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# Evaluation of Various Protein Sources for Growing and Finishing Awssi Lambs

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**Abstract:** Sixty four newly weaned Awassi lambs (initial BW = 21.0 ± 0.75 kg) from both sexes were randomly allocated to one of the four treatments (8 males & 8 females/treatment) and grouped into 8 pens with 8 lambs from each sex per pen. They were then used to evaluate the different sources of protein on a finishing performance trial. The lambs were fed for a period of 114 days using four different rations. These rations were so formulated as to contain the same percentage of crude protein 14 %, but from different sources namely sunflower seed meal (SSM), bitter vetch seed (BVS) and urea. Comparisons were made with the control diet having soybean meal (SBM) as a major source of protein. Four animals from each group were slaughtered and the right leg from each carcass was dissected for examination of differences in muscularity and for carcass and leg composition.

Average feed intake over the first 8 weeks of the trial increased linearly (P<0.001) for both sexes within each treatment. Total feed intake for all lambs did not differ significantly between treatments, but there was a significant difference (P<0.001) between sexes, being higher for males. No differences (P>0.05) in final live weight, average live weight gain or average daily gain were detected between lambs given different protein sources. Male lambs, however, had significantly (P>0.001) higher final live weight (47.2 Vs 37.9 kg), average live weight gain (26719 Vs 16409g) and average daily gain (234 Vs 144 g/day) than female lambs.

The SBM ration had significantly a higher feed efficiency value compared to the other experimental rations (3.22, 4.20, 3.99, and 3.77 kg/kg for SBM, SSM, BVS, and urea, respectively). The production responses to the rations were observed only in the first 14 days of the experiment. Thereafter, no significant differences in intake on body weight were obtained through day-56 or day-114. Thus, the BVS and urea rations both gave a high feed efficiency which was comparable to that of the SBM ration (6.21, 6.20 Vs 6.10 kg/kg for BVS, urea and SBM, respectively).

The male lambs showed higher feed efficiency (P<0.05) than the female lambs over the three periods. Supplemental protein sources had no efect (P>0.05) on hot and cold carcass weight, dressing-out pencentage, tail fat weight, all non-carcass component weights, all carcass linear dimensions or on the dissected leg tissue weight. The male lambs, however, had higher (P<0.001) hot and cold carcass weight, kidney weight, liver weight and heart weight, but had lower (P<0.001) mesenteric fat weight, kidney fat weight, total leg fat weight (P<0.05) and muscle-to-bone ratio (P<0.05) than the female lambs.

Key Words: Awassi lambs; protein; performance; feedlot; carcass characteristics.

