

EFFECT OF DIFFERENT ENERGY LEVELS ON GROWTH, CARCASS TRAITS , BODY COMPOSITION AND DIGESTIBILITY OF NUTRIENT IN AWASSI LAMBS

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ABSTRACT

This experiment was designed to investigate the effect of different level of energy on growth, carcass traits, body composition, digestibility and some blood parameters. Twenty one Awassi lambs (4 month old and 23 kg body weight) were used and after 10 days of adaptation, the lambs were divided equally and randomly and penned individually into three treatment groups, and fed ad lib on low (10.8 T₁) medium (11.6 T₂) and high (12.3 T₃ MJ/kg DM). After 72 days of fattening, 5 lambs from each treatment were chosen and slaughtered. Results revealed that lambs of T₃ had numerically higher daily gain (189.72 g), lower dry matter intake (849.46 g), higher feed efficiency (4.7), higher dressing percentage (48.43) and a significant increase (P≤0.05) was noticed in dry matter, organic matter, crude protein, nitrogen free extract and total digestible nutrient as compared with lambs received low or medium level of energy. It could be concluded that the high dietary energy produce the best performance, nutrient digestion and carcass trait of lambs.

Keywords: metabolizable energy, growth performance, carcass characteristics, awassi.

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تأثير مستويات مختلفة من الطاقة في النمو، صفات الذبيحة، تركيب الجسم و معامل الهضم للحملان

العواسية

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باحث

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المستخلص

تم تصميم هذه التجربة لدراسة تأثير مستويات مختلفة من الطاقة في النمو، صفات الذبيحة، تركيب الجسم، معامل الهضم و بعض الصفات الدموية للحملان العواسية، بعد فترة تمهيدية امدها عشرة ايام، تم توزيع 21 حمل عواسي بعمر 4 اشهر و وزن 23 كغم بصورة متساوية و عشوائية الى ثلاثة مجاميع لتتغذى على مستوى واطىء (10.8)، متوسط (11.6) و عالي (12.3 ميكا جول/ كغم مادة جافة) و تم ايواها بصورة فردية و كانت تقدم لها عليقة المركزة بصورة حرة. تشير النتائج الى تفوق الحملان المغذاة على مستوى عالي من التغذية في معدل الزيادة الوزنية اليومية (189.72 غم). انخفاض المتناول من المادة الجافة (849.46 غم) و كفاءة تحويل غذائي اعلى (4.7) و اعلى نسبة تصافي (48.43) الا ان الفروقات لم تكن معنوية. كما تبين بأن الحملان المغذاة على مستوى اعلى من الطاقة قد تفوقت على نظيراتها المغذاة على مستوى واطىء او متوسط في معامل هضم المادة الجافة، المادة العضوية، البروتين الخام، المستخلص الخالي من النايتروجين و مجموع المواد القابلة للهضم. ويمكن الاستنتاج بأن الطاقة العالية قد ادت الى زيادة اداء النمو و صفات الذبيحة و هضم المواد الغذائية.

الكلمات المفتاحية: الطاقة المتأيضة، اداء النمو، صفات الذبيحة، العواسي.

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INTRODUCTION

In Iraq, sheep are considered the most important farm animals, and an enormous share of income come from the sale of lambs. Nevertheless their importance is further enhanced because they are the most suitable farm animals to the extensive area of arid and semi- arid of the country, as well as, the major sources of livelihood for the rural inhabitants of the area (5). It is known that a number of factors affected growth performance, the quality and quantity of the carcass as well as productivity in sheep marketing (23). Moreover, it is well documented that proper growth and development of growing lambs depends heavily on the animals level of nutrition (30) in which energy is considered the major dietary element that is responsible for the efficient utilization of nutrient and thereby the productivity and gain of an animal (19). It have been indicated that increasing dietary energy level generally can improve the daily gain and feed efficiency of sheep (15,19), and most are in accordance that feed intake increased with increasing protein level and decreased with increasing energy level (3). Also, it have been shown that the amount of tissue deposited as carcass components is largely determined by the level of protein intake and the energy available for retention in muscle (10). Since there is a limited research on energy requirements for fattening Awassi lambs, therefor, the objective of this study was to explore the fattening performance, carcass traits and composition in response to different energy level.

