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Comparison Among Protein Levels and Sources on Performance and Carcass Traits of Assaf Lambs

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Dedication

This project is dedicated to my parents, brothers, sisters and my wife and kids; the completion of this work was not possible without their support and help.

Acknowledgments

I would like to express my deepest respect and most sincere gratitude to my supervisor, Prof. Dr. Jamal Abo Omar, for his guidance and encouragement at all stages of my work.

Another word of special thanks goes to Hebron University especially for all those in the Faculty of Agriculture.

I would like to express my sincere thanks and appreciation to my mother, brothers and sisters for their support. My fervent thanks extended also to my wife and kids.

الإقــــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Comparison Among Protein Levels and Sources on Performance and Carcass Traits of Assaf Lambs

مقارنة بين مستويين ومصدرين مختلفين من البروتين على أداء وصفات ذبائح خراف العساف

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخـــاص، باســتثناء مـــا تمــت الإشارة إلية حيثما ورد، وان هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجـــة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name:………………………………………………...: اسم الطالب

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List of Abbreviations

ADF	Acid Detergent Fiber
ADG	Average Dailey Gain
BWG	Body Weight Gain
Ca	Calcium
CF	Crude Fiber
CGF	Corn Gluten Feed
CP	Crude Protein
DE	Digestible Energy
DMI	Dry Matter Intake
EE	Ether Extract
FE	Feed Efficiency
FCR	Feed Conversion Ratio
GE	Gross Energy
IBW	Initial Body Weight
ME	Metabolized Energy
MJ	Mega Joule
NDF	Neutral Detergent Fiber
NFE	Nitrogen Free Extract
NIS	New Israeli Shekel
P	Phosphorus
SBM	Soybean Meal
SFM	Sunflower Meal
TDN	Total Digestible Nutrients
TMR	Total Mixed Ration

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Abstract

Twenty male Assaf lambs were used, in this experiment, to investigate the effects of feeding sunflower meal (SFM) as a substitute for soybean meal (SBM) in rations at two crude protein (CP) levels (14 and 18% as fresh basis) on the feedlot performance, (average daily gain, feed conversion ratio, visceral organs, some carcass merits and digestibility), of fattening Assaf lambs. Lamb's average initial body weight was 29.04 kg (S.D. = 4.69 kg). Lambs were randomly divided into four groups of five lambs in each group. Lambs were fed in morning and evening individually with total mixed rations (TMR), and was considered as replicate. Lambs in groups 1 and 2 were fed fattening rations where soybean meal is the source of protein at two CP levels, 14 and 18%. However, lambs in groups 3 and 4 were fed fattening ration similar to the first two groups except that sun flower meal was the protein source. Lambs were weighted on a weekly basis. Body weight change, feed intake, average daily gain and different

carcass traits were determined. In addition, visceral organ mass as well as dressing percentage and carcass cuts were also measured. Major nutrients digestibility was determined through conduction of a digestion trial.

From the first week until the eighth week of the trial, the lambs fed with the 18% CP SBM ration recorded the highest ($P<0.05$) weight (48.79 kg) compared to lambs fed with the 18% CP SFM ration which showed the lowest weights (43.45 kg). The mean weight gain in lambs fed with the14% CP SFM was similar to that of lambs fed with both crude protein levels of SBM. The weight change tends to decline as SFM level increased after 4 weeks compared to other treatments.

Furthermore, the highest average feed intake was observed in the 14% CP SFM and the lowest was with 18% CP SBM.

Digestibility of DM and, CP were similar among all treatment rations, but level of protein and source had no effect on EE and OM digestibility. There were no significant differences in the average final body weight (FBW), average daily gain (ADG) and average feed conversion ratios (FCR) among the treatments. Results also showed that source and level of protein had a significant effect on average leg and shoulder weights. Lambs fed with 18% CP SFM had the highest weight loss during carcass chilling at 3°C for 24 hr., while the 14% CP SFM had the lowest weight loss value. However, there were significant differences ($P<0.05$) between hot and cold carcass weights. Level of SBM had a significant effect on lung average weights. However, liver average weights were significantly by protein source (14% CP of SBM vs. 18% CP SFM). Heart average weights were not affected by type or level of protein.

In general, this study further confirmed that SFM could replace SBM as a protein source; also increasing protein level will not result in any improvement in lamb performance.

Overview

Fattening process is very important in local animal production sector. The income from fattening operation was estimated to be more than 50% of total income generated from animal sector (MoA, 2000).

Soybean meal (SBM) is the main protein source in animal rations (Schingoethe *et al.*, 1977). Utilizing SBM was satisfactory in almost all systems as well as in nutritional experimental (Stake *et al.*, 1973). As a result, soybean is usually used as a reference feedstuff for comparison with other feedstuffs (Green and Kiener, 1989). However, high prices of SBM in some parts of the world and fluctuation in its production have raised the interest in alternative protein sources for feeding livestock. Meanwhile, the importance of sunflower seed meal (SFM) as a high quality feed is increasing. World production of sunflower seeds is ranked fourth in oil seeds production (Zhang and Parsons, 1994). Chemical analysis of sunflower seeds differs according to their cultivar, soil characteristics, climatic conditions and seeds processing. Despite these wide variations, on average, sunflower meal contains 30–40% CP, 13–15% CF, and 11.8 MJ ME (Nishino *et al.*, 1980; Richardson *et al.*, 1981). Recently, SFM is becoming available in Palestine for animal nutrition and as a by-product of extraction of sunflower oil locally. SFM could be used as a substitute for SBM. Sunflower seed meal could be partially used as a substitute for SBM.

As a protein supplement, SFM could replace SBM in rations of growing and fattening lambs with similar gain and feed efficiency (Erickson *et al.*, 1980; Richardson *et al.*, 1981). Economides and Koumas (1999) concluded that SFM could successfully replace SBM in lamb fattening diets. No differences were found in digestibility of CP, CF and ADF. However, digestibility of DM, OM, NDF and NFE was lowest with the SFM-based diet (Eweedah *et al.*, 1996). It looks like the response to the SFM varied due to wide variation in chemical composition.

Any attempts to reduce the high input cost will be of essential importance. Protein levels in local fattening rations are questionable since the majority of fattening rations have high protein content which results in higher cost of feeds. On the other hand, local farmers are hesitant in using cheaper alternative protein sources with low crude protein levels (14%) or alternative plant protein sources such as SFM and corn gluten feed CGF.

Therefore, this experiment was conducted to investigate the effects of feeding two levels of SFM and SBM on lamb performance, feed conversion, feed intake, nutrient digestibility, carcass traits, visceral organ of Assaf lambs as well as the economic saving that can be achieved.

Chapter One

1. Introduction

Livestock sector is an important branch for the Palestinian national economy. In the West Bank and Gaza Strip, there are two main breeds of sheep: Awassi and Assaf.

In the Mediterranean area, the protein and energy requirements of fast-growing, intensively fattened lambs are usually satisfied by soybean and maize, respectively. Both are major ingredients in the manufactured concentrates which is mainly imported at high costs.

The main problem facing the sector of animal production, in Palestinian National Authority, is the limited feed sources. Feeding contributed more than 70% of the total production costs in any livestock operation (Abo Omar, 1998). In addition, the dramatic restriction in the use of animal protein produced a gap in protein supply for ruminants compared to the increasing demand for animal protein (Wilkins *et al.,* 2000).

Profitability of lamb's production is dependent on reducing input costs and/or increasing production output. Any reduction in feed intake or increase in feed efficiency without compromising growth rate or carcass quality can have a significant positive economic impact on lamb production (Snowder and Van Vleck, 2003). Increasing energy density in diets for lambs and kids showed improvement in feed efficiency and carcass characteristics (Haddad and Husein, 2004; Haddad, 2005). However, feeding very high grain diets to ruminants could induce acidosis (Owens *et al.*, 1998).

There is a need for additional protein for maximum performance in the growing and finishing period of lambs fattening (Scott, 1988). In the finishing period, lambs crude protein requirements range from 10 to 14.5% (NRC, 1985). Also, it is suggested that lambs between 15-40 kg of live weight need 17% dietary CP (Andrews and Qrskov, 1970). In other studies in which different crude protein levels were evaluated (10-18%), it was suggested that live weight gain of lambs increased by the higher dietary crude protein level, but feed conversion was decreased as protein level increased (Purroy *et al.*, 1993; Muwalla *et al.*, 1998; Haddad *et al.*, 2001). Although, dry matter digestibility was not different among the different dietary crude protein levels (10-17%). Digestibility was higher in lambs fed with higher level of CP (Hart and Glimp, 1991; Kaya and Yalcin, 2000; Haddad *et al.*, 2001; Dabiri and Thonney, 2004).

2. Literature Review

2.1 Sunflower seed meal for growing lambs

2.1.1 Sunflower seed meal composition:

Sunflower seed meal is the fourth largest source of protein supplement which comes near to soybean, cottonseed, and canola meals (Hesley, 1994). Nutrients in sunflower meal can vary depending on several factors. The high fiber content of the SFM is responsible for its limited use, especially in ration of young ruminants (Villamide and San Juan, 1998).