## Awassi Koyunlarının Yetiştirilmesindeki Son Kullanılan Değişik Protin Kaynaklarının Değerlendirilmesi

**Özet:** Sütten kesilmiş altmış dört yeni Awassi koyunu (başlangıçta BW=21+0.75 Kg) iki cinsiyetten rastgele dört işlemden birine tahsis edilip (8 erkek 8 dişi her işleme) ve sekiz kümese yerleştirildiler, her kümeste her cinsiyetten 8 koyun. Ondan sonra son performans denemesinde değişik protin kaynaklarının değerlendirilmesinde kullandırılmıştır. Koyunlar 114 gün süre ile değişik miktarlarla beslendiler, bu miktar eşit derecede düzenlendi ve eşit derecede ham protin bulundurması için değişik kaynaklardan bu besin maddeleri temel olarak Ay çiçek tohumu (SSM) sert tohum (BUS) ve üre oldu. Karşılaştırılmada denetim olarak soyafasulyesi öğünü (SBM) diyet olarak ana protin kaynağı gösterildi Her gruptan dört hayvan kesilerek sağ bacağı test edilmesi için bölünmüştür, bu teste değişik bacak karşılaştırılmalar yapılmıştır. Ortalama besleme denemesinin ilk 8 haftasında doğrusal olarak büyümüştür (P<0.001) iki cinsiyet için bu işlem içinde, genel besleme tüm koyunlar için önemli biçimde işlemler içinde değişmemiştir, yanlız cinsiyetler arasında önemli değişiklik ortaya çıkmıştır. (P<0.001) ve erkeklerde daha yüksektir (P>0.05) son ağırlık ortalama kazanılan veya ortalama günlük kazanç koyunların arasıda değişik protin miktarı verilmek üzere değişiklik görmemiştir. Erkek koyunlar önemli ölçüde (P>0.001) daha yüksek ağırlık gösterdi (47.2 karşı 37.9 Kg) ortalama kazanılan ağırlık (26719 karşı 16409 g) ve günlük kazanç (234 karşı 144 g her gün için) dişi hayvanlardan farklı olarak. SBM miktarı önemli ölçüde daha yüksek besleme verimlilik değeri vermiştir. Karşılaştırma yapılınca miktarda (3.22, 4.2, 3.99 ve 3.77 Kg/Kg sırasıyla SBM, SSM, BUS ve ÜRE orantıları yüksek besin etkisi vermişlerdir SBM karşılaştırılınınca (6.21, 6,20 karşı 6.10 Kg/Kg sırasıyla BUS, ÜRE ve SBM için). Erkek koyunlar dişi koyunlardan daha yüksek besin etkisi göstermişlerdir (P<0.05) üç süre için. Ek protin kaynaklarının herhangi bir etkisi olmamıştır (P>0.05) kesilmiş sıcak veya soğuk hayvanların ağırlığının üzerinde, kuyruk ağırlık ve tüm bölümlerin üzerine ve doğrusal yön üzerine veya bölünmüş ayak dokusunun ağırlığı üzerinde bulunan kesilmiş hayvan ağırlığı, böbrek, karaciğer ağırlığı ve kalp ağırlığı gözetilmiştir, yanlız dişi koyunlarda daha düşük (P<0.001) mesentric ağırlık, böbrek ağırlığı, ve toplam ayak ağırlığı (P<0.05) kemik orantısı (P<0.05).

Anahtar Sözcükler: Awassi koyunları, protin, performans, yedirmek, kesilmiş hayvan özellikleri.

## Introduction

The high cost of soybean meal used in fattening lambs in Jordan has forced the need for researching alternative sources of protein. Bitter vetch (*vicia ervillia* ), local name "Karsaneh" is well adapted to areas receiving more than 250mm rainfall, and has good drought and frost tolerance. The crop is a widely grown forage legume in the North of Jordan, mainly for seed and hay production but not as grazing crop (1). In the past, sheep, cattle and camel owners have traditionally used bitter vetch as a supplement for being an inexpensive source of protein. Little research, however, has been conducted to evaluate bitter vetch as a source of protein for feedlot lambs in Jordan. Urea is aNPN (non-Protein-nitrogen) supplement that could be incorporated into feed rations to reduce their high costs. It has been demonstrated that equal performance can be attained with ruminants fed all concentrate ration with urea or soybean meal as sources of supplemental nitrogen (2, 3). Sunflower. on the other hand, also has a great potential as a dietary protein supplement in rations fed to almost all classes of livestock (4, 5).

The present study was conducted to determine the effects of the alternative sources of protein (sunflower seeds, bitter vetch, and urea) on performance and carcass characteristics of growing Awassi lambs fed high-energy diets. Comparisons were made with those lambs fed soybean meal, the most conventional protein supplement for fattening lambs in Jordan.

## Materials and Methods

### Animals and diets

Sixty four newly weaned Awassi lambs (32 entire males and 32 females) with an everage initial weight of 21.0 ± 0.75 kg were randomly assigned to one of the four treatments (8 males and 8 females/treatment) and grouped into 8 pens with lambs from each sex per pen. The lambs were all fed for a period of 114 days on four different rations. The rations were formulated by analysis and estimates to contain the same crude protein (CP) concentration 14%, but from different sources namely, soybean meal (SBM) as a control, sunflower seed meal (SSM), bitter vetch seed (BVS), and urea (Table 1).

