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The Effect of Dietary Levels of Zinc-Methionine on the Performance of Growing Awassi Lambs

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Abstract: Twenty lambs were used in this experiment to determine the effect of zinc methionine on productive performance of growing Awassi lambs. The lambs were divided to five groups, the dietary treatments were the control diet (C), the control diet plus zinc oxide (ZnO), the control diet plus (0.1 g h^{-1} d^{-1} (Z1)), (0.2 g h^{-1} d^{-1} (Z2)), (0.3 g h^{-1} d^{-1} (Z3)) zinc methionine. Although there is no significant differences between the groups in the daily gain and feed conversion but the growth rate of Z1 and Z3 were higher than C and values of feed conversion of ZnO, Z2 and Z3 were higher than C. The growth rate in the last three weeks for the lambs of Z3 group is higher than the other groups but the differences were not significant. There are no significant differences ($P< 0.05$) between C, ZnO and Z3 groups in dressing percentage and carcass measurements; but the back weight in ZnO group was higher ($P< 0.05$) than it in the C group. The concentration of Zn in (spleen, liver, heart, lung and kidney) in the groups of C, ZnO, Z3 was not affected by treatment but its concentration in meat was significantly ($P< 0.05$) lower in ZnO group than C group. The differences between ZnO, Z3 and C groups in the concentration of Cu in (meat, spleen, heart, lung, kidney) were not significant but the concentration of Cu in the liver of Z3 group lambs was significantly lower ($P< 0.05$) than C and ZnO groups. The concentration of Zn and Cu in the blood of all group lambs did not significantly differ. The results suggest that the dietary Zinc methionine supplementation may enhance the growth rate of growing Awassi lambs especially in the last period of finishing. Moreover it appears that Zn from ZnO or Zinc methionine is absorbed to a similar extent, but may be metabolized differently after absorption.

Key words: Awassi lambs, productive performance, dietary

Introduction

The small ruminants contribute around 14000 tons out of 17000 tons of red meat produced in Jordan (FAO, 1994). Lamb fattening has a great potential to make a significant contribution to red meat production and reducing the imported amounts of red meats. The most important requirements are energy and protein. The requirements of ruminant animals of energy can easily be covered by feeding them cereals such as corn, barley, wheat and etc. However, covering their needs from protein is very complicated because of the ruminal degradation of protein and the high demand for specific amino acids. 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).

Zinc (Zn) is widely distributed throughout the animal body and plays an important role in many metabolic processes. Many enzymes systems, which are concern with the utilization and metabolism of feed constituents, require Zn for proper functioning both as a part of the molecule and as an activator. Zinc is required for normal protein synthesis and metabolism. Zinc stabilizes the structure of RNA, DNA and ribosomes (Prask and Plocke, 1971). Early deficiency of Zn in ruminant animals include reduce of feed intake, growth rate and feed efficiency (McDowell *et al*., 1993). There is also research evidence the important of Zn on the efficiency of utilizing of absorbed amino acids in protein synthesis for growing lambs and calves (McDowell, 1995). Underwood (1981) reported that Zn deficiency is most apparent when cells are rapidly divided, growing and synthesizing. As a result, growth activities, reproduction efficiency and milk production may be reduced and impaired by inadequate dietary Zn levels.

Zinc methionine and zinc lysine are introduced to the market as chelated mineral and protected amino acids. Hatfield and others (1995) studied the effects of dietary crude protein percentage and supplemental zinc methionine on the performance of pregnant Targhee ewes at prepartum and postpartum. They reported that ewes fed 14.9% crude protein and supplemental with zinc methionine showed a significant improvement on the

ewes dry matter intake (DMI), average daily gain (ADG) and milk production. Moreover, their average daily gain (ADG) and weaning weights were significantly improved with the treatment, also (Berthour, 1984) reported that adding zinc methionine to steers diets improve growth performance and carcass characteristics So, a research to study the effect of supplemental zinc methionine on the performance of Awassi lambs is needed in Jordan.

National research council (NRC, 1985) identified only the quantities of crude protein for growing lambs and at different age, but not the quantities of the essential amino acids such as methionine and lysine as protected amino acids. Because of that, this study was conducted to determine the effect of addition of three levels of protected source of methionine as a Zn-methionine and Zinc oxide on the growth rate, feed efficiency and zinc concentration in the blood, meat and internal organs of growing Awassi lambs.

