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Growth Efficiency and Trace Mineral Status of Growing Awassi Lambs Fed Two Levels of Zinc Methionine

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ABSTRACT

Eighteen growing Awassi lambs were used in this study to determine the effect of supplementing two levels of protected Zinc-methionine (Zn-met) on their growth rate, trace minerals concentrations and growth performance. The lambs were divided to three groups, the dietary treatments were the control diet (C), the control diet plus 400 mg Zn-met/ kg feed (T1), the control diet plus 800 mg Zn-met/ kg feed (T2). The lambs received 200 mg/ lamb/ day and 400 mg/ lamb/ day for T1 and T2, consequently. Lambs general performance were recorded and mineral concentrations in blood, liver, kidney, bone and meat were analyzed using Atomic Absorption Spectrophotometery (AAS).

Results show a significant higher (P<0.05) total gain, average daily gain and lower feed conversion ratio in lambs from T1 compared with lambs from the control and T2 groups. No significant effect (P>0.05) of Zn-met supplementation on total feed intake and dressing percentage. Significant effects (P<0.05) of treatment and treatment×time interaction on Cu, Co and Mn concentrations in blood serum were detected, but no effect on Zn concentrations. Moreover, lambs received 200-mg/ day Zn-met showed a significantly higher (P<0.05) Cu, Zn and Co concentrations in liver and only Zn in kidney when compared with the control and T2. Zinc, Cu and Co concentration in meat of lambs from T2 (400 mg/ lamb/ day Zn- met) were significantly higher (P<0.05) when compared with lambs from the control and T1.

In conclusion, feeding growing Awassi lambs methionine in a form of Zn-met, with a low level of 200 mg/ lamb/ day, improved growth and utilization of dietary Cu, Zn and Co by growing lambs and consequently increased profit.

Keywords: Awassi Lambs, Growth, Zinc Methionine, Tissues and Minerals.

1. INTRODUCTION

In ruminants, levels of the amino acids supplied to the small intestinal tract are the most limiting factors for protein synthesis and therefore the growth rate of growing ruminant animals (Merchen and Titgemeyer, 1992; Sloan, 1997). Nitrogen metabolism in the rumen and reticulum has an important role on the quality and quantity of amino acids absorption in the small intestinal tract through the Microbial Protein (MP) and Undegradable Protein (UP) (Kung and Rode, 1996). Since microbial protein supply only 40 to 80% of the daily amino acids requirements (Sniffen and Robinson,

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1987), the level of UP is very crucial source for the rest of essential amino acids required for maximizing the growth rate of growing ruminant animals.

Storm and Orskov (1984) and Nolte et al. (2004) reported that Methionine is the first limiting amino acid in the microbial protein that may limit the growth of lambs. Therefore, protected amino acids supplementation is required to improve growth rate and performance of growing lambs. Rumen Protected Amino Acids (RPAA) must be either modified or protected in a ways to be not susceptible to rumen degradation by microorganisms. Metal chelated amino acids have been used to improve bioavailability of minerals. Using the same principle, Zn-methionine and Zn-lysine have been used efficiently as PRAA source and Zn (Kincaid and Cronrath, 1993).

Zinc is considered to be essential for functions of many enzymes, gene expression and transport for protein synthesis which influence growth and immune system of farm animals (Chester, 1997; McDonald, 2000). Zinc-methionine has been used widely as a source of both Zn and rumen protected methionine to improve the productivity of the ruminant animals especially when methionine is limiting.

Spears (1989) and Kerley and Ledoux (1992) reported that Zn from Zn-oxide or Zn- methionine was highly available to the same extent by lambs, with more Zn was retained in tissues as a result of lower Zn excretion when using Zn-methionine. More recently, Abdelrahman et al. (2003) conducted an experiment feeding growing Awassi lambs Zn oxide and different levels of Zn-methionine. They reported that Zn-methionine may improve growth rate and general performance of growing Awassi lambs, but varied according to the level of Zn-methionine supplementation. Moreover, Zn from Zn oxide or Zn-methionine was absorbed to similar extent, but metabolized differently because of differences in their tissues Zn concentrations.

Therefore, the objectives of this experiment were to evaluate the effect of using two levels of rumen protected zinc-methionine (Zn-met; low and high) on growth performance and the concentrations of Zn and other trace mineral in tissues of growing Awassi lambs.

