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General Performance of Growing Shami Kids Fed High Energy and Protected Methionine

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Abstract: This experiment was carried out to evaluate the effect of high dietary energy and protected methionine (Smartamine)™ on the growth, feed intake and efficiency and mineral concentrations in blood serum and tissues of shami kids during finishing stage. Fifteen growing shami kids (3 to 4 month old) were distributed equally to three treatments groups as follow: Control (NRC requirements); T_1 (High energy 3.0 Mcal ME kg^{-1}) and T_2 (high energy 3.0 Mcal ME kg^{-1} and 5 g/head/day methionine as Smartamine). Treatment causes a significant change ($p<0.05$) on monthly and overall weight gain. Feeding shami kids high energy significantly increased weight gain, lower feed intake and consequently improve feed conversion. A significantly lower concentrate and alfalfa hay intake were reported in Shami kids fed high energy and protected methionine (T_2) when compared with kids from the control and T_1. Moreover, dressing and tissues percentages were not significantly affected ($p>0.05$) by treatment, except testicales which was significantly reduced in kids from T_2. Magnesium and Cu concentrations in meat were significantly increased ($p<0.05$) in kids fed high energy and methionine when compared with the control. On the other hand, the inorganic matter percentages were significantly reduced with feeding high energy (T_1) and high energy with methionine (T_2) when compared with the control group. In conclusion, feeding shami kid during the finishing period with high levels of energy improves the total weight gain and total feed conversion. Furthermore, methionine supplementation as Smartamine didn't affect shami kids performance, which means the energy requirements by Shami kids during finishing period is above the recommended levels in NRC for goats.

Key words: Shami kids, energy, Smartamine, minerals and tissues

INTRODUCTION

The daily nutrients requirements of ruminant animal depend on the breeds (genetic potential), age and physiological status. The most important nutrient requirements are the dietary energy and protein and their interaction which affect animal productivity (Kioumaris *et al*., 2008; Bellof and Pallauf, 2004; Haddad *et al*., 2001). The partitioning of protein, amino acids and energy between requirements for maintenance and production is the major importance to the nutrition of livestock. The requirements of ruminant animals of energy can easily be covered by feeding cereals such as corn, barley, wheat and etc. Sometimes, dry fat and oil can be used for farm animals' ration as a substitution of cereals as an energy source. Many producer concerns about using animal fat because of 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. Magnapac is one of the soap stock palm fatty acids calcium salt for animal use which introduce recently to Jordanian market. The chemical composition of Magnapac is: crude fat% = 84; Moisture% = 3.5; Ash% = 18; acid insoluble ash% = 0.5 and Ca% = 9.

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, not only 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). The primary methods of preventing ruminal fermentation of amino acids are coating with resistant materials and structural manipulation to produce analogs. Amino acids have been coated with formalized protein, fat, mixture of fat and calcium and chelated amino acids. Smartamine™ is a new product introduced to the market as a protected Methionine (Adessio-France). On the other hand, using dry fat (high calcium and ash percentages) and protected methionine (sulfur amino acid) may affect the bioavailability of other minerals. Studying the negative or positive effect is necessary by measuring the accumulation of minerals in blood serum and tissues as a reliable indication (Underwood and Suttle, 1999).

National Research Council (NRC, 1981) for goats requirements identified ouly the quantities of crude protein for growing kids for international breeds at different age, but not the quantities of the essential amino acids such as methionine and lysine. Moreover, the expression of AA requirements as a ratio to energy didn't exist which may be particularly useful for ruminants, because microbial protein production is related to the intake of fermental energy (Rohr *et al*., 1986; Sniffen and Robinson, 1987; Clark *et al*., 1992). Unfortunately, no data available regarding the AA and energy requirements for our local goats breeds.

Because of that, the goal of this experiment was conducted to estimate the energy and protein requirements for growing shami kids by using dry fat (Magnapac) and protected methionine supplementation as Smartamine™.

MATERIALS AND METHODS

Kids Trail Conditions, Management and Sampling

Fifteen growing shami kids, 3 month old and 26.1±2.2 kg initial body weight, were used in this experiment. Kids were individnally housed at Mu'tah University research station, from April to July 2005 and injected sub-cutaneously with 2 mL enterotoxaemia vaccine. The shami kids were divided into three groups and each kid in separate pen. The dietary treatments were as follow: Control (C; NRC requirements); T_1 (High energy 3 Mcal ME kg^{-1}) and T_2 (high energy 3 Mcal ME kg^{-1} and 5 g/head/day methionine as Smartamine). A 14 days adjustment period was used for kids adaptation to new feed and facilities. Kids were treated according to animal welfare regulations of Mu'tah University, Deanship of Academic Research, Jordan.