The amount and composition of SFM is affected by seed oil content, extent of hull removal and efficiency of oil extraction (Hesley, 1994). The proportion of hulls removed, before processing, can differ among crushing plants. In some cases, a portion of the hulls may be added back to the meal after crushing. The amount of hulls or fiber in the meal is the major source of nutrient variation (Table 1). Pre-press solvent extraction of whole seeds with no de-hulling produces meal with a crude protein content of 25 to 28 %. However, de-hulling yields 34 to 38 % crude protein content, while the completely de-hulled sunflower seed meal commonly yields 40 % crude protein. Up to 50 % crude protein has been observed (National Academy of Sciences, 1971).

Sunflower seed meal is marketed and shipped as a meal or pelleted. Sunflower seed meal is dry and can be stored for extended periods of time without significant loss or degradation (Hesley, 1994).

Table (1): Nutrient content of solvent extracted sunflower meal based on amount of hulls retained**.**

Composition (%)	**Hulled**	**Partially De-hulled**	**De-hulled**
Dry Matter	90.0	90.0	90.0
	Dry matter basis		
Crude Protein	28.0	34.0	41.0
Fat	1.5	0.8	0.5
Crude Fiber	24.0	21.0	14.0
ADF	33	31	15
NDF	40	35	25
Ash	6.2	5.9	5.9
Calcium	0.36	0.35	0.34
Phosphorous	0.97	0.95	1.30
Potassium	1.07	1.07	1.07
Magnesium	0.80	0.79	0.79

Hesley (Ed.) National Sunflower Association, 1994

2.1.2 Protein in sunflower seed meal:

Nitrogen required by rumen microbes can be provided in the form of rumen-degradable protein from sunflower meal. NRC (1996) reports an exceptionally low crude protein value for sunflower meal (Table 2). This value is not typical of current commercial meal production (Table 1). Heat treatment or toasting of meal from the solvent extraction process may increase the proportion of undegradable protein but there is little information on effects of heating and time of exposure. As shown in (Table 2), sunflower meal is more degradable (74% of crude protein) than soybean meal (66%) or canola meal (68%), (NRC, 1996).

2.1.3 Energy in sunflower seed meal:

Metabolizable Energy (ME) contents of sunflower seed meal are lower than that of canola and soybean meal (NRC, 1996) (Table 2). Metabolizable Energy (ME) varies substantially with fiber level and residual oil content. Higher level of hulls included in the final meal product lower the energy content and reduces density. The mechanical process of oil extraction leaves more residual oil in the meal, often 5 to 6 percent or more, depending on the efficiency of the extraction process. Elevated oil content in mechanically-extracted meals provides greater energy density, which may be more valuable for animals with higher nutrient requirements or where limited amounts of supplement are fed. Pre-press solvent extraction reduces residual oil to 1.5 % (Hesley, 1994).

Table (2): Protein and energy fractions for sunflower seed meal, soybean meal, and canola meal.

	Meal		
Item %	Sunflower	Soybean	Canola
	Dry matter basis		
Crude protein	26.0	49.9	40.9
	Crude protein		
Rumen degradable	74.0	66.0	68.0
Rumen undegradable	26.0	34.0	22.0
	Dry matter basis		
Crude fiber	12.7	7.0	13.3
Neutral detergent fiber (NDF)	40.0	14.9	27.2
Acid detergent fiber (ADF)	30.0	10.0	17.0
Digestible energy, Mcal/kg	2.87	3.70	3.04
Metabolizable energy, Mcal/kg	2.35	3.04	2.49
Net energy for maintenance, Mcal/kg	1.47	2.06	1.60
Net energy for gain, Mcal/kg	0.88	1.40	1.0
Total digestible nutrients (TDN)	65	84	69

NRC, 1996

Sunflower seed meal was compared to soybean meal and a sunflower-soybean meal mixture in isonitrogenous supplements in corn-based finishing diets that also contained 1 percent urea. The urea and sunflower meal provided adequate ruminal degradable nitrogen with the undegradable nitrogen provide by the corn (Milton *et al.*, 1997).

2.2 Effect of SBM and SFM on carcasses

Rizzi *et al.*, (2002), showed that lambs given a diet included 20% sunflower seeds tend to have higher percentage of fat in the hind leg compared to animals fed diet containing 15% soybean. Santos-Silva *et al.*, (2002), reported that the replacement of sunflower meal by expanded sunflower seed had no effect on lambs growth performance and carcass composition.

Atti *et al.*, (2003), showed that empty body weight, carcass weight, and dressing percentage were not affected by the increase of the crude protein in the ration.

Altering fatty acid composition of ruminant muscles and adipose tissue may improve the nutritional value of these food products. Decreasing saturated and increasing unsaturated fatty acids in ruminant tissues has been accomplished by feeding soybeans (Rule and Beitz, 1986), sunflower seeds (Chang *et al.*, 1992), and canola oil (Lough *et al.*, 1992).

2.3 Effect of feeding SFM as a replacement of SBM on digestibility

As the SFM portion increased in the ration, a little decrease in DM digestibility was reported, (Irshaid *et al.*, 2003). Yet, this drop in digestibility was not significant. Using SFM as a protein source in fattening rations of lambs did not lower DM digestibility, (Irshaid *et al.*, 2003).

However, this result disagree with (Stake *et al.*, 1973) who found that digestibility of DM for SBM diets fed to Holstein calves was significantly higher than SFM diets. However, protein digestibility for the two diets was not significantly different. Also, (Nishino *et al.*, 1986) found that digestibility of DM was significantly lower in weaned calves fed SFM ration; but the digestibility of CP was not affected. On the other hand, (Eweedah *et al.*, 1996) found that there were no significant differences between groups of lambs in digestibility of CP, CF and ADF, while digestibility of DM, OM, NDF and NFE was lowest with the SFM diet. The response to feeding SFM is associated with the wide variation in its chemical composition.

2.4 Effect of replacing SBM with SFM for fattening lambs

Irshaid *et al.*, (2003), showed that there was no significant difference in ADG or in final BW of lambs when replacing SBM by SFM. However, lambs fed SFM as a sole protein source gained numerically less than lambs fed SBM. Values for daily gain and total weight gain were non significant. However, ADG was higher for SBM fed lambs. Feed conversion for lambs fed SBM was slightly better than that for other lambs. Results of the experiment are in agreement with results obtained by (Erickson *et al.*, 1980) who found that lamb performance based on gains and feed efficiencies were similar for SBM and SFM. Richardson *et al.*, (1981) compared SFM and other meals and found that lambs fed diets containing either SFM, cottonseed meal or both had similar gain and feed efficiency. Rao *et al.*, (1995) examined replacing groundnut cake protein with sunflower cake in complete rations for sheep and found that balanced low-cost complete diets could be formulated for sheep by replacing costly groundnut cake protein with sunflower cake. Economides and Koumas (1999) found that SFM could successfully replace SBM in the fattening diets of lambs. The results of these experiments showed that SFM could be incorporated in the ration of Awassi lambs and ewes without any harmful effect on the digestibility, voluntary intake and growth. According to these results, no reason restricts the usage of SFM for Awassi lambs and lactating dairy ewes except price. Sunflower seed meal could be used as a protein supplement for feeding Awassi lambs and sheep with SBM or instead of SBM according to its availability and price. Feeding SFM for sheep may be encouraged as a replacement for SBM.

The fatty acid composition of oilseeds varies; Sunflower seeds and safflower seeds are among the best sources of unsaturated fats: in fact these seeds contain 66 and 77 % linoleic acid, respectively, but no linolenic acid (0.3 - 1.1%, respectively). Soybeans contain less linoleic acid (55%) but 8% linolenic acid. These differences may suffice to alter the fatty acid composition of milk (Schingoethe *et al.*, 1996)

Chapter Two

3. Materials and Methods

3.1 Animal management and experimental design:

Twenty Assaf male lambs weighting approximately 29 kg were randomly divided equally into four feeding treatment groups. Lambs in each treatment were individually fed a total mixed ration (TMR), thus each lamb was considered as a replicate. Lambs in groups 1 and 2, lambs fed fattening rations with soybean meal as the major protein source (Table 3). Two crude protein levels (14 and 18%), are used. In groups 3 and 4, lambs were fed with sunflower meal as the major protein source and two CP levels 14 and 18%. Lambs were dosed against both internal and external parasites and were injected with enterotoxemial vaccine during the 10 days acclimation period also they were vaccinated against Clostridium Perfringens types C & D. Lamb's weight was recorded weekly and feed intake was recorded daily. The trial lasted for 8 weeks.

Rations were formulated to meet standard requirements stated by (NRC, 1985) requirements (Table 4). The experiment was conducted at the south western of Hebron city, 24 km from the center of the city. The elevation site is 467.87m above sea level; the geographical position is 34.56 East and 31.28 North (figure 1).

The experiment was conducted during late winter and early spring (February-April, 2009), with minimum and maximum ambient temperature ranging from 13.8◦C to 21.5◦C and, relative humidity (RH) from 42% to 91%. Lambs were housed individually at a 1.5 m^2 pen (1.5×1.0 m)/lamb, with artificial light overnight.

Lambs were acclimated to there rations for 10 days prior to the data collection. Feed was offered in the morning and evening. Orts and refusals were removed and recorded daily. Mineral blocks and fresh clean water were available all the times. Samples of the experimental rations were collected and stored for later chemical analysis.

Table (3): Composition of the total mixed ration (TMR) fed to fattening lambs according to the experimental groups.

