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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Protected methionine and dry fat for improving performance of growing Awassi lambs

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Abstract

This study was carried out to evaluate the effect of high dietary energy as dry fat and protected methionine on growth efficacy, feed intake and efficiency and carcass parameters of Awassi lambs during finishing stage. Twenty four Awassi lambs (3-4 months old) were distributed equally into four treatments groups as follow: Control (NRC requirements); T1 (High energy 3.0 Mcal ME/kg); T2 (high energy 3.0 Mcal ME/kg and 2.5 g protected methionine/head/day) and T3 (high energy 3.0 Mcal ME/kg and 5 g protected methionine/head/day methionine). Feeding Awassi lambs with high energy alone or with protected methionine caused a significant ($P<0.05$) increase in weight gain during second, third and overall gain when compared with the control group. Treatments did not cause any significant effect on feed intake, feed conversion, average and relative growth rate, dressing and tissues percentages except for spleen, heart and lungs. Moreover, back fat thickness, omental fat percentage and blood serum cholesterol significantly decreased ($P<0.05$) with feeding protected methionine (T2 and T3) when compared with lambs fed dry fat (T1). In conclusion, increasing dietary energy by using dry fat with or without protected methionine of Awassi lambs during the finishing period improved the total weight gain. This indicated that the requirements of energy by growing Awassi lambs might be higher than reported by NRC.

Keywords: Energy; protected methionine; Awassi; carcass; NRC

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Introduction

Awassi sheep is the most numerous and indigenous breed in the Middle East. This is a multipurpose breed used for meat, milk and wool production having high adaptability to harsh environmental and feeding conditions. The full potential of Awassi sheep is not utilized because of undernutrtion and lack of scientific research regarding the nutrients requirements under their raising conditions. Fattening of Awassi lamb has a great potential to make a significant contribution to red meat production and reducing the imported amounts of red meats in Middle East.

The daily nutrients requirements of ruminant animal depend on the breeds (genetic potential), age and physiological status. The most important requirements are energy and protein. The balance between protein, amino acids and energy for maintenance and production is very important for the livestock. The requirements of ruminant animals of energy can easily be covered by feeding cereals such as corn, barley, wheat etc. Sometimes dry fat and oil can be used for farm animal ration as a substitution of cereals as an energy source. Animal fat is a matter of concern for human being due to some health issues. The soap stock of the vegetable oil fat is a new products introduced to the market for farm animals. Soap stock is a by- product of the vegetable oil refining procedure and rich in polyunsaturated fatty acids (PUFA) and calcium in some cases. Soap stock can easily be used to substitute the oil in farm animals' rations as a source of energy because oil is expensive and compete with human feeding.

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On the other hand, covering their needs from protein is very complicated because of the ruminal degradation of protein and the high demand for specific amino acids. The first goal of ruminant protein nutrition is to optimize the efficiency of the animal's use of dietary protein for growth and production. This implies that protein supplementation for ruminants should be done on the basis of amino acids in addition to crude protein. By providing individual amino acids to the small intestine, the inclusion of undegradable protein can be reduced. This permits more space for other ingredients needed to support ruminal microbial protein synthesis (Clark et al., 1992). Methionine is considered to be one of the most limiting amino acid for protein synthesis of growing ruminants and consequently increase growth rate of beef cattle (Merchen and Titgemeyer, 1992) and lambs (Lynch et al., 1991). This suggests that additional methionine may be required postruminally to optimized growth, particularly for growing ruminant animals (Loerch and Oke, 1989). Smartamine[TM] M (Adisseo, Inc., Antony France) is a new product of a lipid/pH sensitive polymer protected methionine, recently introduced to the Jordanian market as a postruminal methionine.

National Research Council (NRC, 1985) identified only the quantities of crude protein for growing lambs for international breeds at different ages, but not the quantities of the essential and most limiting amino acids such as methionine and lysine. Moreover, the expression of amino acids requirements as a ratio to energy did not exist which may be particularly useful for ruminants, because microbial protein production is related to the intake of fermentable energy (Roher et al., 1986; Sniffen and Robinson, 1987; Clark et al., 1992). Unfortunately, no data is available regarding the amino acids and energy requirements for our local Awassi breed and most of available scientific data is based on studies of temperate breeds.

This study was carried out to evaluate the effect of high dietary energy as dry fat and protected methionine on the growth, feed intake and efficiency, average and relative growth rate of growing Awassi lambs. Moreover, carcass parameters and blood serum metabolites were also evaluated.