MATERIALS AND METHODS

The present experiment was conducted at animal farm, College of Agricultural Engineering Sciences, University of Duhok, where 21 weaned Awassi ram lambs (4 month) with an average live body weight of 23.55 ± 0.34 kg were used. Following an adaptation period for 10 days, the lambs were randomly and equally allocated and individually penned (1 ×2 m) into three treatment groups and fed

concentrate ad-lib containing 10.9 (T₁), 11.7 (T₂) and 12.3 (T₃) MJ/kg (Table 1). The offered concentrate was weighed daily, and the refusal was collected and weighed before morning feeding. Clean water was available constantly.

Table 1. The ingredient and chemical composition of the diet.

Ingredient %	T ₁	T ₂	T ₃
Barley	52	52	52
Corn	1.5	11	20
Wheat bran	11	14	8
Wheat straw	23	8.5	4.25
Soybean meal	10	11	10
Urea	0.5	0	0.25
Oil	0	1.5	3.5
Salt	1	1	1
Mineral & Vitamin	0.5	0.5	0.5
Limestone	0.5	0.5	0.5
Total	100	100	100
Chemical composition ¹ g/kg DM			
Dry matter	918	912	911
Organic matter	957.1	968.2	973
Ash	42.9	31.8	27
Crude protein	141.4	141	140.9
Ether Extract	11.3	26.6	48.8
Crude fiber	132	84.3	64
Nitrogen Free Extract²	589	628	631.3
Metabolizable Energy³	10.9	11.7	12.3

T₁= Treatment 1 (Low energy)

T₂= Treatment 2 (Medium energy)

T₃= Treatment 3 (High energy)

Chemical composition¹ (AOAC, 2007)

NFE² = 1000 - (water + Ash + CP + EE + CF).

ME³ MJ/kg DM = [(CP*0.012) + (EE*0.031) + (CF*0.005) + (NFE*0.014)] (MAFF, 1975).

After 72 days of fattening, five lambs per group were chosen randomly and slaughtered. Feed was withdrawal over night and lambs were slaughtered according to muslim (Halal) way by severing the throat and major blood vessels in the neck. Immediately after skinning was completed, non- carcass components such

as head, skin, feet, liver, spleen, heart, lung with trachea and testes were weighed. Dressed carcass was weighed within 1 h. The gastrointestinal tract was weighed, and then emptied of their content, washed and re-weighed to facilitate calculation of empty body weight by subtracting the weight of gut content from slaughter weight. Also weight of omental, mesenteric and cardiac fat was recorded.

Carcass measurements

Following chilling the carcass at 4° c for 24h, cold carcass was weighed and kidney and pelvic fat was weighed separately. The carcass was split along the vertebral column into two halves, using an electrical saw. The right half was separated into eight whole sale cuts. The cross-sectional area of L.dorsi muscle between 12 and 13 ribs was traced of the cutting and the area was subsequently measured by digital planimeter. Fat thickness over the midpoint of L. dorsi muscle was recorded by using Caliper device.

Physical dissection

All separated whole cuts of the right half carcass were dissected completely into lean, fat and bone. The three components were weighed separately to determine their percentage. Non- carcass fat is the sum of the omental, mesenteric, pelvic, kidney and cardiac fat. Carcass fat including subcutaneous and intramuscular fat was separated from each cut and weighed.

Apparent digestibility

For digestibility trial, 3 lambs in each group were placed in individual pens (1×2 m) at the end of last week of experiment. Total fecal output was determined for 7- days. Each animal feces was weighed daily and 10% of weighed taken and frozen. Feces sample was analysis according to AOAC (9).

Statistical analyses

The experiment was designed by complete randomized design CRD. Data was analyzed

statistically using general linear model procedures within SAS (29). Duncan (14) multiple range test was used to test difference between treatments.

RESULTS AND DISCUSSION

Growth performance

The overall mean of daily gain in weight was 169.62 ± 14.77 gm. (Table 2). The average daily gain recorded in the present investigation is almost comparable with those obtained earlier for the same breed by Alkass (6), Alkass (8) and Rashid (27). However, the average daily gain obtained herein is lower than those recorded by Alkass and Kak (7) and Alkass and Hassan (4). Such finding could be due to variation in genetic makeup as well as environmental factors and feeding practices in particularly. It appear from Table 2 that lambs fed a diet containing high energy level (T₃) had numerically higher gain (189.72 gm.), lower dry matter intake (849.46 gm.) and are more efficient in converting feed to gain (4.70 Kg/Kg) than lambs consumed low (T₁) or medium dietary energy level (T₂). Such result may be related to feed intake which is regulated by dietary energy density in ruminants. Metabolizable energy intake, rather than physical fill, appeared to be the dominant factor influencing the dry matter intake (28) which affected directly the passage rate through gastro intestinal tract and then allows the production of more fermentable metabolizable energy for rumen microorganisms resulting in a rise in the synthesis of microbial protein and in the amount of protein available to animal, which may improve gain and quality and quantity of meat (22). Similarly, Rios- Rincon (28), Taha (32) and Hossain (20) demonstrated that energy level had no significant effect on rate of growth in different breeds of sheep and goats.