	Source of protein supplement			
Ingredient %	**Soybean Meal**		**Sunflower Meal**	
	G1 **14%**	**G2** **18%**	**G3** **14%**	**G4** **18%**
Wheat straw	12	12	12	10
Ground corn	67	55.5	62	50
Soybean meal (SBM)	17	28	0	0
Sunflower meal (SFM)	0	0	22	36
Ammonium chloride	0.3	0.3	0.3	0.3
Vegetable oil	1.2	1.7	1.2	1.2
Limestone	2.075	2.075	2.075	2.075
Sodium sulfate	0.1	0.1	0.1	0.1
Chlortetracycline (AB)	0.025	0.025	0.025	0.025
Salt (NaCl)	0.2	0.2	0.2	0.2
Vitamins premix	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**

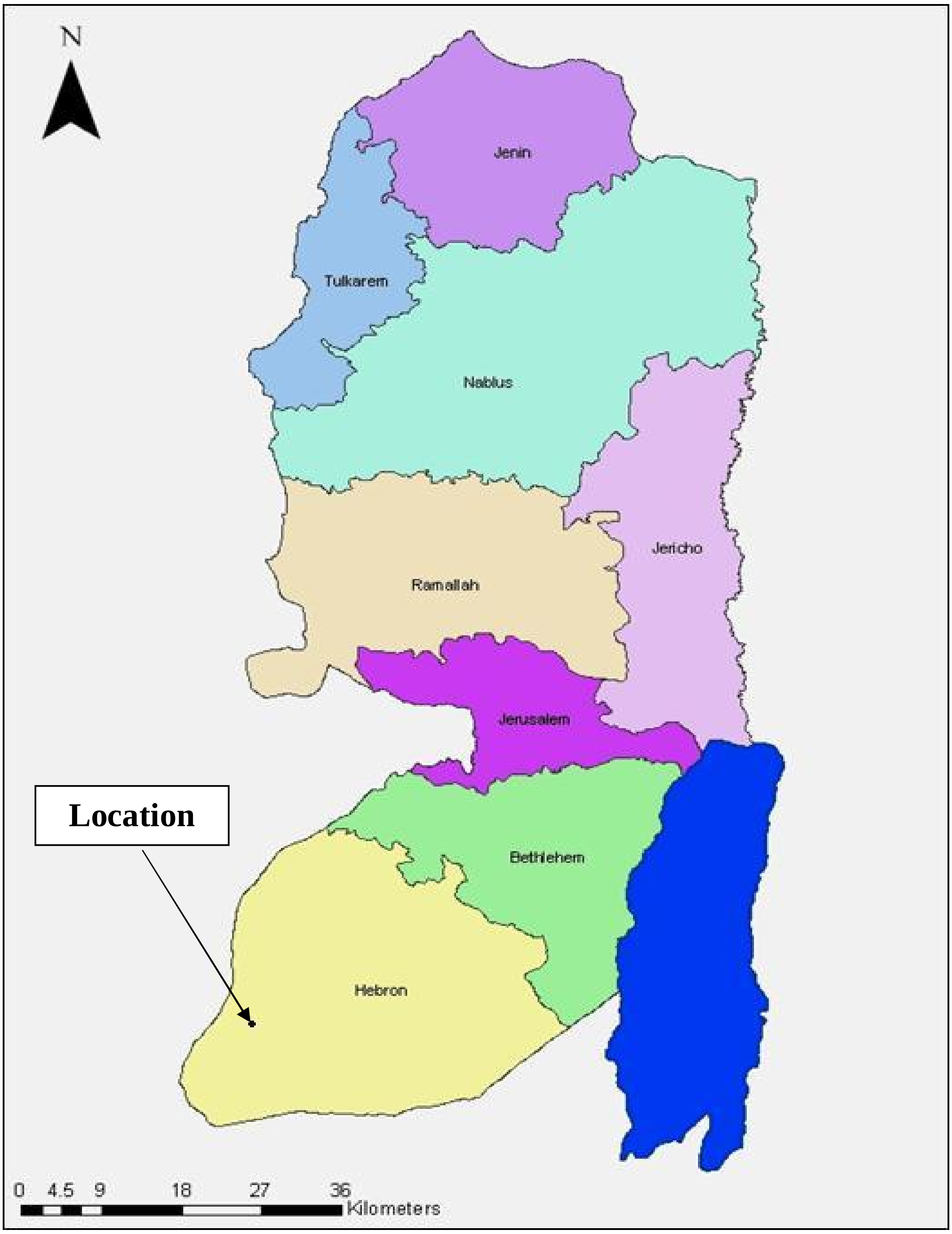


Figure 1. The experimental site**.**

3.2 Chemical composition of experimental rations

Result showed that the dry matter and organic matter content were the same in all rations while the fiber content in the SFM was higher compared to SBM. The nutrient detergent fiber (NDF) levels were higher in SBM compared to SFM.

Table (4): Chemical composition of experimental rations.

Ingredient %	SBM ration (%)		SFM ration (%)	
	G1 14%	**G2 18%**	**G3 14%**	**G4 18%**
Dry matter (DM)	88.4	88.7	88.7	89.1
Organic Matter (OM)	82.9	81.9	83.0	82.6
Crude protein (CP)	16.0[1]	20.5[1]	16.2[1]	20.2[1]
Crude fiber (CF)	8.5	9.6	11.3	12.6
Ether extract (EE)	3.5	3.6	3.3	3.3
Nitrogen Free Extract (NFE)	53.9	48.3	52.2	46.5
NDF	65.0	76.2	46.6	43.1
ADF	5.5	8.3	12.0	16.3
Ash	5.5	6.8	5.7	6.5
Phosphorus (P)	0.3	0.3	0.4	0.5
Calcium (Ca)	0.8	0.9	0.9	0.9
Metabolizable energy (kcal/kg)*	2830	2713	2675	2616

All data are on DM basis.

[1] The % value calculated as DM basis. Fresh basis (14%, 18%, 14% and 18% CP respectively).

*ME: Metabolizable Energy, calculated according to NRC (1985).

3.3 Slaughtering procedure:

At the end of the trial, three lambs from each treatment were assigned at random for slaughter. Animals were fasted for 24 hours then slaughtered following the practices used in commercial slaughter houses. The following measurements were taken after slaughtering:

3.4 Non-carcass components measurements:

After bleeding, killed animals were peeled and eviscerated according to routine dressing procedures. Weights of the following non-carcass components were from the body: heart, liver, lungs, trachea, spleen, gallbladder, kidney, kidney fat, hide, testicles and total gastrointestinal tract (esophagus, 4-compartment of stomach, cecum, small and large intestine) and also gastrointestinal tracts were sectioned for parts and fill. Both dry and wet tissues weight was measured.

3.5 Carcass and chilled components measurements:

Hot carcass weight was recorded for all carcasses. Dressing percentages were calculated by dividing hot carcass weight by fasting live weight.

Each carcass was carefully split longitudinally. The right side was cut into seven standardized commercial cuts (leg, rib, shoulder, lion, shank, breast and neck). Each cut was weighted. The rib eye muscle area was measured by using plastic slid grid. Lion tissue depth and tissue fat thickness were measured by using a millimeter grad ruler.

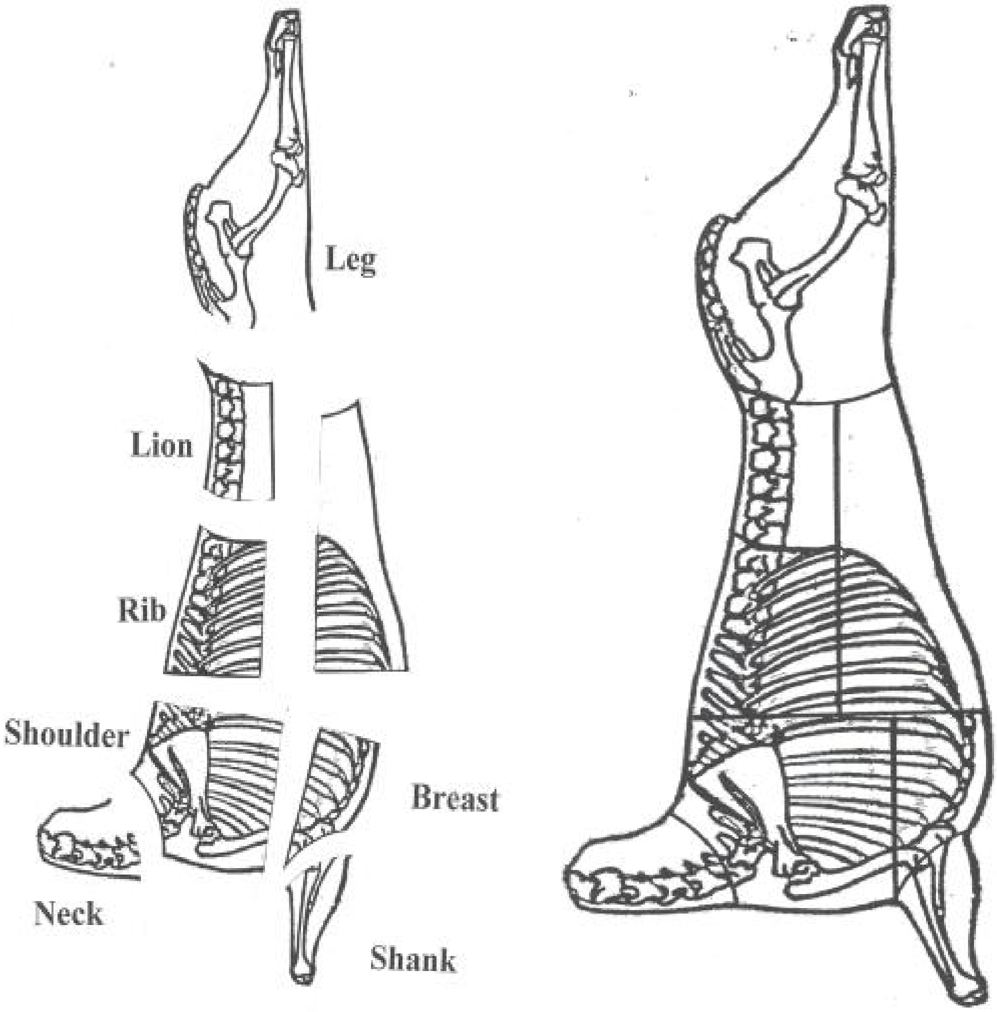


Figure 2. Cuts of the lamb half carcass. Leg, lion, rib, shoulder, breast, neck, and shank.