Materials and Methods

This study was conducted at AL-Khanasry Research Station during the period between March and June (2000). Twenty Awassi weaned lambs were individually housed at separated pens and injected sub-cutaneously with 2 mls enterotoxemia vaccine. Lambs were divided randomly to five groups. The control diet (C) consisted of barley (65), soybean meal (10), wheat bran (8), alfalfa hay (15), lime stone (0.9), salt (1) and vitamins and minerals (0.1%). The diet of the other groups consist of C plus zinc oxide (ZnO), C+0.1g h^{-1} d^{-1} zinc methionine (Z1), C+0.2g h^{-1} d^{-1} zinc methionine and C+0.3 g h^{-1} d^{-1} zinc methionine (Z3). The ZnO diet contains the same level of zinc in Z3 diet. Lambs were fed these diets for 15 weeks. All lambs were bled at the beginning of the experiment and every 4 weeks via the jugular vein. Blood samples were centrifuged at 3000 ppm for 15 min. and serum was separated. Serum samples were stored at –20°C until analysis. Feed intake was recorded daily and body weight was recorded at the beginning of experiment and every week. At the end of experiment, 9 lambs from the control, zinc oxide and zinc methionine (Z3) groups were slaughtered (three lambs of each group) and tissue samples (kidney, lung, heart, spleen, liver and meat) were collected for analysis. After slaughtering hot carcass weights were recorded to determine dressing percentage, carcass parts weights (back, rack, shoulder and thigh) were recorded. Moreover, weights of body weight, head, leather, rumen, tail and testis were recorded.

Blood serum, meat, kidney, heart, lung and spleen samples were prepared according to AOAC (1990) and analyzed for Zn and Cu concentrations.

Statistical Analysis: Data were analyzed using the GenStat, (2000) program with repeated measurements. LSD test were used to compare the means.

Results and Discussion

Table 1 shows initial weight, final weight, daily growth rate and feed conversion did not significantly differ between treatments. The initial weight for all experiment lambs was 25±0.55, although there is no significant difference between the groups in feed conversion but it is noticed that the feed conversion for all of ZnO, Z2 and Z3 groups were higher than C group, also daily growth rate of Z1 and Z3 were higher than it in control group. These results are in agreement with Spears (1989), which found that growth performance did not differ between heifers fed zinc oxide and that receiving zinc methionine, but it tended to be higher for zinc methionine treatment. Also Greene (1988) found that average daily gain and feed efficiency were not affected by feeding zinc oxide or zinc methionine to Angus steers. Stbart *et al.* (1987) reported that lambs did not observe any differences in live weight gain or feed efficiency between animals fed zinc methionine and those fed control diet. Zinc methionine did not improve the performance and feed conversion when added to lambs diet (Phillips, 1990). Also Kegley, *et al.* (1995) found that average daily gain tends to be greater for lambs fed zinc methionine supplementation diet (0.29 vs 0.27 kg day^{-1}) but the differences were not significant. Conversely, Spears and Samsell (1986) found that feeding heifers corn silage-based diet and 25 mg Zn as zinc methionine increase the gain and feed efficiency more than control. According to the data in Table 2 there is no effect of using zinc oxide or zinc methionine on enhancing growth, but the growth rate in the last three weeks for the lambs of

Table 1: Initial weight, final weight, daily gain, total intake, feed conversion, of Awassi lambs fed different levels of zinc methionine or zinc oxide

Treatment	Initial weight (kg)	Final weight (kg)	Daily gain (gm)	Feed intake (kg)	Feed conversion
Control	26.0±1.3	51.3±1.3	244±4.6	147±3.1	5.9±0.2
ZnO	25.9±1.3	50.9±3.3	241±21.4	151±2.3	6.2±0.7
Zinc meth (Z1)	24.8±1.6	51.0±0.5	252±17.2	149±4.9	5.8±0.5
Zinc meth (Z2)	25.1±1.2	50.8±2.5	244±36.4	148±4.3	6.1±0.8
Zinc meth (Z3)	24.5±1.4	48.1±2.2	247±9.5	148±2.4	6.3±0.4

Table 2: Daily weight gain (gm/d) taken after every 3 weeks

Mean±SE of Treatment	Time 1	Time 2	Time 3	Time 4	Time 5
Control	232±27	250±17	318±22	255±32^{ab}	150±18
Zinc oxide	210±42	248±50	265±53	278±31^{ab}	188±28
Zinc meth (Z1)	263±47	263±15	287±30	227±15^{ab}	210±23
Zinc meth (Z2)	247±64	273±35	230±79	313±53^{a}	150±10
Zinc meth (Z3)	220±21	263±48	263±74	190±31^{b}	223±90

Values in columns with different letters are significantly ($P<0.05$) different

Table 3: Measurements of some carcass parts of Awassi lambs fed high zinc methionine, zinc oxide and control diets