Table 2. Effect of different energy level on animal performance

Trait	Over all mean	T ₁	T ₂	T ₃
		Low energy 10.9 MJ/kg DM	Medium energy 11.7 MJ/kg DM	High energy 12.3 MJ/kg DM
Initial wt./ kg	23.69 ± 0.35	23.36 ± 0.61	23.60 ± 0.48	24.12 ± 0.77
Final Wt./ kg	35.90 ± 1.08	33.86 ± 2.50	36.08 ± 1.61	37.78 ± 1.21
Total gain/ kg	12.21 ± 1.06	10.50 ± 2.40	12.48 ± 1.60	13.66 ± 1.49
Daily gain/ g	169.62 ± 14.77	145.84 ± 33.35	173.32 ± 22.36	189.72 ± 20.81
Total DMI/ kg	65.72 ± 3.01	69.64 ± 7.79	66.38 ± 3.48	61.16 ± 3.64
Daily DMI/ g	912.88 ± 41.83	967.24 ± 108.19	921.94 ± 48.40	849.46 ± 50.62
FCR kg/kg	6.26 ± 0.97	8.60 ± 2.70	5.58 ± 0.50	4.70 ± 0.60

Carcass traits

Data related to carcass traits of Awassi lambs are summarized in Table 3. It appears that lambs received high energy level had heaviest slaughter weight (37.78 Kg), carcass weight (18.29 kg), dressing percentage based on slaughter weight (48.43 kg) and empty body weight (53.99 kg) than those fed low or medium energy levels. However, the difference among them was not significant. The increase of carcass weight may be due to the higher feed intake and gut fill in lambs fed low level of energy and such increase in dressing percentage could be attributed to higher slaughter and lower gut content in lambs fed high energy level compared with lambs maintained on low or medium level of energy. This finding is supported by the results obtained in sheep by Dabiri (12), Rios- Rincon (28) and Kioumars (23) and in goat by Abbasi (1), Taha (32) and Yagoub and Babiker (35) who found that carcass weight and dressing percentage was raised with increasing the energy concentration of the diet. Back fat was slightly thicker in lambs fed a high energy level than lambs fed on low energy level. Such result is in accordance with finding of Rios- Rincon (28) and Kioumars (23) in sheep, Shahjala (31) in goat, Elbukhary (16) in Baggra heifer, who noticed an increase in fat thickness with increasing dietary energy level. The L. muscle dorsi area was significantly ($P < 0.05$) larger for lambs fed high energy level

(11.69 cm²) than lambs fed either medium (10.56 cm²) or low energy level (8.74 cm²). Such difference may be due to the positive correlation with final weight and gain (25). This result is in agreement with those found by Elbukhary (16) and Shahjalal (31).

Carcass composition: The proportion of separable carcass tissue of the carcass side of Awassi lambs fed diet of different energy levels are demonstrated in Table 3. Although the highest mean (57.38 %) of lean and the lowest mean of bone (20.93 %) was found in lambs of T₃ as compared with T₁ and T₂ treatments, however, the differences among them was not significant. Fat content of the half carcass was almost the same in the different treatments. These results agreed with the findings in sheep by Dabiri (12) and Rios- Rincon (28) and in goat by Taha (32) and Yagoub and Babiker (35). Also lean to fat ratio and lean to bone ratio both was not affected significantly by the treatments contained different energy level. This result is in accordance with those obtained by Abdullah and Hussein (2) on goat and Rios- Rincon (28) on lambs. However it is generally agreed that animals full-fed high concentrate diet usually produce more- carcass fat, and consequently, are less efficient in converting feed to lean meat than in animal fed slightly below ad libitum energy intake, even though the ad libitum fed animals would be more efficient in total feed energy retention. This is particularly

evident in the late stage of growth, as muscle and bone approach their mature size (21).