The complete diet ingredients for each ration were mixed monthly in a vertical mixer, and were fed ad-libitum in self-feeders. Following a 10-day period of adaptation, all lambs were fed once daily beginning on day-0. On a daily basis, feed refusal was weighed, recorded, and discarded, so that the actual feed intake for each pen could be determined. Body weights of lambs were taken at the beginning and end of the feeding period, and subequently at 14-day intervals after a fasting period of 12 hours to determine lamb performance. Average daily gain and feed efficiency (kilograms of gain/kilograms of feed) were determined for each period.

### Chemical analyses of feed

Feed samples were collected from each mixed ration for chemical analysis. Proximate components were determined using the procedures described by AOAC (6), and fiber contents were determined according to Goering and Van Soest (7).

### Slaughter and anatomical procedures

Four animals from each pen were randomly selected for slaughter taken in consideration that their weights represent the average weight of the group. All animals were slaughtered and dressed after a fasting period of 12.0 hours following normal commercial procedures.

Table 1. The experimental rations used to examine effects of different protein sources on lamb performance

| Diet | Ration (kg/Ton) | | | |
|---|---|---|---|---|
| | SBM | SSM | BVS | Urea |
| Straw | 150 | 150 | 150 | 150 |
| Wheat bran | 100 | 100 | 100 | 100 |
| Barley grain | 630 | 592 | 488 | 720 |
| Soy bean oil meal | 100 | - | - | - |
| Suflower seed meal | - | 138 | - | - |
| Vetch grain | - | - | 242 | - |
| Urea | - | - | - | 10 |
| Limestone (Calcium carbonate) | 10 | 10 | 10 | 10 |
| Dicalcium phosphate | 5 | 5 | 5 | 5 |
| Salt | 3 | 3 | 3 | 3 |
| Trace Min. & Vit. mix | 2 | 2 | 2 | 2 |
| Total (Kg) | 1000 | 1000 | 1000 | 1000 |
| % Cp | 14.36 | 14.17 | 14.03 | 14.23 |

Slaughter procedures and the measurements of non-carcass components were carried out as described by Kadim et al. (8). Carcasses were weighed after being chilled overnight at 1-3°C, and the tail fat weight was then determined after being separated from the area around the hind legs of the carcass.

The cutting procedures made on the carcasses the day after slaughter, together with the measurements of fat depth and dimensions on the transverse section of *M. longissimus thoracis* between ribs 12 and 13 were also made as described by Kadim et al. (8). The right hind leg, separated from the loin by a cut between the last and second to last lumber vertebrae, was dissected into bone, intermuscular fat, subcutaneous fat, muscle, and other tissues. The *M. semimembranosus, M. semitendinosus, M. biceps femoris and M. quadriceps femoris* muscles were also dissected out and weighed. The femur and tibia of each hind leg were both weighed and their lengths were measured with digital calipers.

Muscularity values based on the weights of these four muscles relative to femur length were calculated as described by Purchas et al. (9) as the ratio of an index of muscle depth to the length of an adjacent bone, where the index of depth was obtained by taking the square root of an index of average cross-sectional area of the musceles which, in turn, was obtained by dividing muscle weight by the length of the adjacent bone. A muscle-to-bone ratio (M:B) based on the weights of the same four muscles relative to femur weight, and on the weights of total muscle relative to total bone of the hind leg were also calculated.

### Statistical analyses

All data, except average feed consumption data, were analyzed using the general-least-square procedures within SAS (10) for a completely randomized design experiment with 2 X 4 factorial arrangement of treatment. The model contained effects due to CP source, sex, and the interaction between treatment CP by sex. Preliminary analysis showed no interactions effect between CP source and sex, and thus the interactions effect was not included in the model there after. Average feed consumption data were analyzed using the general-least-square repeated measures procedures within (10), following the same model mentioned above.