2. MATERIAL AND METHODS

2.1. Animals and Diets

The protocols of this experiment were approved by Dean of Scientific Research at Mu'tah University, Jordan. Eighteen growing Awassi lambs (26.5±0.75 kg body weight) were individually housed and injected sub-cutaneously with 2 ml enterotoxaemia vaccine. The lambs were divided randomly to three groups and each lamb was individually kept in separate pen (1.5m × 0.85m) with concrete floor and lambs were provided with clean drinking water ad libitum by using plastic bucket. The dietary treatments were: control diet (C), control diet plus 400 mg/ kg feed zinc-methionine (T1), control diet plus 800 mg/ kg feed of zinc-methionine (T2). The Zinc-methionine supplement (CHOONG ANG company, Korea) contained at least 17% Zinc and 78% methionine. The control diet consisted of the following: 56.1% barley; 12.15% soybean meal; 15% wheat bran; 15% wheat straw; 1.15% calcium carbonate; 0.5% sodium chloride and 0.1% vitamin and minerals premix according to NRC (1985) to cover all lambs requirements in term of metabolizable energy (2.6 Mcal/ kg), crude protein (14.6%) and minerals (43.8 mg Zn/ kg; 9.3 mg Cu/ kg; 36.3 mg Mn/ kg and 0.125 mg Co/ kg). The composition of each gram of mineral and vitamin premix (Vapco Minavit- Forte) are as follow: vitamin A 6250 I.U; vitamin D3 1510 I.U.; vitamin E 4.375 I.U.; potassium iodide 6.367 mg; cobalt chloride 1.933 mg; sodium selenite 0.274 mg; copper sulphate 9.42 mg; ferrous sulphate 85 mg; magnesium sulphate

535 mg; manganese sulphate 41.25 mg; zinc sulphate 77.2 mg and dicalcium phosphate 145 mg. Lambs were fed the diets of 500 g/ day from the treatment diets at 8:00 am and the rest ad libitum at 16:00 pm from the control diet to assure daily constant amount of methionine which is 200 mg/ lamb/ day (low level) and 400 mg/ lamb/ day (high level). Moreover, lambs fed these diets for 12 weeks.

2.2. Samples Collection and Laboratory Analysis

All lambs were bled at the beginning of the experiment and every 4 weeks via the jugular vein using 15 ml non-heparinized vacutainers tubes. Blood samples were centrifuged at 3000 rpm for 15 minutes and serum was separated. Serum samples were stored at – 20º C until analysis. Feed intake and refusals were recorded daily and body weight was recorded weekly. At the end of experiment, all lambs were slaughtered after being removed from feed and water for 12 hrs. Liver, kidney, bone and meat samples were collected for mineral analysis. After slaughtering, hot carcass weights were recorded to determine dressing percentage. All samples were prepared according to AOAC (1990) for mineral analysis. Serum was prepared by mixing 4 parts of Trichloroacetic acid (TCA) with 1 part serum and centrifuged at 3000Xg for 15 minutes. Tissues samples were dry- ashed at 450ºC for 4 hrs and diluted by using concentrate HCl for analysis. Feed samples were dry-ashed at 600ºC for 6 hrs. Blood serum, meat, liver, bone and kidney were analyzed for Zinc (Zn), Copper (Cu), cobalt (Co) and manganese (Mn) by using Atomic Absorption Spectrophotommeter (Perkin-Elmer, 1980).

2.3. Partial Budget Analysis

The partial budgeting analysis was conducted to illustrate and estimate the economic impact of using Zn-met supplementation in growing Awassi lamb' diet. The budget was prepared using the following assumptions: 1) lambs in all treatments (C, T1 and T2) have similar labor, veterinary, fuel, oil, rent and water costs; 2) the index price for 1 kg Zn-met was $6.0, and for 1kg of feed was $0.183; 3) the current price of 1kg of live weight of lambs $3.38 on farm gate; 4) costs of supplementation feed intake was $23.8 for C and T_1, and $23.24 for T_2; 5) costs of Zn- meth supplementation to treated lambs with 200 mg/ lamb/ day was $0.158 and for 400 mg/ lamb/ day was $0.311 (Table 4, a and b).

2.4. Statistical Analysis

Data were analyzed using the General Linear Model (GLM) of the Statistical Analysis System (SAS, 1988) for a Completely Randomized Design (CRD) with repeated measurements for the effect of treatment, time and interaction on the concentrations of trace minerals in blood serum. Initial Awassi lambs weight was used as a covariant for growth performance measurements. Differences among treatment means for significant dietary effect were detected using the least significant differences (LSD) procedure of SAS, with P<0.05 considered statistically significant.