Treat Measurements	Control	ZnO	Zinc meth (Z3)
Dressing percentage %	53.27±1.12	50.57±0.35	48.90±2.21
Back (kg)	1.27±0.03^{b}	1.87±0.12^{a}	1.56±0.15^{ab}
Body wt (kg)	55.33±1.67	48.67±3.67	49.67±2.03
Carcass wt (kg)	27.10±0.74	26.63±1.23	24.97±1.18
Head (kg)	2.80±0.23	3.00±0.12	2.63±0.30
Heart (gm)	187.27±12.25	200.17±23.81	190.17±10.13
Kidney (gm)	200.50±16.54	265.43±8.75	255.13±39.15
Leather (gm)	6.50±0.44	6.27±0.29	6.20±0.12
Liver (gm)	837.07±13.49	890.53±28.77	866.00±16.31
Lung (kg)	0.73±0.07	0.67±0.07	0.77±0.07
Rack (kg)	0.77±0.03	0.90±0.08	0.77±0.06
Rumen (kg)	1.37±0.09	1.18±0.16	1.07±0.24
Shoulder (kg)	3.47±0.09	3.57±0.06	3.63±0.19
Spleen (gm)	73.73±1.35	73.00±7.26	76.07±7.30
Tail (kg)	4.90±0.75	4.33±0.92	3.20±0.25
Testis (gm)	239.47±34.31	327.13±36.93	305.30±26.42
Thigh (kg)	4.00±0.0	3.68±0.10	3.57±0.15

Values in rows with different letters are significantly (P<0.05) different

Table 4: Concentration of Zinc and Copper (ppm) in various tissues as dry matter basis

	Control (C)	Zinc oxide (ZnO)	Zincmeth(Z3)
Liver			
Cu	2.63±0.41^{a}	2.90±0.25^{a}	1.78±0.18^{b}
Zn	1.62±0.05	1.67±0.17	1.54±0.03
Kidney			
Cu	0.34±0.03	0.50±0.09	0.38±0.05
Zn	1.15±0.12	1.43±0.08	1.24±0.09
Meat			
Cu	0.22±0.08	0.09±0.00	0.31±0.17
Zn	1.72±0.22^{a}	1.03±0.07^{b}	1.53±0.10^{a}
Spleen			
Cu	0.27±0.01	0.25±0.03	0.33±0.04
Zn	1.57±0.10	1.37±0.13	1.56±0.09
Heart			
Cu	0.44±0.02	0.03±0.06	0.42±0.05
Zn	1.22±0.06	1.33±0.20	1.30±0.08
Lung			
Cu	0.43±0.10	0.44±0.11	0.58±0.07
Zn	1.36±0.09	1.62±0.21	1.47±0.06

Values in columns with different letters are significantly (P<0.05) different

Z3 group is higher than the other groups so the effect of zinc methionine on improving growth rate may appear in the late time of fattening.

Dressing percentage, carcass measurements and weights of kidney, lung, heart, spleen, liver and head are presented in Table 2. The dressing percentages were (53.27, 50.57 and 48.9 kg) for C, ZnO and Z3 groups respectively but the differences were not significant. There are no significant differences between the groups in the internal organs weights and carcass measurements except the back weight, which is 1.87 kg in ZnO group, which is significantly higher than it in C group (1.3 kg). Although the back weight of Z3 (1.56 kg) was higher than C group but the differences were not significant between this group and the other groups (C, ZnO). Haryanto *et al.* (1994) reported that slaughter weight, carcass yield, carcass percentage and carcass linear measurement did not differ between control and zinc methionine treatment.

Averages for Zn and Cu concentration in tissues of lambs are presented in Table 3. The concentrations of Cu in the meat were (0.226, 0.097 and 0.315 ppm) for C, ZnO and Z3 respectively but the differences were not significant. Zn concentration in the meat of ZnO group was 1.032 ppm, which is significantly lower than C group (1.721 ppm). Zn and Cu concentration in spleen for ZnO group were 0.253 and 1.37 ppm for Zn and Cu respectively which is lower than control group (0.279 and 1.577 ppm) and Z3 group (0.337 and 1.565 ppm) but the differences were not significant.