## Results

The ingredients of the four rations with different protein sources used in this trial are given in Table 1. Proximate analysis of the four rations used in the experiment are presented in Table 2. Average feed intake on a weekly basis for each pen (8 animals) are shown in Table 3. There was a linear ($P<0.001$) increase in average feed intake through the entire periods f the trial but no differences in feed intake between treatments were observed. The results given in Table 3 show a highly significant difference in feed intake between sexes, being higher for males. Their differences, however, have disappeared at week 8 for all animals. This was probably due to the physical limitation imposed on intake as the proportion of dietary fiber in the complete ration increased with age, regardless of the sex of animals. The interaction between treatment and week was not significant, but there were differences ($P<0.05$) for the interaction between treatment by sex.

Performance data for lambs fed various sources of protein for a period of 114 days are presented in Table 4. No differences ($p>0.05$) in final live weight, average live weight gain or average daily gain over the period of 114 days were detected among protein sources, although feeding of BVS or urea rations during this period increased ($P>0.05$) average daily gain by 16.8% and 8.9%, respectively compared with the SBM ration. Throughout the growing period, the male lambs gained faster ($P<0.001$) than the females and had a greater final weights (Table 4). Average daily gain of male lambs were 63% higher, than those of female lambs through the entire experiment. This was probably related to the

Table 2. Chemical composition of the experimental rations (on DM basis)

| | Diet | | | |
|---|---|---|---|---|
| % | SBM | SSM | BVS | Urea |
| Dry matter % | 91.37 | 91.33 | 91.09 | 91.84 |
| Organic matter % | 84.21 | 85.77 | 83.43 | 86.34 |
| Crude protein % | 14.36 | 14.17 | 14.03 | 14.23 |
| Crude fat % | 1.37 | 1.03 | 2.00 | 1.33 |
| Ash % | 7.16 | 5.56 | 7.66 | 5.5 |
| Crude fiber % | 10.5 | 15.46 | 10.30 | 12.04 |
| Nitrogen free extract % | 64.52 | 63.70 | 61.83 | 66.34 |

increased feed intake by male animals through week-8 of life as indicated earlier. The increased ME intake at such an early stage of life is aprimary factor affecting ME utilization for growth in subsequent stages (11).

Data in Table 4 also shows that there was a significant (P<0.05) crude protein source effect on feed efficiency for the first 14 days. The SBM ration had significantly higher feed efficiency values than the other rations, providing an improvement of 30%, 24%, and 52% in feed efficiency of lambs fed SSM, BVS, and urea rations, respectively. There was a tendency for lambs receiving SBM ration to give a higher feed efficiency (P>0.05) than those given by SSM, BVS or urea rations over the period of 56 days or the period of 114 days. However, the BVS or urea rations over the whole period of the experiment exhibited comparable feed efficiency to that promoted by SBM ration. The male lambs also showed a higher feed efficiency (P<0.05) over the female lambs by 16%, 36%, and 33%, respectively over the three periods (Table 4).

The difference between treatment and sex for hot carcass weight, cold carcass weight, dressing-out percentage, tail fat weight and non-carcass component weignts of lambs are presented in Table 5. For all the measured characteristig the differences between treatments were not significant, with the exception of the liver weight where the difference between treatments are approaching the level of significance (0.05<P<0.01). The higher values pertain lambs fed SSM and BVS rations, and the lower for those fed SBM and urea (674 and 608 Vs 588 and 571 g for SSM, BVS, SBM, and urea, respectively). Final liveweight (Table 4) was not significantly higher for lambs fed the BVS and urea rations than for those fed SBM and SSM (44.9, 43.2, 41.4, and 40.7, respectively). This slight difference was also shown in a similar wag for hot and cold carcass weights (Table 5), although the dressing-out percentage for lambs fed urea ration had lower values than all the other treatments (50.0, 49.0, 50.8, and 48.8 for SBM, SSM, BVS, and urea, respectively). Table 5 also indicates that the male lambs had significantly (P<0.001) higher hot and cold carcass weight, kidney weight, liver weight and heart weight, but lower mesenteric fat weight and kidney fat weight than the female lambs.