3. RESULTS AND DISCUSSION

3.1. Lambs Growth Performance

Ruminants don't have specific requirements for dietary Amino Acids (AA), but their physiological needs must be considered to optimize their performance. Rumen Protected Amino Acids (RPAA), mainly methionine and lysine, are potentially important in correcting the imbalances in absorbed amino acids. Unfortunately, most of scientific reports in this topic are inconsistent in the literature. Table 1. shows the effect of supplementing growing Awassi lambs with 200 mg Zn-met/ head/ day (T1) and 400 mg/ head/ day (T2) on the initial and final body weights, average daily gain, total body gain, total feed intake, feed conversion ratio, carcass weight and dressing percentage compared to the control (C). No significant differences (P>0.05) were observed between all groups in initial body weight, final body weight, total feed intake, hot carcass weight and dressing percentage (Table 1). Lambs from treatment 1 (T1) gave a significantly higher (P<0.05) total body gain (kg) compared to those of the control and treatment 2 (T2), but no differences were detected between lambs from the control and T2. Moreover, the same trend was found for the average daily gain. These findings are consistent with results of some other researchers. More recently, Abdelrahman et al. (2003) conducted an experiment feeding growing Awassi lambs Zn oxide and different levels of Zn-met. They reported that Zn-met may improve growth rate and general performance of growing lambs. Meanwhile, Puchala et al. (1999) reported that dietary supplementation of Zn-met increased Average Daily Gain (ADG). This result is supported by similar reports of improved animal performance with Zn-Met supplementation. Spears (1989) reported that heifers fed a corn-based diet (25 ppm of Zn) supplemented with 25 mg Zn as Zn-met had higher ADG than control. Although, in some studies Zn-met has not altered animal performance. Martin et al. (1987) using steers and Stobart et al. (1987) using lambs did not observe differences in ADG or feed efficiency between animals fed Zn-met and those fed control diets. Similarly, Greene et al. (1988) found similar ADG and feed efficiencies for steers consuming diets with or without Zn-met, but this may have involved a relatively high Zn level in the control diet. Moreover, hot carcass weights and dressing percentage were higher in steers supplemented with zinc proteinate (Spears and Kegely, 2002), which disagreed with our findings. On the other hand, Malcolm-Callis et al. (2000) reported no differences in performance of finishing cattle supplemented with 30 mg Zn/ kg from Zn- sulfate, Zn-amino acid complex or a Zn polysaccharide complex.

No significant differences (P>0.05) were detected in total feed intake among all groups, except T2 that showed lower feed intake (Table 1). Lambs from the control and T1 showed a significant higher (P<0.05) average feed conversion compared to those from T2 (6.9, 7.3 vs 6.2 kg, respectively; Table 1). In contrast, Hatfield et al. (1992, 1995) noticed a tendency for feedlot wethers and pregnant ewes given diets high in Zn-met to consume more feed than animals given a control diet.

3.2. Trace Minerals Concentration in Blood Serum and Tissues

The mode of action by which organic trace minerals may improve animal performance has not been defined (Spears, 1993). It is generally believed that organic trace minerals are more bioavailable than inorganic source. However, there is limited evidence to support the concept that organic trace minerals are considerably better absorbed than good quality inorganic sources. Table 2. shows the effect of treatment, time and treatment**x**time interaction on trace minerals (Zn, Cu, Co and Mn) concentrations in blood serum of lambs. Data showed no significant effect (P>0.05) of treatment, time and treatment×time on Zn concentrations in all lambs, but significantly (P<0.05) affected the Cu, Mn and Co with different level of significances. Spears and Kegley (2002) found that serum Zn concentrations were not affected by Zn level or source in growing steers which in agreement with our findings. Generally, it is well accepted that Zn concentrations in blood serum is not a reliable indicator of Zn status unless animal are severely deficient in Zn (Underwood and Suttle, 1999). By the end of the experiment, Cu concentrations were lower (P<0.001) compared with other times of sampling.

Meanwhile, the opposite trend for the Co and Mn concentrations. Moreover, lambs from T1 showed a significantly higher concentration of Cu when compared with lambs from the control and T2 (0.75 vs 0.68 and 0.67 ppm, respectively). The adequate levels of Zn, Cu, Mn and Co in sheep blood serum ranged between 0.8–1.2 ppm, 0.7 – 2.0 ppm, 0.8- 5 µg/ml and 0.2- 0.3 µg/ml respectively (Puls, 1994; McDowell et al., 1984). According to previous adequate levels, all the values for Zn, Cu, Mn and Co were above the normal levels through out the experiment.