Table 3. Effect of different energy level on carcass trait and composition

Trait	Over all mean	T ₁	T ₂	T ₃
		Low energy 10.9 MJ/kg DM	Medium energy 11.7 MJ/kg DM	High energy 12.3 MJ/kg DM
Slaughter weight/ kg	35.90 ± 1.08	33.86 ± 2.50	36.08 ± 1.61	37.78 ± 1.21
Hot carcass weight kg	17.13 ± 0.59	15.78 ± 1.26	17.31 ± 0.96	18.29 ± 0.64
Cold carcass weight kg	16.99 ± 0.59	15.66 ± 1.26	17.17 ± 0.96	18.13 ± 0.63
Shrinkage percentage	0.81 ± 0.05	0.71 ± 0.10	0.86 ± 0.11	0.88 ± 0.08
Dressing % (slaughter wt.)	47.62 ± 0.43	46.54 ± 0.75	47.90 ± 0.67	48.43 ± 0.70
Dressing % (EBW wt.)	53.58 ± 0.51	52.95 ± 1.04	53.80 ± 0.91	53.99 ± 0.82
Rib eye area cm ²	10.33 ± 0.49	8.74 ± 0.66 ^b	10.56 ± 0.54 ^{ab}	11.69 ± 0.87 ^a
Fat thickness mm	0.24 ± 0.01	0.21 ± 0.03	0.22 ± 0.01	0.28 ± 0.04
Lean	56.89 ± 0.94	56.37 ± 1.32	56.91 ± 1.98	57.38 ± 1.88
Fat	21.83 ± 1.02	21.97 ± 2.13	21.85 ± 1.93	21.68 ± 1.65
Bone	21.27 ± 0.56	21.65 ± 1.13	21.22 ± 0.48	20.93 ± 1.31
Lean : fat ratio	2.72 ± 0.18	2.70 ± 0.36	2.72 ± 0.34	2.73 ± 0.30
Lean : bone ratio	2.70 ± 0.09	2.62 ± 0.12	2.68 ± 0.12	2.79 ± 0.23

Values of ^{a, b, c} on the same row with different letters are significant different (P≤0.05)

Carcass and non-carcass fat

It is well known that fat is the most variable tissue in the carcass, and it varies not in its total amount but also in its distribution between the various deposits which alter markedly during growth, and the proportion and location of fat in the body are important in meat animals (21). In the present investigation, the total fats, carcass fat, non-carcass fat and fat tail averaged 4.58, 1.57, 0.95 and 2.05 kg, respectively (Table 6). Thus the relative contribution of different fat depots

to the total body fat was in the order carcass fat 34.18, non- carcass fat 21.23 and fat tail 44.57 % (Table 6). It appears from Table (5) that the effect of treatment was not significant on both weights of fat and their percentages. Different fat deposits increased by increasing energy level numerically. However, the variation among treatments was very little and the reasons could be due to the age of lamb which is younger than six month and because of slow growth rate, fat is a latter maturing tissue and has less priority for nutrients (18).

Table 5. Effect of different energy level on carcass and non- carcass fat

Trait	Over all mean	T ₁	T ₂	T ₃
		Low energy 10.9 MJ/kg DM	Medium energy 11.7 MJ/kg DM	High energy 12.3 MJ/kg DM
Wt. carcass fat/ kg	1.57 ± 0.10	1.50 ± 0.53	1.57 ± 0.44	1.65 ± 0.21
Wt. non- carcass fat/ kg	0.95 ± 0.39	0.87 ± 0.06	0.96 ± 0.23	1.02 ± 0.08
Wt. fat tail/ kg	2.05 ± 0.13	1.90 ± 0.44	2.10 ± 0.79	2.16 ± 0.31
Total body fat/ kg	4.58 ± 0.24	4.28 ± 0.44	4.63 ± 0.60	4.83 ± 0.13
Non- carcass fat %	21.23 ± 0.92	21.17 ± 2.02	21.39 ± 1.97	21.14 ± 0.96
Carcass fat %	34.18 ± 1.00	34.31 ± 2.32	34.00 ± 0.85	34.23 ± 2.10
Fat tail %	44.57 ± 0.96	44.51 ± 1.26	44.60 ± 2.02	44.61 ± 2.00