Data in Tables 6 and 7 show the least-square means for the carcass linear dimensions and dissected leg tissues. In general, there were no significant differences among all linear measurements and dissected leg tissues due to the protein source. Leg fat weight and M:B ratios were significantly higher for female lambs than the male lambs at constant carcass weight, but leg bone weight and femur bone weight were decreased (0.05<P<0.10) for the female lambs. Total leg fat weight for BVS lambs group were 29% higher (0.05<P<0.10) than those of SBM lambs group, and dissected subcutaneous and intermuscular fat weights were also similarly higher in BVS group than those in the SBM group, but at a non-significant level.

Table 3. Average feed consumption (kg/week/pen for 8 animals) for each treatment by sex for the selected periods of experiment.

| Treat[a] | Sex[b] | w1/kg | w4/kg | w8/kg | w12/kg | w16/kg |
|---|---|---|---|---|---|---|
| 1 | 1 | 42.1 | 52.5 | 71.4 | 83.0 | 93.4 |
| 1 | 2 | 37.8 | 48.3 | 53.0 | 55.1 | 62.8 |
| 2 | 1 | 39.6 | 54.9 | 74.9 | 87.0 | 88.8 |
| 2 | 2 | 39.2 | 54.2 | 74.2 | 74.6 | 76.3 |
| 3 | 1 | 43.8 | 55.3 | 76.3 | 91.6 | 89.3 |
| 3 | 2 | 42.4 | 55.0 | 76.3 | 62.0 | 65.3 |
| 4 | 1 | 41.9 | 55.2 | 75.6 | 88.9 | 90.0 |
| 4 | 2 | 39.1 | 53.7 | 73.0 | 63.2 | 55.0 |

a 1 = SBM
2 = SSM
3 = BVS
4 = Urea

b 1 = Male
2 = Female

Note: The significant differences for overall experiment were:

1. Between treatment — NS Not significant
2. Between sexes — *** P<0.001
3. Between weeks — *** P<0.001
4. Treatment x sex interactions — * P<0.05
5. Treatment x week interactions — NS

## Discussion

Lambs supplemented with SBM were more efficient (P<0.05) than those supplemented with SSM or BVS during the first 14 days (Table 4), but the lambs fed the rations supplemented with either SSM or BVS were more efficient than those supplemented with urea. Although the advantage in feed efficiency of lambs supplemented with SBM was not statistically different within the four rations fed at the end of the trial, the magnitude of increased feed efficiency was maintained for lambs fed SBM in a way comparable to the lambs fed urea and BVS, but not for lambs fed SSM. This may be attributed to the high fiber content of the sunflower comparing with the other 3 rations (Table 2). (12, 13, 14) and reported similar results when comparing SBM and urea as protein sources for finishing cattle and lambs.

The similar performance of lambs fed urea and SBM supplemented diets at 56 days is also in agreement with