Significantly higher concentrations of Cu ($P<0.01$), Zn ($P<0.05$) and Co ($P<0.001$) were detected in the livers of lambs from T1 group compared to lambs from the control and T2 groups, but no significant effect ($P>0.05$) of the Zn- met supplementation on Mn concentrations in liver. The normal concentrations of Cu, Zn, Mn and Co in liver, wet weight, range between 25- 100 ppm, 30- 75 ppm, 2- 4.4 ppm and 0.3 – 2.24 ppm, respectively (Puls, 1994; McDowell et al., 1984). Copper and Zn concentrations in liver of lambs from all groups were within the normal range, however Mn and Co were higher (Table 3).

Significantly higher concentrations of Cu ($P<0.001$) in kidney of lambs from T2 group were detected compared to those of control and T1 with no differences between the control and T1. On the other hand, concentrations of Zn, Mn and Co in the kidney of lambs from T1 group were significantly higher ($P<0.05$) compared to the control and T2 (Table 3). The normal concentrations of Cu, Zn, Mn and Co in kidney, wet weight, range between 4.0- 5.5 ppm, 20- 40 ppm, 0.3-2.5 ppm and 0.2 – 1.9 ppm, respectively (Puls, 1994; McDowell et al., 1984). All values of Zn, Mn and Co concentration in kidney were within these normal ranges, except Cu concentrations in kidney of lambs from T2 group, which were significantly higher and above the normal level compared to lambs in the control and T1 groups (7.7 vs 3.7 and 4.4 ppm, respectively).

Copper concentration in meat of lambs from T1 and T2 groups was significantly higher ($P<0.0001$) than that of lambs from the control, but no effect was observed for Mn concentrations. Moreover, Zn and Co concentrations in meat of lambs from T2 group were significantly higher ($P<0.01$) compared to the control and T1 groups, but no effect of treatment on Mn concentrations was found in meat of lambs from all groups.

Significantly higher concentrations of Cu in bones of lambs from T1 and T2 groups were found compared to the control (22.3 and 21.3 vs 11.8 µg/g WW, respectively; Table 3). Lambs from the control group had a significantly high bone Co ($P<0.0001$) and Mn ($P<0.05$) compared to T1 and T2 groups. Moreover, Co and Mn were significantly different in bones of lambs in T1 and T2 groups.

Although the mode of action and bioavailability of Zn from the organic forms is unclear, research suggested that supplementing certain organic forms of Zn, compared with inorganic forms, can increase their absorption and reduce urinary excretion, which resulted in higher Zn retention in animal fluids and tissues. On the other hand, the higher absorption and concentration of Zn may negatively antagonize or positively synergetize affect absorption and utilization of other minerals (Lucille et al., 1983). In this study, lambs received 200 mg Zn-met/ day accumulated higher concentrations of Cu, Zn and Co in liver compared with the control, but only Zn and Co were higher in kidney. Lambs from T2 that received high level of Zn-met (400 mg/ day) showed a lower concentration of Cu and Co and higher Zn in liver compared with lambs from T1. Moreover, higher concentration of Cu and Co and lower Zn concentration in kidney were found. These findings give a good indication that level 2 (high Zn-met intake) cause a negative effect on the utilization and metabolism of Cu and Co after absorption probably by increasing their excretion through the kidney. This result consisted with the findings of Rojas et al., (1995) who reported that supplementation of a sheep diet with different Zn sources (Zn-met, Zn-Lys, $ZnSO_4$ and ZnO) decreased serum Cu concentration. The antagonism of Zn with Cu is consistent with many other researchers (Hurley et al., 1983; Hill, 1987). According to Solomons et al. (1983), enhanced Zn uptake by intestinal mucosal cells stimulate the synthesis of metallothioneins (Hall et. al., 1979; O'Dell, 1981), which bind Cu notably in the intestinal wall and lead to a decrease in its bioavailability. On the other hand, no significant effect of Zn-met supplementation observed in the present case on the absorption and metabolism of Mn because of no differences in Mn concentrations in liver, kidney, meat and bone between all groups. Generally, plasma and tissue Zn concentration have also been similar in ruminants fed organic or inorganic Zn, when Zn has been supplemented at normal to low Zn supplementation rates (Spears, 1989; Rojas et al., 1996; Wright and Spears, 2001). Collectively, these studies suggest that certain organic forms of Zn are absorbed to a greater extent than inorganic forms when supplemented at high concentrations and that organic Zn may be absorbed by a different or at least regulated differently from inorganic Zn. Moreover, recent studies compared the chemical characteristics and relative bioavailability of a number of different commercially available organic Zn (Cao et al., 2000) and copper products (Guo et al., 2001). Organic Zn sources were found to differ in regard to chemical indicators of chelation effectiveness and solubility in pH 2.0 or 5.0 buffers. A few studies have been undertaken in sheep. Those of Spears (1989) and lady et al. (1992) corroborated each other in that each found that absorption was essentially identical for inorganic and chelated Zn, being about 40%, but that the chelated form of Zn was retained better ($p < 0.05$) than the inorganic form of Zn.

