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# Performance, Carcass Percentage, and Production Cost for Awassi Lambs Fed High Energy Diet for Short Fattening Period

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**Abstract**

An experiment was conducted to indicate the effect of feeding high energy diet for 45 days on male and female Awassi lambs' performance, carcass percentage, and cost of production. A total of twenty four Awassi lambs (12 males, and 12 females) averaging 18.2±0.70 kg body weight were used. Lambs were assigned randomly to two different groups (groups A and B); each group had twelve lambs (6 males and 6 females) and fed two different diets (low energy diet and high energy diet). Feed intake, total gain, average daily gain and feed conversion ratio was calculated and body measurements (height and length) were recorded. Lambs were slaughtered at the end of experiment, to evaluate carcass percentage. Cost of production was calculated based on ingredients' price at the time of the experiment. Final body weight, weight gain, and average daily gain were greater ($p < 0.05$); while feed conversion ratio was lower ($p < 0.05$) for lambs fed high energy diet than lambs fed low energy diet. Body length differences measured to be greater ($p < 0.05$) for male lambs fed high energy diet than other lambs. Fasted weight, hot carcass weight, and dressing percentage were higher ($p < 0.05$) for lambs fed the high energy diet. Cost of gain was lower ($p < 0.05$) for lambs in group B compared to lambs in group A. Therefore, the economical efficiency in this experiment was greater for lambs fed high energy diet than lambs fed the control diet during 45 days fattening period.

**Keywords:** Awassi lambs, body length, economical efficiency, high energy diet, hot carcass weight, performance

## 1. Introduction

Small ruminants, mainly sheep, are growing in importance for animal production. The proper body growth and development of growing lambs depends largely on the animal's level of nutrition. One of the major limitations of sheep production in Jordan is the inadequate availability of feedstuffs and lacking of natural pastures (Awawdeh, 2011). Natural pastures are available only in limited times of the year with variable quantity and quality of protein and energy contents (Awawdeh & Obeidat, 2011). Moreover, Jordan considered as an arid and semi- arid country, with low annual rainfall that affects pastures development. On the other hand, extensive grazing by animals reduces pastures availability (Ghanem, 2013). Natural pastures are mostly low in energy and proteins and usually do not meet nutrients requirements for livestock (Salem & Nefzaoui, 2003). The main principle in intensive lamb fattening process is concerned with the use of intensive feed ingredients in order to increase the rate of growth and development. Energy is a major dietary element which is responsible for the different utilization of nutrients and thereby enhances animal productivity and gain (Hosseini et al., 2008). Grains are the most common feedstuff used in finishing lambs. In Jordan, grains are commonly imported with high prices. As reported by the Ministry of Agriculture, Jordan imported about 71, 76, and 35 million tons of corn, barley, and soybean meal, respectively (Ministry of Agriculture, Annual Report, 2015). Other factors that limit sheep production in Jordan, other than insufficient local production of grains (Awawdeh et al., 2009) are harsh climate conditions, reduced governmental support to farmers (Obeidat & Gharaybeh, 2011), and an increasing demands for humans to grains. Moreover, high feeding cost is another issue to be considered and a major part of production cost in sheep industry (Obeidat et al., 2011). While most of the fattening trials performed with lambs for reaching marketing weight is taking more than 65 days (Sayed, 2009; Obeidat et al., 2011; Ata, 2016), the aim of this study was to indicate the effect of feeding high energy diet for 45 days on Awassi lambs' performance

and carcass percentage. Moreover, evaluating production cost during the experimental period to help local farmers choosing the best diet with lower cost to be used for fattening lambs in a short period.