Table 4. Least-square means for lamb performance on different treatments

| Item | Treatment[a] | | | | Sex[b] | | Significance | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | M | F | $R^2$ (%) | RSD | Trt | sex |
| No of lambs used | 8M 8F | 8M 8F | 8M 8F | 8M 8F | 32 | 32 | | | | |
| Initial Live wt (kg) | 21.2 | 21.2 | 20.4 | 21.1 | 20.4 | 21.5 | 02 | 4.5 | NS | NS |
| Final live wt (kg) | 41.4 | 40.7 | 44.9 | 43.2 | 47.7 | 37.4 | 77 | 3.9 | NS | *** |
| Average live wt gain (kg) | 20.4 | 19.7 | 23.9 | 22.3 | 26.7 | 16.4 | 71 | 3.8 | NS | *** |
| Average Daily growth rate (g/day) | 179 | 173 | 209 | 195 | 234 | 144 | 71 | 33 | NS | *** |
| Av. feed efficiency (kg of feed/kg gain) for | | | | | | | | | | |
| The first 14 day | 3.22[a] | 4.20[b] | 3.99[b] | 4.89[c] | 3.77 | 4.37 | 95 | 0.24 | * | * |
| The period of 56 day | 4.96 | 6.95 | 5.78 | 5.35 | 4.88 | 6.64 | 89 | 0.66 | NS | * |
| The period of 114 day | 6.10 | 8.18 | 6.21 | 6.20 | 5.73 | 7.62 | 85 | 0.88 | NS | * |

a,b = see footnotes to Table 3
$R^2$ = Cooefficient of determination
RSD = Residual standard deviation
NS = Not significant; S =0.05<0.10; * p<0.05; ** p<0.01; ***p<0.001

Note: The final live weight was adjusted by the initial live weight and was highly significant.

Table 5. Least-square means of hot and cold carcass weights, dressing-out percentages, tail fat weight and non-carcass component weights for Awassi lambs

| Item | Treatment[a] | | | | Sex[b] | | Signifancec | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | M | F | R2(%) | RSD | Trt | sex | d |
| Hot Carcass wt (kg) | 20.8 | 20.0 | 22.8 | 21.2 | 23.9 | 18.5 | 77 | 2.2 | NS | *** | *** |
| Cold carcass wt (kg) | 20.1 | 19.2 | 22.0 | 20.3 | 23.1 | 17.8 | 73 | 2.4 | NS | *** | *** |
| Dressing-out% | 50.0 | 49.0 | 50.8 | 48.8 | 50.1 | 49.2 | 36 | 1.8 | NS | NS | *** |
| Fail fat wt (g) | 2540 | 2344 | 2527 | 2419 | 2630 | 2284 | 83 | 485 | NS | NS | ** |
| Mesenteric fat wt (g) | 363 | 415 | 496 | 589 | 319 | 612 | 44 | 195 | NS | *** | *** |
| Kidney fat wt(g) | 243 | 264 | 235 | 280 | 102 | 409 | 69 | 9.7 | NS | *** | *** |
| Kidney wt (g) | 107 | 106 | 107 | 96 | 112 | 96 | 60 | 15.8 | NS | ** | ** |
| Lungs & trachea wt. (g) | 443 | 498 | 468 | 490 | 500 | 449 | 56 | 64 | NS | S | *** |
| Liver wt (g) | 588 | 647 | 608 | 571 | 651 | 556 | 83 | 58 | S | *** | *** |
| Heart wt (g) | 148 | 147 | 149 | 154 | 159 | 140 | 70 | 13.5 | NS | *** | *** |
| Spleen wt (g) | 64 | 67 | 64 | 69 | 65 | 67 | 53 | 10.3 | NS | NS | *** |

a, b, c = See footnotes to Table 3 and 4
d = The covariate was initial live weight for hot carcass weight, cold carcass weight and dressing % and carcass weight for all other variables

similar results when comparing SBM and urea as protein sources for finishing cattle at 56 days (2, 3, 13, 15). In another trial with lamb performance, (13) reported on their comparison between SBM and urea as protein sources for finishing lambs that there were no significant differences among gains, feed efficiencies and feed intakes due to nitrogen source. This is in agreement with the results reported here and with works reported by (16, 17, 18. These studies indicate that in the case of self-fed high concentrate rations, urea utilization is high and performance is essentially comparable to that promoted by SBM. Each of the protein concentrates studied by (17) supported a high peformance by lambs in the feedlot except for guar meal. Soybean meal and cottonseed meal showed a slight but insignificant advantage over urea, feather meal and blood meal. (18) reported no differences in gain, intake, or efficiency when urea, SBM, or roasted SBM were compared as supplemental protein sources for finishing steers. In another study with steers, (19) reported from a performance study over a 175 days when several supplemental protein sources were compared with a urea supplemented control diet, that replacing urea with SBM increased ($P<0.05$) ADG and DMI during 28-70 days, period and increased ($P<0.05$) feed efficiency during 28-days.The source of supplemental protein fed during the first 70 days had no effect ($P>0.05$) on DMI or feed efficiency during 175 days; however, feeding of SBM