Dry fat (Magnapac™) usnally use for increasing the energy contents of concentrate diets. The nutritive values of Magnapac (Norvel-Misr-Egypt) were: crude fat% = 84; Moisture% = 3.5; Ash% = 18; acid insoluble ash% = 0.5 and Ca% = 9.

Moreover, kids were fed the assigned diets for 12 weeks. All kids were bled at the beginning of the experiment and every 4 weeks via the jugular vein. Blood samples centrifuged at 3000 rpm for 15 min and serum was separated (AOAC, 1990). Serum samples were stored at -20 Co until analysis. Feed intake was recorded daily and body weight every 4 weeks. At the end of experiment, all kids were slaughtered and tissues samples were collected (liver, kidney, spleen and meat) and omental fat were collected for further analysis. After slaughtering, hot carcass weights for all slaughtered kids were recorded to determine dressing percentage.

Blood serum was treated with 10% trichloroacetic acid (1:4) and tissues samples were wet digested with acids and prepared according to Association of Official Analytical Chemists (1990) for mineral concentrations analysis using Atomic Absorption Spectrophotometery (AAS; Perkin-Elmor, 1981).

Data were analyzed by using SPSS™ version (10.0) as a Complete Randomized Design (CRD). The Duncan multiple range test was used to determine differences among treatments means for significant dietary effect (Steel and Torrie, 1980), with $p<0.05$ considered statistically significant unless otherwise noted. The linear model was:

$$Y_{ij} = \mu + t_i + E_{ij}$$

Where:

Y_{ij} = Dependent variable
μ = Overall mean
t_i = Effect of dietary treatments (high energy and high energy with protected methionine)
E_{ij} = Random error associated with observations

RESULTS AND DISCUSSION

General Performance of the Shami Kids

The ingredients and the chemical composition of diets fed to the growing Shami kids were shown in Table 1. These diets formulated according to National Research Council (1981) to cover their nutrients requirements. In order to increase the metabolizable energy to 3 Mcal kg^{-1}, dry fat (Magnapac™) was added. On the other hand, protected methione as Smartamine™ was added with high level (5 g/head/day) as a source of methionine as a most limiting amino acid for growth (Shan *et al*., 2007) which fed to kids as top dressing to concentrate ration of treatment diet.

Table 2-5 show the effect of feeding Shami kids finishing diets contain high energy or high energy with protected methionine (5 g/head/day) on their general performance in term of body weight gain, feed intake, feed conversion and dressing and tissues percentages. The group of kids that fed high energy (T_1) showed a significantly higher total weight gain compared with the control and T_1 (16.75 vs 15.62 and 14.56 kg, respectively) with lower total feed intake and feed conversion (103.74 kg and 5.56, respectively). This finding is in agreement with the principle that in ruminants, feed intake is regulated by dietary energy density. Lu and Potchoiba (1990) reported that dry matter intake was influence by dietary energy in a curvilinear fashion which considered the dominant factor. 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

Table 1: Ingredients composition of diets (As fed)

Ingredients	Control (NRC, 1981 recommended ME energy)	T (high ME energy diet for T_1 and T_2)
Corn	10.00	5.00
Barley	61.40	62.40
Soybean meal	0.00	1.00
Wheat bran	12.00	12.00
Alfalfa hay	15.00	15.00
Dry fat (Magnapac)	0.00	3.00
$CaCO_3$	1.00	1.00
Salt	0.50	0.50
Mineral and vitamins premix[3]	0.10	0.10
Chemical composition		
Crude protein (g kg^{-1} DM)	141.54	141.90
Metabolizable energy (Mcal kg^{-1} DM)	2.82	3.00
Calcium (g kg^{-1} DM)	8.83	9.12
Phosphorus (g kg^{-1} DM)	4.63	4.53
Ca:P ratio	1.91	2.01

[1]Minivit-Forte, VAPCo, each 1 kg contains: Cu sulphate = 9.417 mg, Fe sulphate = 85 mg, Mg sulphate = 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