## 2. Materials and Methods

### *1.1 Experimental Design, Animals, and Diets*

The experiment was conducted including a total of twenty four (12 males, and 12 females) Awassi lambs, averaging 3 months of age and 18.2±0.70 kg body weight. Lambs were reared in a local private farm near Jerash University. A 2 × 2 factorial design was used and lambs were assigned randomly to two different groups; each group had twelve lambs (6 males and 6 females) and fed two different diets. The diets were A (low energy diet) and B (high energy diet). The diets were iso-nitrogenous and formulated to have 15% crude protein (CP on DM basis; Rios-Rincon et al., 2014; Table 1). Feed was given at 1% of the body weight to each animal. Lambs offered the high energy diet (group B) were allowed to free grazing twice weekly at available pastures to obtain their roughage requirements; while lambs fed low energy diet (group A) offered a total mixed ration which contains roughage. Lambs from each group were housed individually in shaded pens (1.5 m × 0.75 m), and fed twice daily for 45 days. Diets were mixed biweekly during the study. Feed offered and refusals were recorded to calculate feed intake, while body weight was recorded weekly. Total gain, average daily gain (ADG) and feed conversion ratio (FCR) was calculated at the end of the experiment. Body measurements (height and length) were recorded at the beginning and the end of the experiment. At the end of the experiment, after 18 h fasting, all lambs were slaughtered at 8 am by trained personnel according to a standard slaughter procedure (Abdullah et al., 1998) to evaluate carcass percentage. Fasting live weight was recorded before slaughter and hot carcass weight (HCW) was immediately recorded after slaughter. Dressing percentage was calculated as the hot carcass weight percentage of the fasted live weight. Following the AOAC (1990) standard procedures, rations samples were analyzed for their dry matter (DM), organic matter (OM), and crude protein (CP; Table 1). The methods were as follows: DM (100 °C in air-forced oven for 24 h; method 967.03), OM (550 °C in ashing furnace for 6 h; method 942), and CP by using (Kjeldahl procedure; method 976.06).

### *2.2 Statistical Methods*

Data were analyzed using PROC MIXED of SAS (version 9.0, SAS Institute, Inc. Cary, NC, USA) with lamb considered the experimental unit using diets × gender effects. The mean separation was performed using t-test. The interaction means were reported as least square means by using Tukey test, and differences were referred to those having a $P \leq 0.05$.

Table 1. Ingredients of the experimental diets fed to Awassi lambs

| Item | Diets[1] | |
|---|---|---|
| | A | B |
| *Ingredient (% of the diet)* | | |
| Corn grains | 0.0 | 22.0 |
| Barley grain | 52.0 | 60.0 |
| Soybean meal | 20.0 | 15.0 |
| Wheat straw | 25.0 | 0.0 |
| Salt | 1.4 | 1.4 |
| Limestone | 1.5 | 1.5 |
| Mineral and Vitamins[2] | 0.1 | 0.1 |
| *Nutrient, % of DM* | | |
| DM | 97.2 | 96.8 |
| OM | 91.2 | 90.4 |
| CP | 15.1 | 14.9 |
| ME[3] (Mcal/kg) | 2.20 | 2.70 |

*Note*. [1] Diets offered were low Energy Diet = Control (A), or High Energy Diet (B) on DM basis.

[2] Composition per 1 kg contained (vitamin A, 8,000,000 IU; vitamin $D_3$, 1,5000,000 IU; vitamin E, 1000 IU; Mn, 0.40 mg; Zn, 0.15 mg; Fe, 0.50 mg; Cu, 0.50 mg; and Co 0.01 mg).

ME[3]: Metabolizable energy; calculated using NRC (2007).

## 3. Results

The parameters measured reflecting lambs growth performance that was affected by feeding different diets is shown in Table 2. Lambs fed high energy diet (group B) had greater ($p < 0.05$) final body weight than lambs in group A with 32.1 kg for males and 30.6 kg for females fed high energy diet, while it was 28.8 kg for male and 26.8 kg for female lambs fed the control diet. Total gain was significantly higher ($p < 0.05$) for lambs in group B with 13.2 kg for females and 13.1 kg for males than female 8.68 kg and male 10.5 kg lambs in group A. Lambs feed intake was not affected ($p > 0.05$) by the different diets and gender. Average daily gain (ADG) was greater ($p < 0.05$) for male and female lambs fed the high energy diet compared to male and female lambs fed low energy diet. Feed conversion ratio (FCR) was greater ($p < 0.05$) for female lambs fed the low energy diet than other lambs fed the different experimental diets.

Table 2. Performance of Awassi lambs fed the different diets

| Item[2] | Diets[1] | | | | SEM | P value[3] |
|---|---|---|---|---|---|---|
| | A | | B | | | |
| | Male | Female | Male | Female | | |
| Initial BW (kg) | 18.3 | 18.1 | 18.9 | 17.4 | 0.45 | 0.15 |
| Final BW (kg) | 28.8 [b] | 26.8 [b] | 32.1 [a] | 30.6 [a] | 0.73 | 0.02 |
| Total Gain (kg) | 10.5 [b] | 8.68 [c] | 13.1 [a] | 13.2 [a] | 0.74 | 0.00 |
| Feed Intake (g) | 960 | 945 | 925 | 976 | 0.03 | 0.25 |
| ADG (g) | 233 [b] | 193 [c] | 290 [a] | 294 [a] | 0.01 | 0.00 |
| FCR | 4.12 [b] | 4.95 [a] | 3.19 [c] | 3.33 [c] | 0.17 | 0.00 |

*Note*. [1] Diets offered were low Energy Diet = Control (A), or High Energy Diet (B) on DM basis.