Apparent digestibility

Digestibility coefficients of nutrient are given in Table 6. It appears from the table a significant (P<0.05) increase in each of dry matter, organic matter, crude protein, nitrogen

free extract and total digestible nutrient and numerically ether extract and crude fiber increases with increasing the energy level in the diet. Such increase may be due to the diet contained less coarse material (non-fibrous

carbohydrates), which either lead to an increase palatability of the diet that rapidly digested by rumen microorganism and resulted in increasing dry matter digestibility, or may be is due to slow rate of passage through gastro- intestinal tract and thus increase exposure time, allow the rumen microorganism to break down the feed particle which lead to an increase digestibility of crude protein and crude fiber. The increase in organic matter digestibility in lambs fed on medium energy (T₂) and high energy (T₃) may be attributed to the higher digestibility of dry matter, and organic matter is form the higher portion of dry matter (33), or due to the high rate of passage in lambs fed low energy diet

due to higher fiber content in their diet which lead to decrease in digestibility of organic matter (17). Also the increase of ether extract may be due to the diet contained oil in T₂ and T₃ (Table 1) which improves the ether extract digestibility probably due to the higher fat intake (13, 26). Total digestible nutrient was significantly affected by treatment and their values increased by increasing energy level. This increase of total digestible nutrient is due to the increased digestibility of crude protein, crude fiber, ether extract and nitrogen free extract by increasing energy level. These results agree with those found by Costa (11) on Morda nova lamb and Sayed (30) on Sheep.

Table 6. Effect of different energy level on apparent digestibility

Digestibility Coefficient %	Over all mean	T ₁	T ₂	T ₃
		Low energy 10.9 MJ/kg DM	Medium energy 11.7 MJ/kg DM	High energy 12.3 MJ/kg DM
Dry matter	70.16 ± 1.39	65.76 ± 1.88 ^b	70.86 ± 1.55 ^{ab}	73.86 ± 0.80 ^a
Organic matter	73.27 ± 1.58	67.75 ± 1.55 ^b	74.36 ± 1.38 ^a	77.71 ± 0.55 ^a
Crude protein	65.73 ± 2.48	59.20 ± 3.63 ^b	66.16 ± 4.03 ^{ab}	71.83 ± 2.09 ^a
Crude fiber	31.07 ± 2.11	30.33 ± 3.83	29.13 ± 4.12	33.76 ± 4.00
Ether extract	64.70 ± 3.21	58.54 ± 5.92	61.85 ± 3.72	73.72 ± 3.36
Nitrogen free extract	81.28 ± 0.69	79.04 ± 1.11 ^b	81.76 ± 0.49 ^a	83.05 ± 0.22 ^a
TDN	66.68 ± 1.91	60.42 ± 1.72 ^c	66.84 ± 1.41 ^b	72.80 ± 0.73 ^a

Values of ^{a,b,c} on the same row with different letters are significant different (P≤0.05)

Blood parameters

The overall means of serum biochemical parameters are presented in (Table 7). It appears no significant effect of treatment on it. Blood biochemical indexes are important indicator that reflects nutritional status and diagnosis of various diseases (34), such as

insufficient animal dietary intake can lead to low serum content (36). Therefore, it become clear from the current study, those three treatments were sufficient for normal growth and not affect animal health. Similar results have been reported by Wang (35) on Hu lambs.

Table 7. Effect of different energy level on blood parameters

Items	Over all mean	T ₁	T ₂	T ₃
		Low energy 10.9 MJ/kg DM	Medium energy 11.7 MJ/kg DM	High energy 12.3 MJ/kg DM
Glucose mg/dl	67.40 ± 2.23	68.50 ± 4.14	65.85 ± 4.64	68.00 ± 3.28
Total protein g/dl	6.43 ± 0.10	6.55 ± 0.23	6.32 ± 0.19	6.44 ± 0.12
Albumin g/dl	3.11 ± 0.07	3.21 ± 0.17	3.00 ± 0.13	3.14 ± 0.08
Globulin g/dl	3.32 ± 0.09	3.33 ± 0.07	3.32 ± 0.24	3.31 ± 0.14
Cholesterol mg/dl	58.50 ± 2.40	59.66 ± 4.63	56.14 ± 2.81	59.85 ± 5.24
Triglyceride mg/dl	24.40 ± 1.25	24.50 ± 3.34	23.85 ± 2.14	24.85 ± 1.22
Urea mg/dl	35.50 ± 1.65	36.50 ± 2.52	35.00 ± 3.69	35.14 ± 2.53

CONCLUSION

It could be concluded that Awassi lambs can be finished on diet containing (12.3MJ/kg DM) to achieve better performance, nutrient digestion and carcass trait of lambs.

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