3.6 Measuring of the digestibility for the fattening rations:

The digestibility of the four rations used was determined on twelve lambs; three lambs from each treatment group were selected at random for digestibility trial. The animals were kept in metabolic cages and fed the four rations that were used in the fattening. The rations were given *ad libitum* for adaptation and also for estimation of voluntary feed intake for 5 days which were considered as preliminary period and then 5 days of total feed and feces collection period. Fresh clean water was available to lambs all the time. Total fresh weight of feces for each animal was record daily and representative sample of 150 g was taken every day during the collection period. The samples of the fresh feces were collected in sealed (zib-log) bags then stored for later chemical analysis.

3.7 Chemical analysis:

Chemical analysis was conducted according to the recommendation of (A.O.A.C. 1999). Feed and dried fecal samples were grounded by Wiley-Mill to pass through a 1 mm screen and analyzed for dry matter in a forced air oven at 105◦C for 24 hours. Crude protein was determined by Kjeldal method for nitrogen determination. Fibers (CF, NDF and ADF) were determined according to Van Soest methods. Crude fat was determined by using Soxhlet extraction method. Samples were burned in a muffle furnace at 550◦C for 3 hours to determine ash content, calcium and phosphorus. Finally, the digestibility coefficient of: dry matter, organic matter, crude protein, crude fiber and nitrogen free extract (NFE) were measured for the experimental rations.

3.8 Statistical analysis:

Data collected for feed intake, weight gain, carcass, non-carcass, and digestibility were analyzed by using General Linear Model (GLM), Factorial ANOVA in a balanced 2×2 factorial treatment (2 protein sources, SBM & SFM and 2 levels of protein, 14%&18%). Least square means for all variables in the study were calculated and the protected LSD test was used to determine significant differences (Statistica, 1995), significance was declared at $P<0.05$.

Chapter Three

4. Results and Discussion

4.1 Lamb fattening:

4.1.1 Body weight changes (Table 5, figure 3):

Table (5): Average live weight changes during 8 weeks feeding trial (kg).

Item (kg)	SBM ration		SFM ration			
	14%	18%	14%	18%	S.E.	
Initial BW	29.22	29.82	29.66	27.47	2.2	ns
BW week1	30.74	31.81	31.68	29.78	2.2	ns
BW week2	33.46	34.27	34.30	32.11	2.3	ns
BW week3	36.34	36.32	35.92	33.52	2.4	ns
BW week4	38.33	39.45	38.45	36.13	2.8	ns
BW week5	40.84	41.37	40.36	38.10	2.6	ns
BW week6	43.54	43.53	42.74	39.99	2.7	ns
BW week7	45.68	46.37	45.04	41.57	2.9	ns
Final BW	47.51	48.79	47.98	43.45	3.1	ns

ns: not significant (P>0.05).

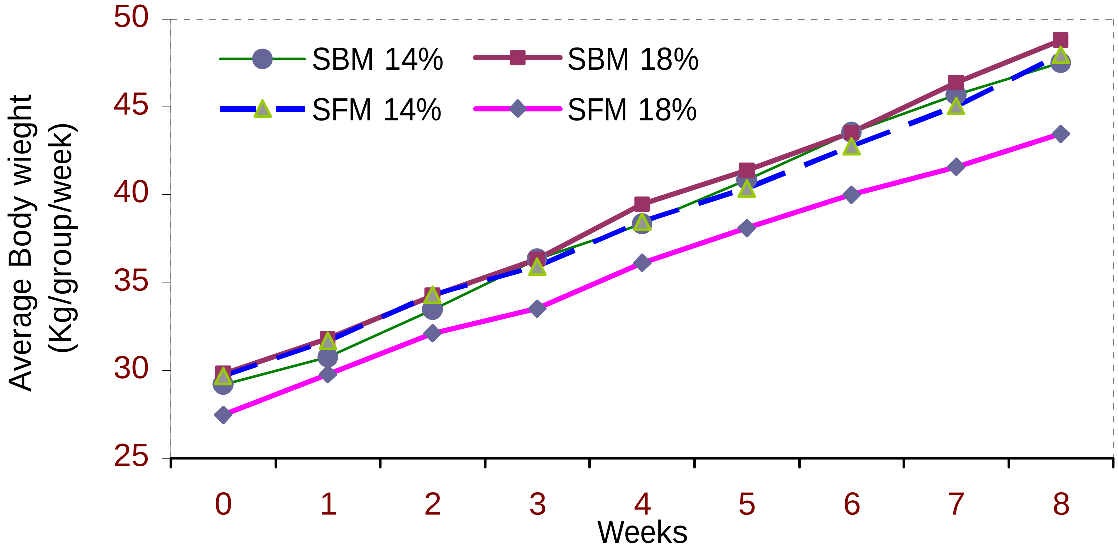


Figure 3. Average weight changes during 8 weeks feeding trial (kg).

From the first weak until the end of the feeding trial, lambs fed the 18% CP SBM ration had the highest weights, (48.79 kg) compared to lambs fed with the 18% CP SFM (43.45 kg). The mean body weight gain in lambs fed the 14% CP SFM was similar to that of lambs fed both levels of SBM.

As a general trend, the weight development tended to decline as SFM level increased. In addition, the changes of weight gain increased with time, but declined in lambs fed 18% CP SFM after 4 weeks compared to other treatments. In the same direction, (Haddad *et al.*, 2000) reported similar results after the same period of fattening with Awassi lambs, where increasing the dietary crude protein levels resulted in an increase in average daily gain up to the 16% dietary crude protein level.

4.1.2 Feed intake (Table 6, figure 4):

Table (6): Average feed intake during the 8 weeks feeding trial (g/day).

Time (week)	**SBM ration**		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
1	977	976	997	1137	111	ns
2	1160	1083	1111	1217	87	ns
3	1337	1247	1240	1347	102	ns
4	1313	1334	1334	1393	153	ns
5	1477	1427	1500	1389	106	ns
6	1503	1536	1654	1514	112	ns
7	1514	1624	1709	1473	119	ns
8	1730	1786	1950	1640	136	ns

ns: not significant (P>0.05).

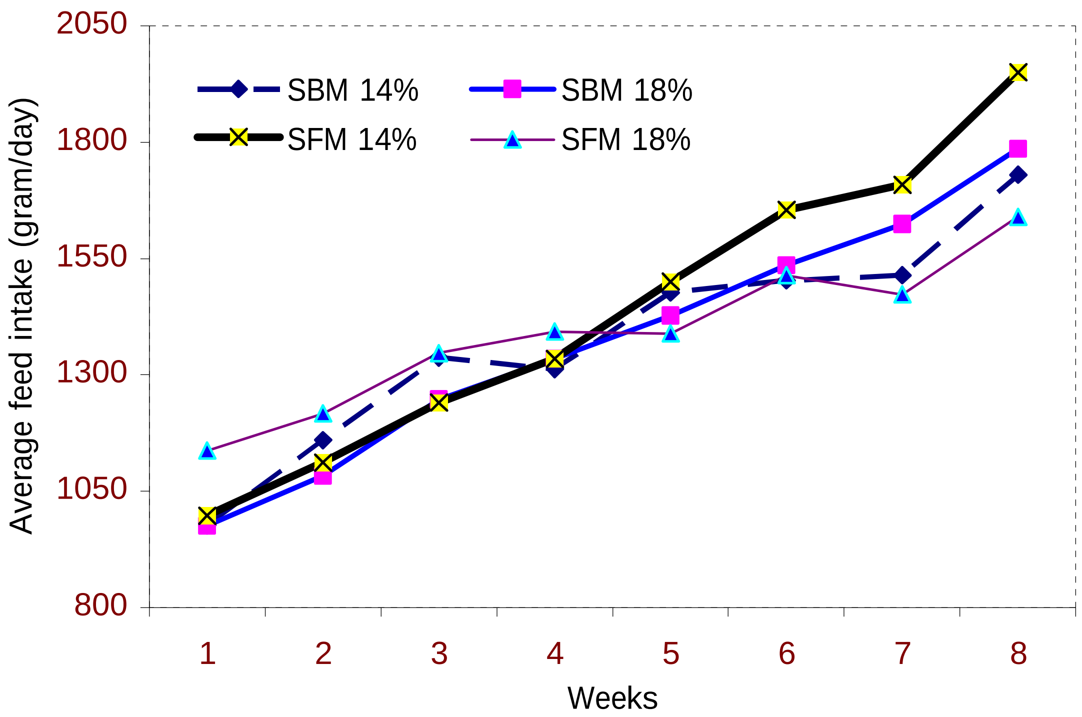


Figure 4. Average feed intake of lambs fed two sources of protein at low and high levels (g/day) as fed basis.