[2] BW = Body Weight, Gain = Final BW – Initial BW, ADG (Average daily gain) = Gain/45 days, FCR (Feed conversion ratio) = Intake/ADG.

[3] Means for the interaction between diets and gender having different superscripts within a row are statistically significant ($p < 0.05$).

Body measurements were recorded at the beginning and the end of the experimental period as shown in Table 3. There were no significant differences ($p > 0.05$) in body height and length for lambs fed the different diets in both groups except for males in group B. Body length difference measured to be greater ($p < 0.05$) for male lambs fed the high energy diet and was 16.7 cm compared to female lambs in the same diet group (13.2 cm) and other male and female lambs fed low energy diet (13.2 cm and 13.5 cm, respectively).

Table 3. Body measurements of Awassi lambs fed the different diets

| Item[2] | Diets[1] | | | | SEM | P value[3] |
|---|---|---|---|---|---|---|
| | A | | B | | | |
| | Male | Female | Male | Female | | |
| Initial Body Height (cm) | 51.5 | 51.2 | 51.0 | 51.3 | 1.44 | 0.74 |
| Final Body Height (cm) | 60.7 | 60.5 | 61.0 | 62.2 | 1.01 | 0.53 |
| Height Difference (cm) | 9.20 | 9.30 | 10.0 | 10.8 | 0.58 | 0.57 |
| Initial Body Length (cm) | 66.2 | 63.7 | 64.8 | 65.3 | 1.48 | 0.32 |
| Final Body Length (cm) | 79.3 | 77.2 | 81.5 | 78.5 | 1.27 | 0.74 |
| Length Difference (cm) | 13.2[b] | 13.5 [b] | 16.7 [a] | 13.2 [b] | 1.01 | 0.02 |

*Note*. [1] Diets offered were low Energy Diet = Control (A), or High Energy Diet (B) on DM basis.

[2] Body height and length differences were calculated by subtracting the initial from the final measurements.

[3] Means for the interaction between diets and gender having different superscripts within a row are statistically significant ($p < 0.05$).

At the end of the experiment, lambs were slaughtered and carcass percentage was measured as shown in Table 4. Fasted body weight was greater ($p < 0.05$) for lambs fed the high energy diet compared to lambs fed the control diet. Hot carcass weight was greater ($p < 0.05$) for lambs in group B than lambs in group A. Dressing percentage was lower ($p < 0.05$) in lambs fed the low energy diet compared to lambs fed the high energy diet (46.4 kg and 46.6 kg for male and female lambs in group A, while 47.5 kg and 48.1 kg for male and female lambs in group B).

Table 4. Carcass percentage of Awassi lambs fed the different diets

| Item[2] | Diets[1] | | | | SEM | P value[3] |
|---|---|---|---|---|---|---|
| | A | | B | | | |
| | Male | Female | Male | Female | | |
| Fasted Weight(kg) | 27.8 [b] | 25.6 [b] | 30.9 [a] | 29.4 [a] | 0.73 | 0.00 |
| HCW (kg) | 12.9 [b] | 11.9 [b] | 14.7 [a] | 14.1 [a] | 0.34 | 0.00 |
| Dressing (%) | 46.4 [b] | 46.6 [b] | 47.5 [a] | 48.1 [a] | 0.22 | 0.00 |

*Note*. [1] Diets offered were low Energy Diet = Control (A), or High Energy Diet (B) on DM basis.

[2] HCW = Hot Carcass Weight, Dressing % = Dressing percentage was calculated as the hot-carcass weight percentage of the fasted live weight.

[3] Means for the interaction between diets and gender having different superscripts within a row are statistically significant ($p < 0.05$).

Cost of feed used in this experiment was calculated as presented in Table 5. Cost of formulating the low energy diet was higher (the price of hey straw added to the diet increased the total cost) and it was 336.48 US $/Ton, while it was 312.22 US $/Ton for the high energy diet (the diet did not contain hay straw). Cost of feed consumed was similar ($p = 0.95$) in lambs fed the different experimental diets. Cost of gain (cost of Kg's of feed that was consumed by lambs during the 45 days divided by lambs total gain at the same period) was lower ($p < 0.05$) in lambs fed the high energy diet (Group B) than lambs fed the low energy diet (group A).