Table 2: The effect of treatment on the monthly and total weight gain (Kg), feed intake and feed conversion of Shami kids

Treatments	M[3]1 WG[4]	M2 WG	M3 WG	Total WG	TFI[5]	TFC[6]
Control	5.46	6.65	3.50	15.62	113.54	7.300
T11	5.96	5.03	6.10	16.75	103.74	5.560
T22	4.08	4.43	4.89	14.65	88.32	6.210
SEM	0.57	0.61	0.77	1.03	5.31	0.411
Significancy	*	*	*	*	*	*

Control: NRC requirements; [1]High energy diet; [2]High energy+5.0g/d/head smartamine; [3]M = Monthly weight gain (M1 = First month; M2 = Second month; M3 = Third month). [4]WG = Weight gain. [5]TFI = Total feed intake. [6]TFC = Total feed conversion; SEM = Standard error of means; *$p<0.05$

performance. Haddad (2005) reported an increase in average body gain, feed efficiency and carcass characteristics of Jordanian Baladi kids with increasing the dietary energy up to 2.9 Mcal ME kg^{-1} DM which agreed with this findings with Shami kids. The same trend was reported by Kioumaris *et al.* (2008) who reported an improvement of performance of Taleshi lambs with feeding high energy. The explanations of this general trend is high dietary energy help to produce 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 kids from group T_1 can be considered as an acceptable limit to cover the requirements without the negative effect on the performance in term of weight gain and feed intake. On the other hand, kids from T_2 group which fed high energy and methionine showed a lower feed intake and total weight gain (88.32 and 14.65 kg, respectively). The only explanation of this finding is feeding methionine and high energy negatively affects the feed intake and utilization of dietary nutrients and consequently affects performance. Wiese *et al.* (2003) found 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) reported 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% CP diet. Atti *et al.* (2004) suggested that the optimum crude protein level in growing goats' concentrate for maximizing performance is approximately 130 g kg^{-1} and any increase above this level seems not to improve their performance. This mean feeding protected methionine to goats cause very little effect on some traits and their effect reduced significantly with high dietary percentage of crude protein. It is clear that feeding growing shami kids 14% crude protein as recommended by National Research council (NRC, 1981) to cover their requirements of protein and no need for supplementation. A significantly lower concentrate and alfalfa hay intake were reported in shami kids fed high energy and protected methionine (T_2) when compare with kids from the control and T_1 (Table 3). Moreover, Table 4 shows that 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. Moreover, dressing and tissues percentages were not significantly affected ($p>0.05$) by treatment, except testicales which was significantly reduced in kids from T_2 (Table 5). Wiese *et al.* (2003) reported that feeding lambs protected methionine as Smartamine did not improve hot carcass weight, dressing percentage which completely agreed with our findings. Similar trend was reported by Shiran (1995) for dressing percentage of lambs fed different levels of energy.

Trace Mineral Concentration in Blood Serum and Tissues

Trace mineral bioavailability is very critical issue regarding farm animal health and productivity. The trace mineral bioavailability from different sources can be affected by many factors including animal species, physiological state, previous feeding and nutrition, positive and negative interaction with dietary nutrients and ingredients and chemical form and solubility of the mineral element (Ledoux and Shannon, 2005). Some animal tissues such as liver, kidney, blood etc are very sensitive to change in dietary minerals in term of deficient and toxic levels (Underwood and Suttle, 1999). In this study, trace mineral concentration were measured to evaluate the effect of feeding the dry fat (high calcium content) and protected methionine (sulfur amino acid) on the bioavailability of

Table 3: The effect of treatments on concentrate and alfalfa hay intake by shami kids during the experiment

Measure	Control	T1[1]	T2[2]	SEM	Sign.
Concentrate	97.3	89.8	72.4	5.59	*
Alfalfa hay	16.2	16.4	15.8	0.09	*

Control: NRC requirements; [1]High energy diet; [2]High energy+5.0 g/d/head smartamine; SEM: Standard Error of Means *p<0.05

Table 4: Average (AGR) and relative growth rate (RGR) of shami kids during the experiment