It is noticed in Table 3 that the concentration of Cu in the liver of Z3 group lambs was significantly lower (1.783 ppm) than it in C group (2.638 ppm) and ZnO group (2.906 ppm). Although Zn concentration in the liver of Z3 group lambs was lower (0.154 ppm) than it in the other groups (1.622 and 1.67 ppm) for C and ZnO groups respectively but the differences were not significant, The concentration of Cu in the heart of ZnO and Z3 lambs were lower (0.311 and 0.429 ppm) than its concentration in C group (0.447 ppm) but the differences were not significant. On the other hand the concentrations of Zn in the heart of ZnO and Z3 group were (1.334 and 1.304 ppm) which are higher than it in the control group (1.229 ppm) but the differences also not significant.

As shown in Table 4 the concentration of Cu in the lung of Z3 lambs was higher (0.582 ppm) than it in ZnO (0.444 ppm) and C (0.433 ppm) but the differences were not significant. The concentration of Zn in the lung of ZnO group lambs was higher (1.62 ppm) than it in Z3 (1.478 ppm) and C group (1.362) but the differences were not significant. It was found that the concentration of Cu and Zn in ZnO group was (0.503 and 1.431 ppm) which is higher than in Z3 group (0.389 and 1.245 ppm) and C group (0.34 and 1.153 ppm) without significant differences between them.

There is no significant effect of feeding zinc methionine or zinc oxide on concentration of Cu in the blood of lambs through the period of experiment Fig. 1. Also zinc concentration did not affected by the treatments Fig. 2. Greene *et al.* (1988) and Spear *et al.* (1998) found that serum zinc concentration did not affected by adding zinc oxide or zinc methionine to the diets of steers and lambs. But Huerta *et al.* (2002) reported that supplementation steers with zinc methionine had greater concentration of zinc in liver and plasma than steers in control. Also it's found that supplementation of Angora goat diet with zinc methionine increase plasma zinc concentration compared to control group but there is no differences in zinc concentration zinc mthionine and zinc oxide treatments, Puchala *et al.* (1999).

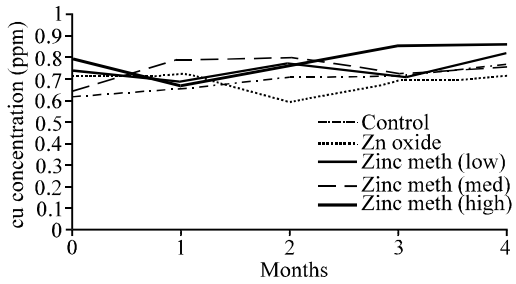

Fig. 1: Copper concentration in blood serum

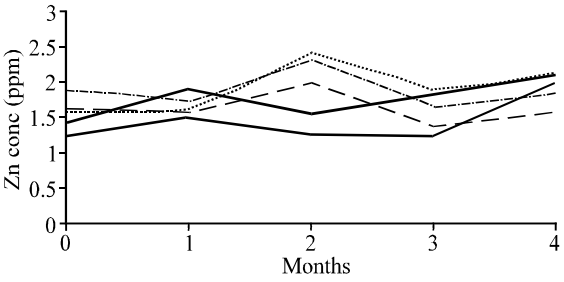

Fig. 2: Zinc concentration in blood serum

As shown in Fig. 1 and 2 the concentrations of zinc and cupper in the blood serum of lambs of (Z3) treatment increased in the last three weeks of experiment and this may explain the increase of the growth rate in this group in the last three weeks.

The concentrations of Copper (ppm) in the blood serum rangedbetween 0.62±0.05-0.77±0.07, 0.59±0.19-0.72±0.08, 0.69±0.08-0.82±0.05, 0.72±0.08-0.80±0.06 and 0.67±0.04-0.86±0.08 for control, ZnO, Z1, Z2 and Z3 respectively. The normal level of Cu in sheep blood serum range between 0.7 to 1.5 ppm which mean that all the concentrations of Copper in the blood serum through the experiment period for all treatments were within the normal levels.

The concentration of Zinc in blood serum ranged between 1.6±0.25-2.3±0.18, 1.6±0.18-2.4±0.18, 1.3±0.3-2.0±0.05, 1.4±0.15-2.0±0.06 and 1.4±0.45-2.1±0.3 for Control, ZnO, Z1, Z2 and Z3 respectively, whereas the normal level of Zinc in sheep blood serum ranged between 0.8 to 1.2 ppm which means that the concentrations of Zinc in the blood serum of all treatments through the experiment period were higher than the normal levels and this may explain the effect of Zinc methionine did not appear clearly.

Conclusion: it appears from the blood for Zinc concentration that Zinc absorped similarly from the inorganic source (ZnO) and organic source (Zinc methionine), but may be metabolized differently after absorption because of differences in their concentration in some tissues. Moreover growing Awassi lambs may required more methionine for the last stage of finishing (age of 5 months)

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