Table 6. Least-square means for carcass linear dimensions and leg weight, leg length, and dissected tissue weights of Awassi lambs

| Item | Treatment[a] | | | | Sex[b] | | Significant | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | M | F | $R^2$(%) | RSD | Trt | sex | d |
| Eye muscle Width A (mm) | 53.9 | 52.9 | 53.6 | 53.7 | 53.8 | 53.2 | 31 | 4.9 | NS | NS | * |
| Eye muscle depth B (mm) | 27.9 | 27.2 | 26.5 | 25.2 | 26.3 | 27.1 | 45 | 2.2 | NS | NS | *** |
| Fat dept c (mm) | 4.8 | 5.6 | 3.1 | 5.4 | 4.0 | 5.4 | 45 | 2.2 | NS | NS | *** |
| Tissue depth GR (mm) | 17.7 | 17.0 | 16.3 | 16.7 | 16.0 | 17.9 | 61 | 3.4 | NS | NS | *** |
| Rib fat depth J (mm) | 10.7 | 10.6 | 10.1 | 10.5 | 9.6 | 11.4 | 50 | 3.0 | NS | NS | *** |
| Leg fat dept L3 (mm) | 16.3 | 13.7 | 14.1 | 14.8 | 13.2 | 16.3 | 48 | 3.9 | NS | NS | *** |

a, b, c = See footnotes to Table 3 and 4
d = The covariate was carcass weight

Table 7. Least-square means for all dissected leg tissue weights

| Item | Treatment[a] | | | | Sex[b] | | | | Signifiancec | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | M | F | $R^2$(9) | RSD | Trt | sex | d |
| Leg wt (g) | 2798 | 2895 | 2591 | 2811 | 2818 | 2910 | 89 | 199 | NS | NS | *** |
| Leg length T (mm) | 273 | 266 | 265 | 281 | 277 | 267 | 23 | 19.4 | NS | NS | NS |
| The wt. of 4 leg muscle | 860 | 860 | 810 | 861 | 833 | 862 | 86 | 65 | NS | NS | *** |
| Subcutaneous fat wt. (g) | 524 | 580 | 696 | 533 | 535 | 642 | 68 | 132 | NS | S | *** |
| Intermuscular fat wt (g) | 142 | 180 | 162 | 132 | 180 | 158 | 15 | 184 | NS | NS | NS |
| Total separable fat of the leg (g) | 666 | 760 | 858 | 685 | 715 | 800 | 69 | 144 | S | * | *** |
| Leg bone wt. (g) | 435 | 448 | 438 | 434 | 462 | 416 | 57 | 58.1 | NS | S | *** |
| Leg muscle wt. (g) | 1656 | 1651 | 1563 | 1653 | 1635 | 1627 | 86 | 122 | NS | NS | *** |
| Femur weight (g) | 131 | 133 | 130 | 131 | 136 | 125 | 65 | 13.6 | NS | S | *** |
| Femur lenght (mm) | 174 | 172 | 173 | 175 | 174 | 173 | 51 | 5.9 | NS | NS | *** |
| Muscularity index | 0.404 | 0.408 | 0.395 | 0.397 | 0.395 | 0.406 | 58 | 0.016 | NS | NS | *** |
| M:B ratio/femur | 6.61 | 6.49 | 6.25 | 6.55 | 6.07 | 6.86 | 48 | 0.562 | NS | ** | *** |
| M:B ratio/leg | 3.90 | 3.68 | 3.57 | 3.84 | 3.53 | 3.97 | 26 | 0.489 | NS | * | * |

a, b, c = see footnotes to Table 3, 4
d = The covariate was carcass weight

increased (P<0.05) ADG during 175 days compared with feeding urea. (19) noted that the improvement in ADG may have been related to the increased microbial protein synthesis when true protein such as SBM was fed and could also be partially related to improved DMI due to increased diet acceptability.