3.3. Partial Budget Analysis

Table 4 (a and b) shows the partial budget analysis of feeding growing Awassi lambs 200 (T1) and 400 mg (T2) Zn-meth/ head/ day. The total profit of lambs from T1 is $6.90/ lamb and only $0.457/ lamb from T2. The net difference subtracting of the profits from T1 and T2 is $6.443. Feed supplemented with Zn-met caused an improvement in lambs total weight gains; therefore the additional costs less than additional benefits and consequently increases profitability. The trend of improvement in lambs' performance is not linear with increasing the level of Zn-met supplementation. However, lambs would have to be supplemented with 200-mg/ day of Zn- met for improving lambs performance and consequently profit.

In conclusion, the addition of the methionine in the form of Zn-met (78% methionine and 17% Zn) with a level of 400 mg per kg feed (200 mg Zn-met/ lamb/ day) improved the growth and general performance of growing Awassi lamb starting from average daily gain and ending with dressing percentage. Moreover, high intake of Zn-met (> 400 mg/ lamb/ day) can negatively affect the utilization of copper and probably other minerals especially whose valence shell electronic structures are similar.

Table (1): The effect of Zn-methionine supplementation on the general performance measurements of the growing Awassi lambs*.

Item	Control[1]	T_1[2]	T_2[3]
Number of lambs	6	6	6
Initial body weight (kg)	25.6 ± 1.5	26.8 ± 0.2	27.0 ± 1.2
Final body weight (kg)	44.0 ± 2.1	47.8 ± 0.93	45.7 ± 3.2
Total gain (kg)	19.3 ± 0.17a	21.4 ± 1.2b	19.5 ± 1.2a
Average daily gain (kg)	0.21 ± 0.02 a	0.23 ± 0.01b	0.22± 0.01a
Total feed intake (kg)	130.0 ± 1.1	131.2 ± 1.2	129.5 ± 2.1
Feed conversion ratio	6.9 ± 0.45 a	6.2 ± 0.31b	7.3 ± 0.75c
Hot carcass weight (kg)	23.5 ± 1.5	25.0 ± 1.0	24.0 ± 1.5
Dressing%**	53.8± 1.2	52.4± 3.1	52.5± 0.6

[1] control diet NRC.

[2] control diet plus 200 mg Zn-methionine/ lamb/ day.

[3] control diet plus 400 mg Zn-methionine/ lamb/ day.

[a,b,c] Means with different superscripts within a column differ significantly (P<0.05).

* mean ± standard error of means.

** Hot carcass weight/ live weight * 100%.

Table(2): The effect of Zn-methionine supplementation on copper, zinc, cobalt and manganese concentration (ppm) in blood serum of the growing Awassi lambs.

Item	Time					Significance		
	1	2	3	4	SEM	TRT[1]	TM[2]	TRT*TM[3]
Zn, ppm	1.23	1.37	1.30	1.26	0.03	NS	NS	NS
Cu, ppm	0.71	0.75	0.70	0.65	0.13	*	**	*
Mn, ppm	1.12	1.44	1.86	1.40	0.05	*	**	*
Co, ppm	0.91	0.57	0.17	0.23	0.02	*	***	**

[1] treatment effect.

[2] time effect.

[3] treatment by time interaction effect.

[*] P<0.05.

[**] P<0.01.

[***] P<0.001.

NS= Not Significant.