Materials and Methods

Feeding trial and sampling

Twenty four growing Awassi lambs, 3-4 months old, were used in this experiment. Animals were individually housed at University Research Station and were vaccinated against enterotoxaemia. During the experiment, lambs were divided equally into four groups and each was housed in an individual pen (0.8x 1.4 m) with separate feeder and drinker. The dietary treatments for each group were as follow: Control (NRC requirements; 2.8 Mcal ME/kg); T1 (High energy 3 Mcal ME / kg); T2 (high energy 3 Mcal ME /kg and 2.5 g methionine/ head/day) and T3 (high energy 3 Mcal ME/kg and 5 g/head/day methionine). The concentrate diets were formulated according to NRC (1985) and the energy levels were increased by using dry fat (Magnapac). Magnapac is usually use for increasing the energy contents of concentrate diets. The nutritive value of Magnapac (Norel-Misr, Egypt): crude fat%= 84; Moisture%= 3.5; Ash%= 16; acid insoluble ash%= 0.5 and Ca%=9. Moreover, lambs were fed the assigned diets which for 12 weeks (Table 1).

All lambs were bled at the beginning of the experiment and every 4 weeks via the jugular vein. Blood samples were centrifuged at 3000 rpm for 15 minutes and serum was separated. Serum samples were stored at –20ºC until analysis. Feed intake was recorded daily and body weight every 4 weeks. At the end of experiment, all lambs were slaughtered and tissues were collected (liver, heart, kidney, spleen, testicles, lungs and meat) and omental fats were weighed and samples were taken for further analysis. After slaughtering, weights of hot carcass were taken for all slaughtered lambs and recorded to determine dressing percentage. Moreover, cross section of the carcass ribs (12 and 13) were removed to measure the back fat thickness (cm). Care and management of lambs during the trial was followed according to the regulation of the university, Dean of Academic Research.

Blood serum samples were prepared and analyzed for glucose, total protein and cholesterol using available commercial kits (BIOLABO SA, Maizy, France) by spectrophotometer.

Table 1: Ingredients composition of diets (Dry matter basis)

Ingredient (%)	Diet 1[1]	Diet 2[2]
Barley	64.38	64.10
Soybean meal	4.26	5.50
Wheat bran	14.19	10.10
Alfalfa hay	15.37	15.32
Dry fat (Magnapac)	0.00	3.18
$CaCO_3$	1.20	1.20
Salt	0.50	0.50
Mineral & vitamins premix[3]	0.10	0.10
Chemical composition :		
Crude protein (g/ Kg DM)	159.54	158.33
Metabolizable energy (Mcal/kg DM)	2.80	3.00
Calcium (g/ kg DM)	8.11	9.72
Phosphorus (g/ kg DM)	5.3	4.8

[1]Formulated according to NRC (1985) to cover nutrients requirements; [2]Increasing metabolizable energy by adding dry fat (Magnapac); [3]Minivit-Forte, VAPCo, each 1 kg contains: Cu sulphate= 9.417 mg, Fe sulphate= 85 mg, Mg sulphste= 535 mg, Mn sulphate= 41.25 mg, Zn sulphate= 77.2 mg, Di-Ca phosphate = 145 mg. Vit A= 6250 I.U, vit D3= 1510 I,U, vit E= 4.375 I.U., Cobalt chloride= 1.933 mg, K iodide= 6.367 mg and Na selenite= 0.274 mg.

Statistical Analysis

Data were analyzed by using SPSS™ version (16.0) as a complete randomized design (CRD). The protected least significant differences test (LSD) was used to determine differences among treatments means for significant dietary effect (Steel and Torrie, 1980). The P<0.05 was considered statistically significant unless otherwise noted.

Results and Discussion

Live weight gain, feed intake and efficiency

The data on Table 2 shows the effect of feeding high energy and protected methionine (Smartamine) on monthly and overall weight gain of Awassi lambs fed finishing diets. There were no significant differences (P>0.05) in weight gain in the first month as a result of treatments, even though the control showed higher values compared with lambs from the other groups. A significant increase (P<0.05) of weight gain were detected on the second and third months. For the second month, treatments caused a significant higher weight gain for lambs in T1 and T3 compared with the lambs in the control and T2. In third month, lambs in T3 showed a significantly higher (P<0.05) weight gain compared with other treated groups. For the total weight gain during the whole feeding period, lambs fed high energy (T1) and high energy with the two levels of the protected methionine (T2 and T3) gave a significantly higher weight gain compare with the control group Table 2).