Comparing SSM with SBM in this experiment for final live weight, average live weight gain, average daily growth rate and average feed efficiency resulted in a small but not statistically different to that produced by SBM at the end of the trial. (4) reviewed several works on different source of protein and reported that the sunflower meal produces average daily gain and feed efficiency inferior to that produced by soybean meal, but the author did not show the magnitude of this difference or if it is statistically different from the SBM. (5) reported from an experiment with steers fed corn silagebased diets containing either sunflower or soybean meal that protein source had no effect on feed intake, average daily gain, and feed efficiency. The author also reported other researches conducted at North Dakota State University comparing sunflower meal to soybean meal for growing heifers and steers gaining approximately 2 Ibs/day.

Bitter vetch is widely grown forage legume in the north of Jordan, and as such, it is considered as a good source of summer feed, because of its being inexpensive source of protein. However, little research had been conducted to evaluate bitter vetch as a source of protein to feedlot lambs in Jordan. (20) suggested the vetch seeds are best used with cereal chopped straw to comprise 10-20% of the mixture. In an experiment with lambs conducted in north Jordan to compare different types of vetch, lamb growth rate was found to be 200 g/head/day (Sagric International, 1990). The range of live weight gain has been 172-239 g/lamb/day. These results are in agreement with our work which showed that BVS is a good protein source for finishing lamb compared with SBM in terms of giving a similar growth rate and feed efficiency.

(21) discussed the effects of sex on growth and development patterns and pointed out that ewes had a slower rate of growth, a more early maturing carcass and reached a lower mature size than rams. This response was attributed mainly to the effect of estrogen in restricting the growth of the long bones of the body. Consequently, males have carcasses of different shape from female, being more muscular and contained less fat. (22) reported from an experiment with Merino X Border Leicester lambs that rams contained on average more muscle, more bone and less fat than wethers of similar live weight. They also reported that wethers contained less fat and more muscle than ewes, but the muscle-to-bone ratio was highest for ewes (3.95), lowest for wethers (3.52) and was intermediate for rams (3.79). (23) showed that the rams of the purebred Dorset Down lambs were significantly lower in muscle-to-bone ratio than ewes of the same breed when compared at the same carcass weight. Similar results were reported by (24, 25, 26).

The findings that female animals had inferior carcass characteristics and growth patterns are in full agreement with the above studies from other breeds than Awassi. The effect of sex on the weight gains of Awassi lambs is variable. The average body weights of male and female Ivesi (Awassi) lambs in Turkey, whether poorly or well-fed, show that male lambs grow considerably faster than females (27, 28). Similarly, in northern Iraq, (29) recorded the average weaning and yearling weights of male and female single and twin Awassi lambs, and found that while ram lambs were on average 1 kg heavier than ewe lambs at weaning, the differences were not statistically significant. In yearling weight, however, the males exceeded the females by an average of 9.7 kg and here the differences were highly significant.

Least-square means for lamb performance, all carcass and non-carcass component weights, carcass linear dimensions measurements and all dissected leg tissue weight are presented in Tables 4, 5, 6 and 7. Replacing urea, SSM or BVS with SBM had no impact on lamb performance or carcass characteristics, although cold carcass weight and the dressing-out percentage were slightly higher (P>0.05) in the BVS treatment than in the SBM treatment. Limited data are available regarding the effects of protein source on carcass characteristics, but (19) reported similar results with steers when they compared different protein sources.

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