Table 5. Feed cost of Awassi lambs fed the different diets

| Item | Diets[1] | | SEM | P value[5] |
|---|---|---|---|---|
| | A | B | | |
| Cost of Feed (US $/Ton)[2] | 336.48 | 312.22 | | |
| Cost of Feed Consumed (US $/Kg)[3] | 0.32 | 0.33 | 0.02 | 0.95 |
| Cost of Gain (US $/Kg)[4] | 1.57 [a] | 1.10 [b] | 0.08 | 0.00 |

*Note*. [1] Diets offered were low Energy Diet = Control (A), or High Energy Diet (B) on DM basis.

[2] Calculated based on ingredients' price at the time of the experiment (May, 2017).

[3] Cost of Feed consumed = Cost of Feed intake in Kg/Lamb.

[4] Cost of gain = cost of intake of lamb during the 45-day study/total gain in kg.

[5] Means having different superscripts within a row are statistically significant ($p < 0.05$).

## 4. Discussion

A study was performed to indicate the effect of feeding high energy diet for 45 days fattening period on male and female Awassi lambs performance, carcass traits, and feeding cost per kg gained. As shown in Table 2, final weight, total gain, and ADG were enhanced by high energy diet fed to male and female Awassi lambs. This result is consistent with that reported by others (Sayed, 2009; Hosseini et al., 2008; Yagoub & Babiker, 2008). Rios-Rincon et al. (2014) reported that lambs fed high-energy diets for 84 days showed an increase in gain to feed ratio. Increasing feed efficiency has been a common response when comparing high-energy to low-energy diets (NRC, 2007; Sayed, 2009). However, the effect of increased dietary energy levels on ADG varies according to different energy levels. In this study, the enhancement of ADG during the 45 days experimental period might be due to the increase in energy level that allows the production of more fermentable ME for rumen

microorganisms which leads to a rise in the microbial protein production and in the amount of protein available to the animal to grow. Feed conversion ratio (FCR) decreased in lambs fed the control diet (low energy diet) and that reflects the decrease in growth rate and live weight attained by those animals. This agreed with the findings by Ebrahimi et al. (2007) and Hosseini et al. (2008) who reported similar results but with longer fattening period (around 90 days fattening period).

Body measurement was not affected by the different diets except for body length differences (Table 3). The average changes in length between lambs fed high energy diet compared to lambs fed the control diet might be due to better utilization of the feed during the experimental period. The results of this study are in agreement with Bassano et al. (2003) results. The researchers also found a relationship between weight and body measurements which changed mainly by the effect of sex and season.

Fasted weight, HCW and Dressing percentage were increased with lambs fed the high energy diet than the low energy diet (Table 4). The increase in fasting weight and HCW reflects the increase in final weight gained by lambs fed the high energy diet for 45 days. Jabbar and Anjum (2008) reported similar results; they found that lambs fed high concentrate diet for 66 days had greater ($p < 0.05$) dressing percentage than lambs fed high forage diet. Moreover, Mahgoub et al. (2000) studied the effects of dietary energy density on carcass chemical composition of Omani lambs and found that meat production was improved in the form of higher body weight gains and better carcass composition by increasing energy levels in the diet. On the other hand, it was reported by Rios-Rincon et al. (2014) that the energy level in high-energy finishing diets had small effects on HCW and dressing percentage, while an increase in visceral fat as a result of increasing the energy density of the diet was attained.

Feed cost was higher for the control diet (336.48 US $/Ton) compared to the high energy diet (312.22 US $/Ton) as illustrated in Table 5. Total cost of feed consumed was similar between the different diets. However, cost of feed per kg weight gain decreased with increasing energy level. Lambs fed the low energy diet had high cost of gain due to the fact that animals on that treatment had lower live weight gain during the experimental period. Cost of gain was lower for lambs fed the high energy diet which indicates that this diet was most economical for fattening sheep in this experiment.

## 5. Conclusion

The economical efficiency in this experiment was greater for lambs fed high energy diet than lambs fed the low energy diet during the 45 days fattening period. It could be concluded that increasing energy level in lamb's diet for a short fattening period resulted in increasing growth performance, body length measurements, carcass percentage, and reduces cost of gain of Awassi lambs.

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