Jindal et al. (1980) reported that high dietary energy causes deposition of fat in tissues and increase weight gain. Moreover, Khinizy et al. (2004) found that feeding high levels of energy to weaned lambs increased the average daily gain and improved feed efficiency, but no effect of high protein intake on their general performance was observed. Kioumarsi et al. (2008) found that feeding Taleshi lambs high energy improved average daily gain by producing more metabolizable energy and fermentable products for microorganisms to increase synthesis of microbial protein as a supply of amino acids to the small intestinal tract and consequently improve growth performance (Early et al., 2001). Hence, the energy intake of lambs from T1 can be considered as an acceptable limit to cover the energy requirements without negative effect on the performance in term of weight gain and feed intake. On the other hand, lambs from T2 and T3 groups which were fed high energy and protected methionine showed a similar total weigh gain when compared with lambs in T1, but significantly higher when compared to the control. This give an evidence that feeding protected methionine to growing lambs do not affect the growth performance since dietary protein is high (16% CP). This result agreed with the recommendation of Titi et al. (2000) and Haddad et al. (2001) who identified the optimum level of dietary crude protein for growing Awassi lambs in Jordan. Furthermore, Wiese et al. (2003) reported that increasing the dietary level of methionine as Smartamine to merino lambs did not lead to an increase in growth rate, daily feed intake, feed conversion or final body weight. In addition, Wright (1971) found that feeding methionine with animal fed low protein (8% CP) increased rate of gain and feed efficiency, but had no effect on those fed a 12% crude protein diet. This mean feeding protected methionine to sheep may cause very little effect on some traits and their effect reduced significantly with high dietary percentage of crude protein which might supply lambs with their needs of essential amino acids, such as methionine. Treatment didn't cause any significant effect on total and monthly feed intake and total feed conversion in term of concentrate and alfalfa hay (Table 3 and 4.). This finding is in disagreement with the finding of Lu and Potchoiba (1990) who reported that dry matter intake was influenced by dietary energy in a curvilinear fashion which is considered the dominant factor. But our results are consistent with the findings of Wiese et al. (2003), Baldwin et al. (1993), Wright and Loerch (1987) and Deswysen et al. (1991) in which protected methionine failed to increase feed intake, average daily gain and nitrogen retention in lambs. Furthermore, treatment did not cause any significant effect on average and relative growth (AGR and RGR) except for the first and second months for the AGR (Table 5).

Carcass yield and tissues weights

The dressing percentages and different tissues percentages (calculated of hot carcass weight) of lambs in different experimental groups are given in Table 6. Treatment did not cause any significant effect on the dressing percentages between treated groups (T1, T2 and T3) compared with the control. Wiese et al. (2003) reported that feeding lambs protected methionine as Smartamine did not improve hot carcass weight, dressing percentage which agreed with our findings. Furthermore, no significant differences between all groups in term of tissues percentages except for the spleen (P<0.001), heart (P<0.05) and lungs (P<0.05) with higher values for lambs fed high energy and protected methionine (T3) were observed. On the other hand, omental fat percentages were significantly higher for lambs from T1 group compared with the lambs from the control, T2 and T3, but the differences between the previous three groups were not significant (Table 6.). Ebrahimi et al. (2007) reported a trend of increasing fat deposition in the carcass and noncarcass parts of Mehraban lambs with feeding high dietary energy density which agreed with our findings. Moreover, the same trend was found for the back fat thickness (BFT),

Table 2: The effect of treatment on monthly and total weight gain (Kg) of growing Awassi lambs

Treatments	M1 WG[4]	M2 WG	M3 WG	Total WG
Control	9.10	5.08[a]	4.46[a]	18.25[a]
T1[1]	8.82	7.16[b]	4.07[a]	19.95[b]
T2[2]	7.97	5.59[a]	3.85[b]	18.72[b]
T3[3]	7.63	6.43[b]	5.30[c]	19.15[b]
SEM	0.481	0.64	0.39	1.21
	NS	*	*	*

Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5 g/d/head smartamine; [3]High energy+5.0g/d/head; smartamine; [4]MWG= Monthly weight gain; SEM= standard error of means; NS = not significant; $^{*}P < 0.05$.

