of volatile fatty acids were also presented in (Table 5) cleared that incorporated SFSM at 10, 15 and 18% (R_3, R_4 and R_5) caused a significantly (P<0.05) decreasing in acetic and propionic acids %, meanwhile inclusion 5% SFSM (R_2) occurred in-significant (P>0.05) decreasing in acetic and propionic acids % compared to the control (R_1). On the other hand, R_3, R_4 and R_5 significantly (P<0.05) increasing butyric acid %, however, R_2 caused in-significantly (P>0.05) decreasing compared to the control (R_1). Dietary treatments recorded a significantly (P<0.05) increasing in iso-butyric acid %. Furthermore, inclusion 10, 15 and 18% SFSM (R_3, R_4 and R_5) realized a significantly (P<0.05) increasing in values of valeric and iso-valeric acids %, meanwhile incorporated 5% SFSM (R_2) showed in-significantly (P>0.05) increasing in values of valeric and iso-valeric acids %. Values of acetic acid: propionic acid ratio were in the same trend that ranged from 2.63 to 2.65 among the five groups. These results disagreement with those obtained by Paengkoum and Wanapat [11] studied the impact of replacing soybean meal (SBM) by sunflower seed meal (SSM) in growing goats at different levels (0, 25, 50 and 75%) that equals (0, 7.3, 14.5 and 22% of total concentrate feed mixture formulation. They noted that ruminal NH_3-N, TVFA and acetic acid concentrations significantly (p<0.05) increased with the introduce the SSM in concentrate up to 14.5% in concentrate, thereafter decreased (p<0.05) in goats fed SSM 22%. They also, noted that ruminal ph, propionic acid and butyric acid were not significantly (p>0.05) differed among the different treatments. Mould and Ørskov [109]; Wanapat, *et al.* [110] demonstrated that cellulose digestion is limited when ruminal pH reaches values below 6.0. Ruminal Total VFA's concentrations and fermentation rates are correlated as mentioned by [111]. In contrast, Koster *et al.* [112] observed that that TVFA's increased dramatically in response to supplemental rumen degradable protein fed to beef cows. Ruminal pH is one of the most important factors affecting the fermentation and influences its functions. It varies in a regular manner depending on the nature of the diet and on the time, it is measured after feeding and reflects changes of organic acids quantities in the ingesta. The level of NH_3-N and TVFA's as end products of fermentation and breakdown of dietary protein has been used as parameters of ruminal activity by Abou-Akkada and Osman [113]. The results of ruminal fermentations showed that decreasing in values of TVFA's might be related to the less utilization of dietary energy and negative fermentation in the rumen. The reduction of ammonia nitrogen in the rumen liquor appears to be the result of increased incorporation of ammonia nitrogen into microbial protein and it was considered as a direct result to stimulated microbial activity. When occurring an increasing in TVFA's this might be related to the more utilization of dietary energy and positive fermentation in the rumen. The addition of more fermentable carbohydrate to ruminant rations causes a decrease in rumen ammonia [114] probably due to a greater uptake of ammonia by rumen microorganisms in support of enhanced microbial growth. The rate of TVFA's production may in this situation exceed the rate of TVFA's absorption through the rumen epithelium and TVFA's concentration in the rumen juice is increased [115]. It should be mentioned that TVFA's concentration in the rumen is governed by several factors such as dry matter digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to the other parts of the digestive tract and the microbial population in the rumen and their activities Allam *et al.* [116]. Increasing of ruminal TVFA's concentration is an indicator for better utilization of dietary carbohydrate as described by Fadel *et al.* [117].

Blood Parameters of the Experimental Groups: Results of (Table 6) mentioned that dietary treatments (R_2 to R_5) significantly (P<0.05) increased blood glucose, hemoglobin, white blood cell (WBC) count, total protein and albumin contents compared to control (R_1). Mean while, incorporated 15 or 18% SFSM (R_4 and R_5) significantly (P<0.05) increased values of red blood cell (RBC) count in comparison with the control (R_1). Only inclusion 18% SFSM in lamb rations cause a significantly (P<0.05) increasing in blood globulin content comparing to the others groups (R_1 to R_4).

Incorporation SFSM in lamb rations (R_2 to R_5) significantly (P<0.05) decreased blood contents of total cholesterol, total lipids, triglycerides, Glutamic pyruvic transaminase (GPT), urea and creatinine comared to control (R_1). On the other hand, incorporated 15 and 18% SFSM in lamb ration (R_4 and R_5) significantly (P<0.05) decreased blood contents of glutamic oxaloacetic transaminase (GOT). Meanwhile, Only inclusion 18% SFSM (R_5) significantly (P<0.05) decreased blood contents of Alkaline phosphatase.