Measure	Month 1	Month 2	Month 3	Overall
AGR (kg day^{-1})				
Control	0.196	0.237	0.125	0.185
T1[3]	0.212	0.189	0.213	0.201
T2[4]	0.113	0.106	0.099	0.105
SEM	0.020	0.025	0.030	0.022
Significancy	*	*	NS	NS
RGR				
Control	0.193	0.164	0.080	0.552
T1[3]	0.249	0.139	0.162	0.680
T2[4]	0.135	0.097	0.082	0.390
SEM	0.022	0.015	0.019	0.068
Sig.	NS	NS	NS	NS

Control: NRC requirements; [1]AGR = Final monthly weight (kg)- initial weight (kg)/period (days); [2]RGR = Final monthly weight (kg)- initial weight (kg)/initial weight (kg); [3]High energy diet; [4]High energy+5.0g/d/head Smartamine; SEM = Standard error of means; NS = Not Significant; *p<0.05

Table 5: Dressing and different tissues percentages (of hot carcass eight) of slaughtered Shami kids

Measure	Control	T_1[1]	T_2[2]	SEM	Sign.
Dressing	48.730	49.130	47.930	0.570	NS
Liver	4.110	4.120	3.940	0.130	NS
Kidney	0.593	0.640	0.643	0.021	NS
Spleen	0.360	0.496	0.473	0.040	NS
Heart	1.170	1.020	1.130	0.034	NS
Lungs	2.630	2.790	3.020	0.117	NS
Testicals	1.670	1.730	1.450	0.075	*
Omental fat	3.950	4.120	4.160	0.184	NS

Control: NRC requirements; [1]High energy diet; [2]High energy+5.0g/d/head smartamine. SEM: Standard Error of means; NS: Not Significant; *p<0.05

Table 6: The effect of high energy intake and methionine supplementation on trace mineral concentration in blood serum of finishing shami kids

Concentration of metals (μg mL^{-1})	Control	T_1[1]	T_2[2]	SEM	Sign.
Mg					
Initial	37.76	36.74	31.48	1.58	NS
Final	32.61	31.71	35.68	1.66	NS
Cu					
Initial	0.76	0.81	0.94	0.06	NS
Final	1.31	1.05	1.07	0.05	NS
Zn					
Initial	1.53	1.51	1.48	0.14	NS
Final	1.95	2.73	1.51	0.35	*
Co					
Initial	0.19	0.14	0.15	0.01	NS
Final	0.11	0.12	0.12	0.01	NS

Control: NRC requirements; [1]High energy diet; [2]High energy +5.0 g/d/head smartamine. SEM: Standard Error of Means; NS: Not Significant; *p<0.05

magnesium (Mg), 7 copper (Cu), cobalt (Co), zinc (Zn) and iron (Fe) which can be reflected by their concentrations in tissues.

Treatments did not cause any significant (p>0.05) effect on Mg, Cu and cobalt concentration in the blood serum at the end of the experiment (Table 6). On the other hand, treatment caused a significant increase (p<0.05) in the concentration of Zn at the end of the experiment compared with the initial blood at the beginning. The Zn concentration were higher for kids fed high energy (T_1) followed by the control and finally the kids from T_2 which fed high energy and methionine (2.73 vs 1.95 and 1.51 μg mL^{-1}, respectively).

Magnesium and Fe concentrations in meat were significantly ($p<0.05$) increased in kids fed high energy (T_1) and energy with methionine (T_2) when compared with the control. Copper concentrations in meat of kids from T_1 were significantly ($p<0.05$) lower when compared to the control and T_2 kids with significantly higher values for the kids from T_2 which fed high energy and methionine. On the other hand, the inorganic matter percentages were significantly reduced with feeding high energy (T_1) and high energy with methionine (T_2) when compared with the control group (Table 7). A significantly higher levels of magnesium were found in spleen of shami kids from T_2 group compared with other groups, but the inorganic matter percentages were significantly ($p<0.05$) higher for kids from T_1 compared with the control and T_2 kids (Table 7). The same trend regarding the inorganic matter

Table 7: The effect of treatment on the trace mineral concentrations (μg g^{-1} DM basis), dry and inorganic matter percentages of Shami kids tissues in