The average daily feed intake was1376, 1377, 1437 and 1389 g/day for the 14 and 18% CP SBM and 14, 18% CP SFM, respectively. The highest average feed intake was observed in lambs fed 14% CP SFM ration and the lowest was in lambs fed 18% CP SBM ration. Furthermore, during the first 4 weeks, lambs fed with 18% CP SFM showed the highest feed intake compared to other treatment within the same period. Whilst during the last 4 weeks of the experiment, lambs fed 18% CP SFM have less feed intake and their weight gain was relatively decreased compared to other groups. The differences between means were not statistically significant in both SBM and SFM rations.

Results indicated a relatively high intake of SFM ration. This suggests that no palatability problems associated with this ingredient. Similar results of feeding SFM were reported by (Stake *et al*., 1973) on calves, (Schingoethe *et al*., 1977) on lactating cows and by (Economides and Koumas, 1999) on fattening lambs. However, our results contrasted other investigations in which the intake of SFM ration was reduced due to palatability problems (Stake *et al*., 1973). On the other hand, some studies reported that SFM was utilized at a less efficient rate than SBM (Schingoethe *et al*., 1977; Nishino *et al*., 1980), which resulted in increased feed consumption of the SFM compared to SBM to compensate for the difference.

4.1.3 Average daily gain (Table 7, figure 5 and 6):

Table (7): Average weight gain (g/day) for lambs fed SBM and SFM at two crude protein levels.

Time (week)	**SBM ration**		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
1	217	284	289	330	57	ns
2	389	351	374	333	64	ns
3	411	293	231	201	104	ns
4	284	447	361	373	94	ns
5	359	274	273	281	83	ns
6	386	309	340	270	88	ns
7	306	406	329	226	65	ns
8	261	346	420	269	75	ns

ns: not significant (P>0.05).

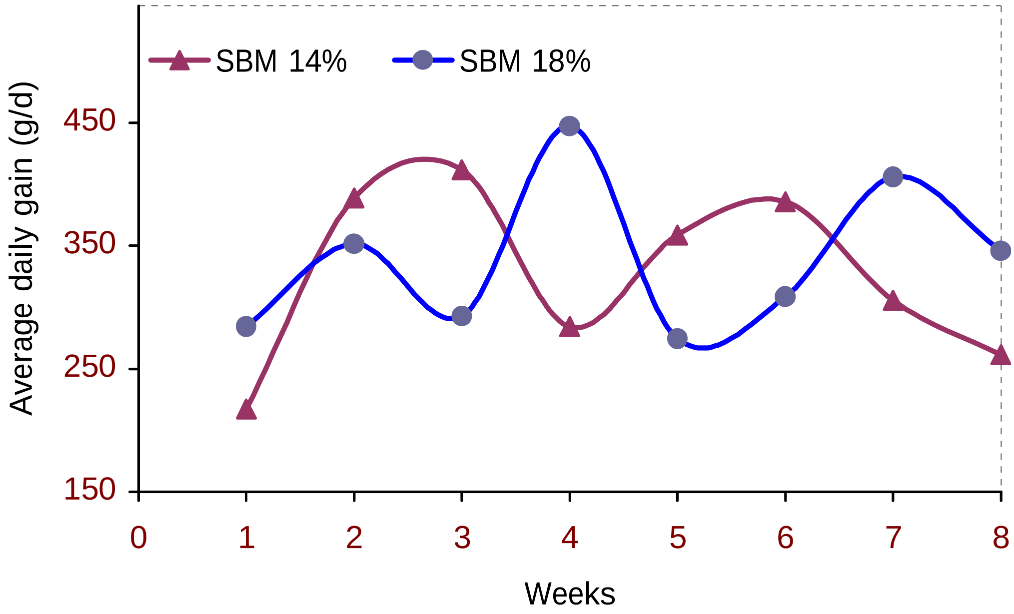


Figure 5. Average weight gain (g/day) for lambs fed at SBM (14% and 18% CP).

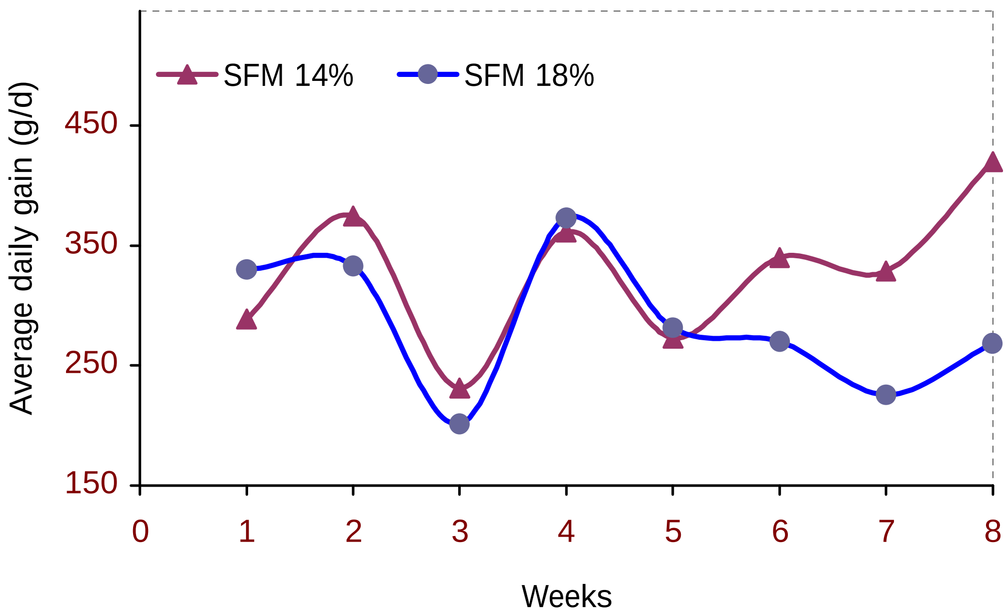


Figure 6. Average weight gain (g/day) for lambs fed at SFM (14% and 18% CP).

There was no significant difference between using 14or 18% CP from SBM or SFM on average daily gain (ADG). The mean daily gain was 327, 339, 327 and 285 g. for 14% CP SBM, 18% CP SBM, 14% CP SFM and 18% CP SFM, respectively. Mean ADG was the highest in lambs fed 18% CP SBM ration, while gain was similar when 14% CP SBM and 14% CP SFM fed; the 18% CP SFM ration caused the lowest ADG. The results on body weight change in lambs fed SBM and SFM agreed with other studies that showed no differences in total gain or average daily gain resulted from both sources and protein levels (Stake *et al.*, 1973; Richardson *et al.*, 1981; Finn *et al.*, 1985; Steen, 1989; Economides and Koumas, 1999). While, (Steen, 1989) reported that performance and body weight gain of lambs fed SFM was less compared to SBM fed lambs.

4.1.4 Feed conversion (Table 8, figure 7):

Table (8): Feed conversion (kg feed/kg gain) in Assaf lambs fed SBM and SFM (14% & 18% CP) during 8 weeks.

Item	SBM ration		SFM ration			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Feed conversion	5.43	3.30	3.03	4.58	1.22	ns

ns: not significant (*P*>0.05).

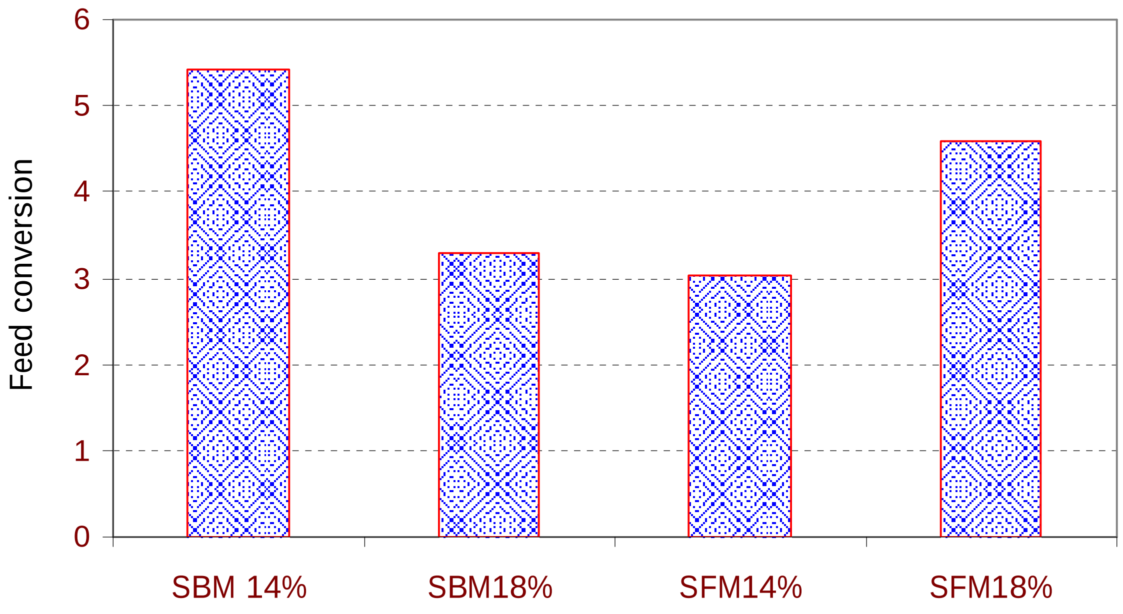


Figure 7. Feed conversion (kg feed/kg gain) for lambs fed SBM and SFM (14% & 18% CP) during 8 weeks.