Table 6: Blood parameters of the experimental groups

Item	Experimental rations R1	R2	R3	R4	R5	
Level of sunflower seem meal	0 % SFSM	5% SFSM	10% SFSM	15% SFSM	18% SFSM	SEM
Glucose (mg/dl)	70.16[b]	71.40[a]	71.93[a]	72.11[a]	71.95[a]	0.21
Hemoglobin (g/dl)	12.12[c]	12.36[b]	12.52[ab]	12.46[ab]	12.61[a]	0.05
Red blood cell (RBC) count (n x10^6/µl)	3.92[b]	3.98[ab]	4.03[ab]	4.12[a]	4.09[a]	0.03
White blood cell (WBC) count (n x10^3/µl)	4.05[d]	4.16[c]	4.25[b]	4.31[a]	4.29[ab]	0.03
Total protein (g/ dl)	7.12[c]	7.26[b]	7.32[b]	7.45[a]	7.51[a]	0.04
Albumin (g/ dl)	4.33[c]	4.42[b]	4.55[a]	4.61_a	4.58[a]	0.03
Globulin (g/ dl)	2.79[b]	2.84[b]	2.77[b]	2.84[b]	2.93[a]	0.02
Albumin: globulin ratio	1.55[c]	1.56[bc]	1.64[a]	1.62[ab]	1.56[bc]	0.01
Lipids parameters						
Total cholesterol (mg/dl)	95.13[a]	92.14[b]	89.22[c]	84.09[d]	81.88[d]	1.35
Total lipids (mg/dl)	375[a]	360[b]	365[b]	343[c]	356[b]	3.04
Triglycerides (mg/dl)	12.22[a]	12.01[b]	11.85[bc]	11.73[cd]	11.56[d]	0.07
Liver functions						
GPT (U/I)	40.51[a]	39.16[b]	38.20[c]	38.35[c]	39.52[b]	0.24
GOT (U/I)	22.19[a]	22.03[ab]	21.85[abc]	21.62[bc]	21.50[c]	0.09
Kidney functions						
Urea (mg/dl)	19.96[a]	19.19[b]	18.93[c]	18.51[d]	18.63[d]	0.14
Createnin (mg/dl)	1.42[a]	1.13[b]	0.94[c]	0.88[d]	0.74[e]	0.06
Alkaline phosphatase (U/I)	64.36[a]	64.03[ab]	63.83[ab]	63.70[ab]	63.55[b]	0.11

a, b, c, d and e: Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean.

GOT: Glutamic oxaloacetic transaminase.

GPT: Glutamic pyruvic transaminase..

R_1: 1st experimental ration assigned as control and it contained 0% SFSM.

R_2: 2nd experimental ration contained 5% SFSM.

R_3: 3rd experimental ration replace ration contained 10% SFSM.

R_4: 4th experimental ration contained 15% SFSM.

R_5: 5th experimental ration contained 18% SFSM.

Morsy *et al.* [118] noted that addition 50 g/head/d whole sunflower seeds (SS) or 20 ml /head/day sunflower seeds oil (SO) in lactating goats, they observed that blood contents of total protein, albumin, globulin and albumin: globulin ratio were in-significantly (P>0.05) increased compared to control. Also, they noted that values of blood triglyceride and total cholesterol were in-significantly (P>0.05) decreased compared to control, however, values of blood glucose were significantly (P<0.05) increased in comparison with the control. Sharma *et al.* [119] fed crossbred cows and buffaloes in the Northern plains of India on rations replaced 25 or 50% of the net crude protein (CP) of the control ration by sunflower meal (SFM) to study the impact of inclusion SFM on their blood parameters. They reported that incorporation SFM in cow ration in-significantly (P>0.05) increased blood contents of glucose, total protein, albumin, globulin and albumin: globulin ratio, alkaline phospatase values were slightly different. Meanwhile blood urea contents were significantly (P<0.05) decreased. But cholesterol values were in-significantly (P>0.05) decreased comparing to the control. Blood urea nitrogen (BUN) is a measure to assess protein status of the animal. Blood urea nitrogen and protein intake should have a positive relationship indicating that BUN could be an indicator of protein intake [120]. Higher BUN in lambs fed concentrate diets might be the result of incapacity of ruminal microflora to detain maximum ammonia [121]. Ponnampalam *et al.* [84] reported non-significant difference in plasma urea and glucose in crossbred lambs at first 1st day of the trial due to Canola meal (CM), soybean meal (SBM) and fish meal (FM) supplemented to control diet (lucerne hay: oat hay; 30:70). However, sampling at d 30 and 53 revealed a significant increase in plasma glucose and urea N concentration except for a decrease in urea N concentration in basal treatment. Lupin supplementation as a protein source on a weekly basis increased levels of urea in plasma whereas variations were found in blood glucose levels [122]. Plasma glucose and urea N were not affected in lambs fed concentrate diets [123]. Increase in glucose concentration may be due to more by-pass protein and increased availability of glucogenic amino acids for glucose synthesis [124]. In contrast, Rusche *et al.* [120] observed that feeding crude protein (CP) source with high escape protein decreased plasma glucose and urea N concentration. Whereas, supplementation of lucerne chaff with cotton seed meal (CSM) resulted in an increase in glucose and urea concentration in lambs indicating better energy and protein status [125]. Paterson *et al.* [53] observed lower BUN in lambs offered escape protein supplements compared with SBM supplement (11.07 versus 16.44 mg/100 ml). However, Davies *et al.* [126] noticed no difference in plasma glucose, urea N and plasma minerals in response to various protein sources.

CONCLUSION

The data obtained in the present study mentioned that under conditions that available during carrying out of this work, sunflower seed meal (SFSM) can be incorporated in growing sheep rations up to 18 % of ration formulation (high level of SFSM used in this study) with not occurring any adverse effects on their lamb performance, digestion coefficients, nutritive values, nitrogen balance, ruminal fermentation and improving the health of lambs throughout occurring decreasing in blood contents of total cholesterol, total lipids, triglycerides, GPT, GOT, urea and createnin..

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