Table 3: The effect of treatments on the monthly, total feed intake (kg) and feed conversion of growing Awassi lambs

Treatments	M1 FI[4]	M2 FI	M3 FI	Total FI	TFC
Control	47.19	50.63	38.24	139.6	7.73
T1[1]	48.05	50.1	44.92	140.17	6.45
T2[2]	50.86	45.23	41.05	137.15	8.51
T3[3]	46.58	47.37	41.06	136.76	7.53
SEM	1.01	1.37	1.60	1.81	0.46
	NS	NS	NS	NS	NS

Control: NRC requirements; [1]High energy diet; [2]high energy + 2.5 g/d/head smartamine; [3]High energy+5.0g/d/head smartamine; [4]M FI= Monthly feed intake; TFC= Total feed conversion; SEM= standard error of means; NS = not significant.

Table 4: Total concentrate and alfalfa hay consumption (kg) by growing Awassi lambs

Measure.	Control	T1[1]	T2[2]	T3[3]	SEM	Sign.
Concentrate	126.4	126.5	122.5	119.03	1.9	NS
Alfalfa hay	16.34	16.58	14.65	15.97	0.39	NS

Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5g/d/head smartamine; [3]High energy+5.0g/d/head smartamine; SEM= standard error of means; NS = not significant.

Table 5: Average (AGR) and relative growth rate (RGR) of Awassi lambs during the experiment

Measurements	Month 1	Month 2	Month 3	Overall
AGR:				
Control	0.17	0.14	0.13	0.1
T1[1]	0.19	0.13	0.14	0.13
T2[2]	0.15	0.14	0.15	0.12
T3[3]	0.14	0.12	0.12	0.12
SEM	0.01	0.01	0.02	0.01
	NS	NS	NS	NS
RGR*				
Control	0.221	0.114	0.067	0.383
T1[1]	0.239	0.130	0.075	0.588
T2[2]	0.195	0.085	0.049	0.313
T3[3]	0.200	0.132	0.085	0.496
SEM	0.0166	0.0119	0.009	0.044
	NS	NS	NS	NS

Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5g/d/head smartamine; [3]High energy+5.0g/d/head smartamine; SEM= standard error of means; NS = not significant;* RGR= Final weight at the end of each month – initial weight at the beginning of the month/ initial weight at the beginning of the month.

Table 6: Carcass parameters and tissues percentages of slaughtered Awassi lambs

Measurements.	Control	T1[1]	T2[2]	T3[3]	SEM	Sign.
Dressing (%)	51.67	52.10	52.6	52.82	0.50	NS
Liver (%)	2.57	2.38	2.34	2.66	0.07	NS
Kidney (%)	0.37	0.45	0.39	0.45	0.01	NS
Spleen (%)	0.23[a]	2.60[a]	0.21[a]	0.48[b]	0.04	***
Heart (%)	0.92[a]	0.94[a]	0.89[a]	1.11[b]	0.04	*
Lungs (%)	2.64[a]	2.4[a]	2.10[a]	2.01[b]	0.11	*
Testicls (%)	0.87	1.15	0.99	1.07	0.09	NS
Omental fat (%)	2.15[a]	3.52[b]	2.77[a]	2.64[a]	0.27	*
Back fat thickness (cm)	0.41[a]	0.59[b]	0.42[a]	0.49[a]	0.03	*

[a,b]different superscripts in a row differ significantly P<0.05 Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5g protected methionine/d/head; [3]High energy+5.0g protected methionine/d/head; SEM= standard error of means; NS = not significant; $^{*}P<0.05$; $^{***}P<0.001$.

Table 7: Cholesterol levels (mg/dl) in serum of Awassi lambs during fattening

Treatment	Cholesterol 1	Cholesterol 2	Cholesterol 3	Cholesterol 4
Control	40.43[a]	128.5	185.50	77.85[a]
T1[1]	26.20[b]	150.06	188.26	98.83[b]
T2[2]	33.69[a]	142.77	177.52	82.01[a]
T3[3]	25.87[b]	133.74	152.21	34.34[a]
SEM	2.10	16.96	11.69	5.51
P value	0.05	0.1	0.7	0.05

[a,b]different superscripts in a column differ significantly P<0.05; *Cholesterol 1= for the initial blood samples; cholesterol 2= for blood after first 4 week; cholesterol 3= blood samples after 8 weeks; cholesterol 4= after 12 weeks at slaughtering; Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5g/d/head smartamine; [3]High energy+ 5.0g/d/head smartamine; SEM= standard error of means.