Mean feed conversion (FCR) for lambs was (5.43, 3.30, 3.03 and 4.58 kg feed/kg gain) for 14% CP SBM, 18% CP SBM, 14% CP SFM and 18% CP SFM rations, respectively. Feed conversion was the lowest for lambs fed 14% CP SFM and 18% CP SBM, and the highest for 14% CP SBM However, these differences between all the 4 treatments were not statistically significant ($P>0.05$). Similarly, lambs fed 18% CP SBM and 14% CP SFM has recoded relatively best feed conversion than lambs fed 14% CP SBM or 18% CP SFM. In the same context, several studies reported similar results of no differences in FCR when SFM was used as a protein source in ruminant's rations (Stake *et al.*, 1973; Richardson *et al.*, 1981).

4.2 Carcass characteristics and non-carcass components:

4.2.1 Dressing percentage (Table 9, figure 8):

Table (9): Dressing percentage in hot carcass for Assaf lambs fed SBM at two crude protein levels (14% & 18%).

	SBM ration		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Dressing %	50.56	50.42	50.79	51.85	0.55	ns

ns: not significant (*P*>0.05).

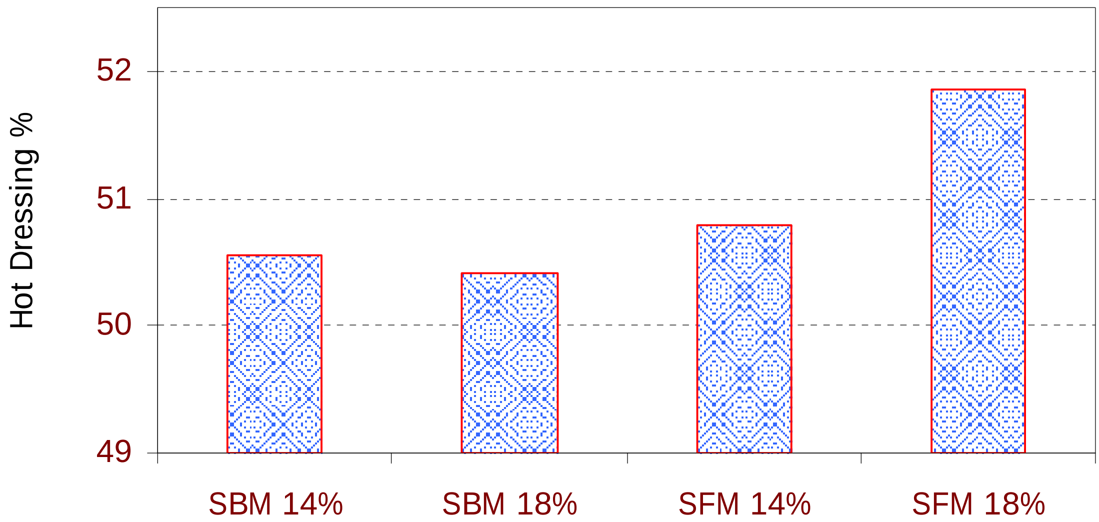


Figure 8. Hot dressing percentage of lambs fed SBM and SFM at two crude protein levels (14% & 18%).

Dressing percentage for lambs fed SBM or SFM at different CP levels were not significantly difference (*P*>0.05). But dressing percent of lambs fed 18% CP SFM rations was the highest compared to other treatments, and the dressing percentages for 14%, 18% CP SBM and 14% CP SFM fed lambs were similar. However, these results are in agreement with the results from (Atti *et al.*, 2003), who showed that empty body weight, carcass weight, and dressing percentage were not affected by the increase of crude protein level in the ration.

4.2.2 Carcass cuts measurements (Table 10):

Table (10): Carcass cuts measurements as (g/kg empty body weight, EBW).

Carcass cuts (g/kg EBW)	SBM ration		SFM ration			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Chilling lost	12.29[a]	16.82[a]	8.68[a]	59.78[b]	5.57	*
Leg	141.36[a]	148.69[ab]	150.18[ab]	152.93[b]	3.11	*
Rib	82.51	80.26	77.82	77.80	1.58	ns
Shoulder	41.14[b]	38.80[ab]	36.49[a]	38.38[ab]	1.33	*
Lion	48.64	50.22	49.09	52.14	2.40	ns
Shank	46.14	43.52	43.49	44.33	1.55	ns
Neck	36.25	39.22	38.58	34.99	1.30	ns
Breast	37.10	38.50	38.31	40.63	2.79	ns
Abdominal fat	28.50	32.75	33.24	34.28	3.77	ns
Thickness of sub cut. Fat (mm)	2.00	3.00	3.67	2.00	0.52	ns
Rib eye muscle area (cm^2)	14.63	14.15	13.95	15.32	1.04	ns
Rib eye muscle depth (cm)	6.37	6.1	6.00	6.40	0.30	ns

Means in the same line with different alphabets (a, b) are significantly different (P<0.05).

ns: not significant (P>0.05).

* (P<0.05)

There were significant differences (P<0.05) between hot and cold carcass weights. However, lambs fed 18% CP SFM had the highest weight loss during carcass chilling at 3◦C for 24 hr., followed by lambs fed 14% CP SFM ration. Leg and shoulder cuts were significant difference (P<0.05) between treatments.

Results showed that there was no significant difference for the other carcass cuts.

4.2.3 Edible parts (Table 11):

Table (11): Edible parts of carcass for the treatments groups (g/kg EBW).

Organs (g/kg EBW)	**SBM ration**		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Lungs	31.5^{a}	40.2^{b}	34.8^{ab}	36.7^{ab}	2.25	*
Heart	13.4	13.8	11.7	13.2	0.67	ns
Kidneys	5.9^{b}	5.9^{b}	5.6^{a}	5.7^{ab}	0.07	*
Liver	37.8^{a}	37.7^{a}	42.2^{ab}	43.7^{b}	1.63	*

Means in the same line with different alphabets (a, b) are significantly different ($P<0.05$).

ns: not significant ($P>0.05$).

* ($P< 0.05$)

Results of the experiment showed that crude protein level of SBM rations had significant effect on lungs weights but had no effects on heart, kidney and liver weights. However, crude protein level of SFM had no effect on all measured edible parts.

4.2.4 Non-edible parts (Table 12 and 13):

Table (12): Weight of the non-edible parts of carcass for the different treatments (g/kg EBW).

Non-edible parts (g/kg EBW)	**SBM ration**		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Hide	282.5	299.5	320.1	271.9	19.35	ns
Head	130.9^{d}	105.5^{c}	103.8^{bc}	97.3^{ac}	7.1	*
Feet	50.6^{b}	48.9^{ab}	49.0^{ab}	47.1^{a}	0.82	*
Kidneys fat	8.2	7.8	7.2	6.8	0.84	ns
Spleen	4.3^{b}	4.9^{cd}	3.4^{a}	5.1^{cd}	0.18	*
Gallbladder	1.5^{ab}	1.8^{b}	1.1^{a}	1.5^{ab}	0.14	*
Total gastro intestinal tract	325.1^{a}	327.6^{a}	379.5^{b}	363.7^{b}	17.91	*
Trachea	3.9^{ab}	4.7^{b}	3.9^{a}	4.3^{ab}	0.23	*
Esophagus	2.9^{c}	2.5^{ab}	2.4^{a}	3.2^{c}	0.09	*
Four compartment stomach	171.4^{ab}	151.2^{a}	207.7^{b}	175.9^{ab}	13.87	*

Means in the same line with different alphabets (a, b, c, d) are significantly different ($P<0.05$).

ns: not significant ($P>0.05$).

* ($P< 0.05$)

Table (13): Weight of dry and wet tissue of digestive tract for the different treatments (g/kg EBW).

Digestive tract tissues (g/kg EBW)	**SBM ration**		**SFM ration**			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Rumen wet tissue	30.9	26.8	31.1	31.7	1.81	ns
Rumen dry tissue	3.9^{a}	4.8^{ab}	5.8^{b}	5.1^{ab}	0.55	*
Reticulum wet tissue	4.8	5.2	4.6	5.3	0.41	ns
Reticulum dry tissue	1.0	1.0	0.9	0.8	0.12	ns
Omasum wet tissue	4.7^{b}	4.2^{ab}	3.8^{ab}	3.4^{a}	0.32	*
Omasum dry tissue	0.9^{a}	1.0^{ab}	1.1^{b}	0.9^{a}	0.06	*
Abomasal wet tissue	7.2^{a}	10.3^{ab}	10.8^{ab}	11.4^{b}	0.81	*
Abomasal dry tissue	2.0	2.4	2.7	2.9	0.30	ns
Small intestine	53.4	62.6	55.6	64.0	3.94	ns
Large intestine	41.9	38.1	41.1	39.4	3.71	ns
Cecum	14.5	17.9	15.4	18.8	1.54	ns

Means in the same line with different alphabets (a, b) are significantly different (P<0.05).
ns: not significant (P>0.05).
* (P< 0.05)

Results showed that small intestines, large intestines and cecum were not difference (P> 0.05). Reticulum at wet and dry basis, rumen wet tissues, abomasal dry tissues, hide and kidney's fat were not different (P>0.05). Head, feet, spleen and gallbladder were significantly different (P<0.05) between treatments. However, total gastrointestinal tract was significantly different (P<0.05) between SBM treatment and SFM treatment.