Minerals	Control	T_1[1]	T_2[2]	SEM	Sign.
Meat					
Mg	15.67	31.42	42.95	5.96	*
Co	4.14	7.82	7.47	0.89	NS
Cu	7.64	4.47	12.50	1.58	*
Zn	93.89	96.30	65.83	10.70	NS
Fe	24.62	49.11	77.61	10.82	*
Dry matter (%)	32.17	29.58	32.18	1.16	NS
Inorganic (%)	1.46	0.77	0.83	0.22	*
Spleen					
Mg	23.33	16.92	44.11	5.46	*
Co	4.86	8.69	3.72	1.27	NS
Cu	8.39	6.38	13.29	1.73	NS
Zn	50.01	55.68	54.08	3.93	NS
Fe	250.94	234.82	131.67	39.84	NS
Dry matter (%)	31.01	27.50	25.46	2.82	NS
Inorganic (%)	1.06	1.33	0.96	0.07	*
Kidney					
Mg	26.75	29.18	39.91	4.44	NS
Co	5.31	7.69	4.32	0.54	**
Cu	14.87	9.95	12.51	1.09	*
Zn	62.92	29.73	38.54	7.14	*
Fe	88.21	78.19	61.24	14.68	NS
Dry matter (%)	31.72	29.98	30.28	1.10	NS
Inorganic (%)	0.97	1.24	0.88	0.07	*
Lungs					
Mg	17.51	14.41	29.39	1.82	*
Co	2.84	9.19	6.98	1.26	*
Cu	6.43	10.69	8.24	1.34	NS
Zn	43.17	61.84	47.17	2.40	NS
Fe	147.97	231.78	188.45	27.86	NS
Dry matter (%)	31.53	26.14	28.72	2.12	NS
Inorganic (%)	1.17	1.05	1.06	0.101	NS
Testicales					
Mg	22.12	53.65	48.39	6.52	*
Co	3.34	11.26	5.94	1.91	*
Cu	8.75	5.50	12.99	1.76	*
Zn	55.50	79.42	46.91	11.08	NS
Fe	58.61	54.77	49.54	6.55	NS
Dry matter (%)	23.29	18.85	25.51	2.18	NS
Inorganic (%)	0.99	1.14	1.29	0.09	NS

Control: NRC requirements; [1]High energy diet; [2]High energy +5.0 g/d/head smartamine. SEM: Standard Error of Means; NS: Not Significant; *$p<0.05$

percentages were reported in kidneys. Further more, treatment caused a significant effect on Co, Cu and Zn. Significant higher values of Co concentrations in kidneys from kids from T_1 were detected when compared with the control and T_2 groups, but lower Cu concentrations were found in kidneys of kids from the T_1 and T_2 groups compared with the control. Moreover, Zn concentrations in kidneys of kids from the control group were significantly higher compared with the treated groups (Table 7). Furthermore, feeding shami kids high energy and methionine (T_2) caused a significant increase ($p<0.05$) of Mg concentrations in lungs and reduced Co level when compared to the kids from the control and T1 (Table 7).

Testicales' Mg, Co and Cu concentrations were significantly affected by treatments as shown in Table 7. Magnesium levels significantly increased with feeding kids high energy with or without methionine, but for cobalt the highest levels reported for kids testicales which fed high energy when compared to the control and T_1 groups. Moreover, feeding shami kids high energy and methionine caused a significant increase in Cu concentrations in testicals when compared to the control and T_1 groups.

Unfortunately, there is no available information in the literature regarding effect of feeding dry fat (high calcium content) and protected methionine (sulfur amino acid) on trace minerals content in ruminants. Few studies ouly focus on the increasing the dietary Ca relative to P above 1:7 or decreasing below 1:1 Some researchers reported an increase in fecal excretion of Mn and Zn in sheep with increasing Ca% from 1 to 2%. Thus, high dietary calcium may be responsible for reducing availability of Cu, Mn and Zn and influence availability of Mg (Verdaris and Evans, 1975). The results of this experiment showed a significantly change in term of increasing and decreasing of trace minerals concentration in the different tissues, but all values were within the normal levels according to Puls (1990). This means the magnitude of the effect of feeding the dry fat and the protected methionine on the Mg, Co, Cu, Zn and Fe in different tissues is relatively small since the C:P ratio within the recommended level.

CONCLUSION

Feeding shami kid during the finishing period with high levels of energy improves the total weight gain and total feed conversion. Furthermore, methionine supplementation as Smartamine didn't affect shami kids performance, which means the energy requirements by shami kids during finishing period is above the recommended levels in the National Research Council (NRC, 1981), nutrient requirements of goats. More research is needed to explain the changes in minerals concentrations in different tissue as a result of different treatments.

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