Table 8: Glucose levels* (mg/dl) in blood serum of Awassi lambs during fattening

Treatment	Glucose 1	Glucose 2	Glucose 3	Glucose 4
Control	43.78	48.23	32.75	61.69
T1[1]	46.53	59.29	47.03	69.45
T2[2]	45.17	56.02	31.48	64.85
T3[3]	42.30	38.55	43.32	70.38
SEM	2.61	3.72	3.13	4.23
P value	0.15	0.21	0.21	0.15

*Glucose 1= for the initial blood samples; glucose 2= for blood after first 4 week; glucose 3= blood samples after 8 weeks; glucose 4= after 12 weeks at slaughtering; Control: NRC requirements; [1]High energy diet; [2]high energy+ 2.5g/d/head smartamine; [3]High energy + 5.0g/d/head smartamine; SEM= standard error of means.

but adding protected methionine lead to decrease the BFT when compared with the lambs from T1 which fed only dry fat. This finding agreed with Wiese et al. (2003) who reported a reduction in back fat thickness with feeding protected methionine as Smartamine. Barry (1981) reported a reduction in lamb's fat carcass as a result of abomasal infusion of casein and methionine which also supported our findings. This means feeding a by-pass methionine as a sulfur amino acid can cause a great effect on fat metabolism in term of BFT and omental fat contents. For comparison, this finding was also reported by other researchers for other species such as young chicks (Boomgaardt and Baker, 1973) and growing broiler (Takahashi et al., 1994; Bunchasak et al., 1998; Wallis, 1999).

Table 9: Protein levels* (mg/dl) in blood serum of Awassi lambs during fattening

Treatment	Protein 1	Protein 2	Protein 3	Protein 4
Control	5.49	5.61	4.66a	4.09[a]
T1[1]	5.64	5.63	5.23b	4.89[b]
T2[2]	6.15	5.70	5.34b	5.29[c]
T3[3]	5.59	5.98	4.99b	5.47[c]
SEM	0.21	0.15	0.57	0.32
P value	0.47	0.85	0.05	0.04

*Protein 1= for the initial blood samples; protein 2= for blood after first 4 week; protein 3= blood samples after 8 weeks; protein 4= after 12 weeks at slaughtering; Control: NRC requirements; [1]High energy diet; [2]high energy + 2.5g/d/head smartamine; [3]High energy +5.0g/d/head Smartamine; SEM= standard error of means

Blood Parameters

The blood serum cholesterol profile was significantly affected by treatments. At the end of experiment, for lambs from the T3 group compared with other group with general trend of higher levels for all groups that fed high energy and protected methionine (Table 7). This trend agreed with a number of previous studies which reported that feeding of fat supplements to ruminants raised the cholesterol concentration in blood serum but not in the tissues and milk (Bohman et al., 1962; Bitman et al., 1973; Nestel et al., 1973). Nestel et al. (1978) studied the effect of fat supplementation on cholesterol metabolism in sheep and goats. They reported a hypercholesterolemia that was primarily due to an increase of the intestinal biosynthesis of cholesterol and partly due to decrease cholesterol excretion of bile duct. Furthermore, treatment did not cause a significant (P>0.05) effect on glucose level in blood serum during the whole experiment (Table 8), even though, the glucose levels at the end of experiment for the lambs from treated groups were numerically higher compared with the control group. Kholif et al. (2006) reported a significant increase in glucose concentration in serum as a result of feeding protected methionine and lysine which partly agreed with our findings trend. The explanation of the trend of increasing the level of glucose in the blood serum may be due to increasing the production of volatile fatty acids (VFA's) especially propionic acid, a precursor of gluconeogenesis, as a result of feeding dry fat (Demeterova et al., 2002). The same trend was found in blood serum protein levels during the whole experimental period (Table 9). The higher levels of protein at the end of experiment agreed with the experiment conducted by Kholif et al. (2006) who reported a significant increase in serum protein levels as a result of feeding protected methionine and lysine. The increases of blood serum protein may be due to the high efficiency of methionine absorption from the small intestines as a result of their protection from rumen digestion. Moreover, our finding also agreed with Blum et al. (1999) who reported that rumen protected amino acids supplementation increased plasma amino acid concentrations.

Increasing dietary energy by using dry fat with or without protected methionine of Awassi lambs during the finishing period improve the overall weight gain. Feeding protected methionine may play an important role in fat metabolism by reducing carcass fat accumulation and blood cholesterol. In general, the requirements of energy by Awassi lambs might be higher than reported in NRC, but 16% crude protein in diet can considered being adequate for growing Awassi lambs.

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