Four compartment stomach weights were the highest in 14% CP SFM, and significantly from 18% CP SBM.

4.3 Economical evaluation:

Table (14): Economical evaluation, growth characters and performance of Assaf lambs fed SBM and SFM at two crude protein levels.

	SBM ration		SFM ration			
	14%	**18%**	**14%**	**18%**	**S.E**	
No. of lambs	5	5	5	5		
Initial weight (kg)	29.22	29.82	29.66	27.47	2.24	ns
Final weight (kg)	47.57	48.79	47.98	43.45	3.13	ns
Feedlot period (day)	56	56	56	56		
Average daily gain (g/head/day)	326.6	338.8	327.2	285.6	35.6	ns
Total gain (kg)	18.29	18.97	18.32	15.98	1.99	ns
Average gain (kg/week)	2.28	2.37	2.29	1.99	0.25	ns
Average feed intake (kg)	77.1	77.1	80.5	77.8	5.5	ns
Daily feed intake (g)	1376.4	1376.6	1436.8	1388.6	97.9	ns
Feed conversion (kg feed/kg LWG	5.43	3.30	3.03	4.58	1.22	ns
Feed cost (NIS/kg)	1.57	1.72	1.33	1.30		
Weight gain cost (NIS/kg LBW)*	6.83	7.16	6.01	6.62	0.58	ns

ns: not significant (*P*>0.05).

* The cost comes only from feed.

4.4 Digestibility (Table 15):

Table (15): Effect of dietary protein source and crude protein level on digestibility of DM, CP, EE and OM of the experiment ration**.**

Digestibility (%)	SBM ration		SFM ration			
	14%	**18%**	**14%**	**18%**	**S.E.**	
Dry matter (DM)	81.29	75.58	78.00	73.56	3.12	ns
Crude protein (CP)	69.59	69.04	70.12	71.21	4.13	ns
Crude fat (EE)	83.37^{ab}	76.26^{a}	76.00^{a}	87.98^{b}	2.90	*
Organic matter (OM)	93.80^{b}	88.90^{a}	94.73^{b}	85.25^{a}	1.31	*

Means in the same line with different alphabets (a, b) are significantly different (P<0.05).

ns: not significant (P>0.05).

* (P< 0.05)

Dry matter and crude protein digestibility of mixed rations were not different among feeding groups. However, dry matter digestibility for 14% CP SBM was the highest compared to other treatments. Also crude protein digestibility was not different in SBM and SFM rations at 14% and 18% CP levels.

The study showed that crude fat digestibility was significantly higher (P<0.05) in 18% CP SFM ration compared to that of 18% CP SBM or 14% CP SFM rations; but relatively similar to SBM 14% ration. Organic matter digestibility was significantly different (P<0.05) in 14% CP SBM and 18% CP SBM; and also between significantly different between 14% CP SFM and 18% CP SFM.

Irshaid *et al.*, (2003) reported that the digestibility was the same when SBM was replaced by SFM when fed to ewes and lambs, the control group rations contained SBM while in the other two rations, and SFM replaced SBM at a level of 50% and 100%, respectively. As level of SFM increased in rations, digestibility's of DM tend to decrease.

Using SFM as a protein source did not decrease DM digestibility. The data obtained here are in agreement with those of (Luger and Leitgeb, 1993) who reported that diets had no effect on nutrient digestibility in male Simmental cattle. However, this result disagree with (Stake *et al.*, 1973) who found that digestibility of DM for SBM-based diets fed to Holstein calves were significantly higher than SFM-based diets while protein digestibility for the two diets were the same. Also, (Nishino *et al.*, 1986) found that digestibility of DM was significantly lower in weaned calves fed SFM-based ration.

Dabiri and Thonney (2004) reported that lambs fed with different levels of CP showed no differences in the aspects of DM and OM digestibility levels but the CP digestibility was higher in 17% CP group than 13% CP group.

5. Conclusion and recommendations

It could be concluded that SFM could be safely and effectively to replace SBM in the ration of fattening Assaf lambs. Protein of the SFM is equivalent to that of SBM in fattening rations. SFM could be used as a protein supplement for feeding lambs with SBM or instead of SBM according to its availability and price. The use of any of the two sources depends on the selling price. The recommended dietary CP level for fattening Assaf lambs appeared to be 14-16% of the ration DM. This CP level must be maintained even if lamb weight reaches 30 kg. Increasing the quantity of SFM in ration, may cause a decline in weight gain of lambs.

6. Appendix

Appendix 1:

Analysis of variance for the effect between treatments on weight changes, weight gain, feed intake, and feed: gain and cost of Assaf lambs (*P< 0.05*).

Source	**df**	**Initial BW**[a]	**Final BW**[a]	**DFI** [a]	**WG** [a]	**FCE** [a]	**WGC** [a]
Treatment	3	5.8	28.3	4120.1	2718.9	6.31	1.1
A	1	3.1	13.2	2880.0	1080.4	0.42	1.1
B	1	4.5	29.6	6552.2	3458.4	1.5	2.3
A*B	1	9.7	42.1	2928.2	3618.0	16.9	0.1
Error	16	25.0	48.9	48018.0	6357.3	7.5	1.6
R^2		0.042	0.098	0.016	0.074	0.136	0.116

df = **Degree of Freedom**

BW **= Body Weight (kg/head)**

DFI **= Daily Feed Intake (g/d)**

WG **= Weight Gain (g/head/d)**

FCE **= Feed Conversion Efficiency (kg feed/kg live BW)**

WGC **= Weight Gain Cost (NIS/kg)**

A **= Crude Protein Level**

B **= Protein Source**

A*B **= Interaction**

[a] **=Mean Square Value**

Appendix 2:

Analysis of variance for the effect between treatments on carcass measurements of the Assaf lambs ($P < 0.05$).

Source	**Treatment**	**A**	**B**	**A*B**	**Error**	**R^2**
df	3	1	1	1	8	
Chilling lost[a]	1702.7	2321.3	1161.1	1625.8	93.3	0.873
Rib[a]	15.3	3.8	38.3	3.7	7.5	0.432
Rib eye depth[a]	0.117	0.013	0.003	0.333	0.278	0.136
Rib eye area[a]	1.148	0.441	0.101	2.901	3.293	0.116
Neck[a]	11.77	0.285	2.717	32.308	5.075	0.465
Breast[a]	6.47	10.43	8.35	0.63	23.47	0.094
Shoulder[a]	10.95	0.15	19.30	13.39	5.36	0.434
Shank[a]	4.63	2.38	2.56	8.96	7.25	0.193
Lion[a]	7.29	16.05	4.22	1.59	17.33	0.136
Leg[a]	73.25	76.25	127.8	15.66	29.01	0.486

df = **Degree of Freedom**

A = **Crude Protein Level**

B = **Protein Source**

A*B = **Interaction**

[a] =**Mean Square Value**

Appendix 3:

Analysis of variance for the effect between treatments on the edible carcass parts of Assaf lambs (*P< 0.05*).

Source	**df**	**Lungs**[a]	**Liver**[a]	**Heart**[a]	**Kidneys**[a]	**Kidneys fat**[a]
Treatment	3	39.59	28.64	2.53	0.057	1.139
A	1	83.68	1.34	2.60	0.008	0.513
B	1	0.047	82.74	4.07	0.139	2.901
A*B	1	35.05	1.86	0.93	0.025	0.003
Error	8	15.23	8.02	1.36	0.016	2.148
R^2		0.494	0.572	0.411	0.571	0.166

df = **Degree of Freedom**

A = **Crude Protein Level**

B = **Protein Source**

A*B = **Interaction**

[a] =**Mean Square Value**

Appendix 4:

Analysis of variance for the effect between treatments on the non-edible parts of carcass of Assaf lambs (*P< 0.05*).

Source	df	Legs[a]	Spleen[a]	Hide[a]	TGT[a]	Bladder[a]	Rumen [a]
Treatment	3	6.42	1.711	1329.29	2176.8	0.217	1664
A	1	10.47	3.887	729.3	133.66	0.285	2027
B	1	8.78	0.364	74.55	6145.8	0.350	2805
A*B	1	0.027	0.880	3184.0	251.0	0.015	101
Error	8	2.02	0.100	1124.2	962.3	0.061	577
R^2		0.543	0.865	0.307	0.459	0.572	0.51

df = **Degree of Freedom**

TGT = **Total Gastrointestinal Tract**

A = **Crude Protein Level**

B = **Protein Source**

A*B = **Interaction**

[a] =**Mean Square Value**

Appendix 5:

Analysis of variance for the effect between treatments on digestibility in Assaf lambs (*P< 0.05*).

Source	df	DM[a]	OM[a]	Protein[a]	Fat[a]
Treatment	3	44.18	78.48	3.42	135.70
A	1	102.76	207.07	0.28	23.79
B	1	28.17	7.39	7.30	18.98
A*B	1	1.60	20.97	2.69	364.33
Error	8	39.07	6.94	68.47	33.66
R^2		0.220	0.739	0.012	0.502

df = **Degree of Freedom**

DM = **Dry Matter**

OM = **Organic Matter**

A = **Crude Protein Leve**l

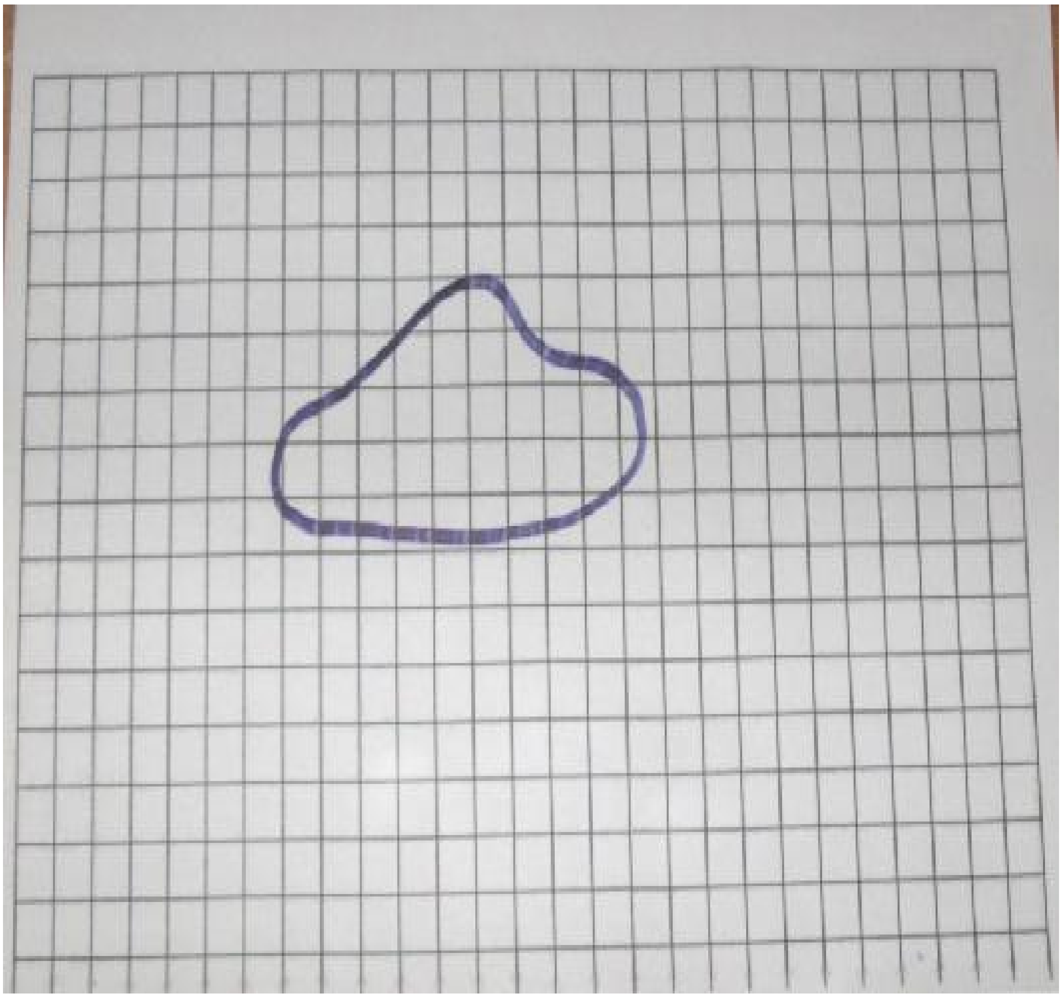
B = **Protein Source**

A*B = **Interaction**

[a] =**Mean Square Value**

Appendix 6:

Plastic grid procedures for quick measurement of lion eye area.



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جامـــعة النجـــاح الوطنية

كليـــة الدراســـات العليـــا

مقارنة بين مستويين ومصدرين مختلفين من البروتين على أداء وصفات ذبائح خراف العساف

إعـــداد

عمـــر خليـــل إبراهيـــم نصـــر

إشــــــراف

أ.د. جمـــال أبـــو عمـــر

قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في الإنتاج الحيواني بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2010

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الملخص

أجريت هذه التجربة على 20 خروفا عساف بمتوسط وزن (29.04 كغم) بهدف دراسة تأثير استخدام كسبة عباد الشمس SFM كمصدر بديل عن استخدام كسبة فول الصويا SBM كمصدر بروتين في تركيب عليقة التسمين، إضافة إلى دراسة تأثير مستويين من البروتين وهما 14% و18 % على معدل الكسب اليومي وصفات الذبيحة. قسّمت الخراف عشوائيا إلى أربع مجموعات بواقع 5 خراف منفردة التغذية، حيث شملت المجموعة الأولى و الثانية عليقة من كسبة فول الصويا كمصدر أساسي للبروتين وبمستوى 14% و18% على التوالي، وشملت المجموعة الثالثة والرابعة عليقة من كسبة عباد الشمس كمصدر أساسي للبروتين وبمستوى 14%و 18% على التوالي. استغرق البحث 56 يوما بعد الفترة التحضيرية.

استهلاك الخراف اليومي من العلف للمجموعات الأربع سجل يوميا، كذلك سجل التغير في الوزن للخراف أسبوعيا، بالإضافة إلى حساب معامل الهضم الأعلاف الأربع لكل من المادة الجافة، المادة العضوية، البروتين والمستخلص الأثيري، وفي نهاية التجربة اختيرت 3 خراف عشوائيا من كل معاملة وأرسلت للذبح من أجل قياس صفات الذبيحة.

دلت نتائج البحث للمجموعات الأربع، بأن معدل التناول الطوعي للعليقه لم يتأثر باستبدال كسبة فول الصويا بكسبه عباد الشمس كمصدر بروتيني ولا بمستويي البروتين في العليقة كما بيَنت النتائج التالية: 1376، 1377، 1437 و 1389 غم/رأس/يوم لكل من 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي. وسجل معدل الزيادة في الوزن نفس المسار حيث كانت الزيادة اليومية للمجموعات الأربع 327، 339، 327 و 285 غم/رأس/يوم

لكل من 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي. إلا أن الفروقات بين المجموعات لم تكن معنوية على (P>0.05)، دلت نتائج التناول الطوعي للغذاء والزيادة اليومية في الوزن بأن كفاءة التحويل الغذائي (FCR) كانت: 5.4، 3.3، 3.0 و 4.5 % (كغم علف/كغم وزن حي) لِ 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي، مع عدم وجود فروق معنوية (P>0.05) بين المجموعات، كسبة عباد الشمس 14 % بروتين سجلت أفضل نسبة تحويل غذائي.

لم تسجل صفات الذبيحة وأوزان قطع اللحمة المأكولة ونسبة التصافي بين الوزن الحي ووزن الذبيحة قبل التبريد أية فروقات معنوية (P>0.05)، باستثناء الوزن المبرد للذبيحة حيث سجل فرقاً معنوياً بين المجموعة 18% كسبة عباد الشمس وباقي المجموعات، سجل وزن الفخذ فرقاً معنوياً (P<0.05) بين المعاملة 14% كسبة فول الصويا و 18% كسبة عباد الشمس مقارنة مع باقي المجموعات، كذلك سجل وزن الكتف فرقاً معنوياً (P<0.05) بين مستوى البروتين 14% بين المعاملتين. وأشارت التحاليل الإحصائية بوجود فروقات معنوية (P<0.05) بين المجموعات الأربع للأعضاء الحمراء (الكبد والكليتان والرئتان). وأشارت نتائج قياسات الجهاز الهضمي عن وجود فروقات معنوية (P<0.05) بين المجموعات الأربع لغالبية أجزاء الكرش والغدد الملحقة بالجهاز الهضمي. كما أشارت نتائج تجربة هضمية المادة الجافة والبروتين الخام عن عدم وجود فرقاً معنويً (P>0.05) بين المجموعات الأربع، إذ كانت للمادة الجافة 81.3، 75.6، 78.0 و 73.5 لكل من 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي، كذلك البروتين كان 69.6، 69.0، 70.1 و 71.2 لكل من 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي. بينما كان هناك فرقاً معنوياً (P<0.05) لنسبة هضم الدهن والمادة العضوية حيث سجلت أعلى هضمية للدهن في المعاملة 18% كسبة عباد الشمس 87.9 وتساوت هضمية كل من 18% لكسبه فول الصويا و 14% لكسبه عباد الشمس فكانت 76.2 و 76.0 ،على التوالي، أما هضمية المادة العضوية فكانت 93.8 و 94.7 للمعاملتين 14% لكسبه فول الصويا و14% لكسبه عباد الشمس، على التوالي، كانت 85.2، 88.9 للمعاملتين 18% كسبة فول الصويا و 18% كسبة عباد الشمس، على

التوالي. تبين من نتائج البحث أن تكلفة الكغم الحي للخراف كانت 6.83، 7.16، 6.01 و 6.62 شيكلا، لكل من 14%، 18% كسبة فول الصويا، 14%، 18% كسبة عباد الشمس، على التوالي.