Table (3): The effect of Zn-methionine supplementation on copper, zinc, cobalt and manganese concentrations (µg/g, WW) in different tissues of the growing Awassi lambs.**

Item	Control[1]		T_1[2]		T_2[3]		Significance (P-values)
Liver (µg/g):	X	SE*	X	SE	X	SE	
Copper	23.3[a]	0.66	43[b]	0.31	25.5[a]	0.78	0.01
Zinc	33.9[a]	6.0	42[b]	6.0	47.9[b]	7.7	0.05
Cobalt	3.83[a]	0.33	4.30[b]	0.86	2.25[a]	0.22	0.001
Manganese	5.57	0.69	5.56	0.92	5.23	1.14	NS
Kidney (µg/g):							
Copper	3.7[a]	0.74	4.4[a]	0.94	7.7[b]	0.56	0.001
Zinc	22.8[a]	2.1	27.2[b]	3.5	24.3[a]	3.9	0.05
Cobalt	0.70[a]	0.07	1.67[b]	0.29	2.72[c]	0.34	0.001
Manganese	2.0[a]	0 .24	2.4[b]	0.23	1.8[a]	0.16	0.05
Meat (µg/g):							
Copper	6.4[a]	0.7	12.7[b]	1.3	15.6[c]	1.1	0.0001
Zinc	28.3[a]	1.7	25.5[a]	1.1	31.6[b]	3.0	0.01
Cobalt	1.59[a]	0.24	1.98[a]	0.18	3.05[b]	0.57	0.01
Manganese	2.99	0.66	2.76	0.44	2.41	0.60	NS
Bone (µg/g):							
Copper	11.8[a]	0.5	22.3[b]	1.3	21.3[b]	5.6	0.0001
Zinc	28.0[a]	1.6	32.3[b]	5.7	29.7[a]	1.1	0.01
Cobalt	2.77[a]	0.05	2.33[b]	0.07	1.76[a]	0.18	0.01
Manganese	3.30	0.6	2.95	0.43	2.10	0.23	NS

[1] control diet NRC.

[2] control diet plus 200 mg Zn-methionine/ lamb/ dat.

[3] control diet plus 400 mg Zn-methionine/ lamb/ day.

[a,b,c] Means with different superscripts within a column differ significantly ($P<0.05$).

* mean ± standard error of means.

[**] as wet weight.

NS= Not Significant.

Table (4a): Partial budget analysis (US$) of feeding growing Awassi lambs 200 mg Zn-methionine daily.

Positive Impacts		Competing Impacts	
Increased Incomes		Increased Expenses	
Additional returns as result of add Zn-Methionine	$72.322	Additional feed intake cost	$23.82
		Additional Zn-Methionine cost	$0.158
Decreased Expenses		Decreased Incomes	
Feed intake cost	$23.79	Reduced returns (returns from control)	$65.234
$96.112	Total Positive Impacts	$89.369	Total Competing Impacts
Total Positive Impacts - Total Competing Impacts =			$6.743

Table (4b): Partial budget analysis (US$) of feeding growing Awassi lambs 400 mg Zn-methionine daily.

Positive Impacts		Competing Impacts	
Increased Incomes		Increased Expenses	
Additional returns as result of add Zn-Methionine	$65.91	Additional feed intake cost	$23.698
		Additional Zn-Methionine cost	$0.311
Decreased Expenses		Decreased Incomes	
Feed intake cost	$23.79	Reduced returns (returns from control)	$65.234
$89.70	Total Positive Impacts	$89.554	Total Competing Impacts
Total Positive Impacts - Total Competing Impacts =			$0.146

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الكفاءة الإنتاجية وتركيز المعادن الصغرى لحملان العواسي النامية بعد تغذيتها على مستويين من الزنك ميثايونين

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ملخـص

استخدمت ثمانية عشر حملاً من الحملان العواسي النامية لدراسة تأثير تغذية مستويين من الزنك ميثايونين المحمي على معدل النمو وتركيز المعادن الصغرى والأداء العام. قسمت الحملان لـ 3 مجاميع كما يلي: الشاهد (C)، المعاملة 1 (T1): تركيز 400 ملغم زنك ميثايونين/كغم علف، المعاملة 2 (T2): تركيز 800 ملغم زنك ميثايونين/كغم علف. تم تسجيل بيانات الأداء العام للحملان، وتحليل عينات الدم والكبد والكلية والطعام واللحم لتراكيز المعادن الصغرى بجهاز الطيف الذري.

وضحت النتائج زيادة معنوية (P<0.05) في الزيادة الوزنية الكلية، ومعدل الزيادة اليومية وانخفاض معدل التحويل الغذائي في حملان المجموعة الأولى (T1). ولم توجد فروق معنوية بين المجاميع من حيث استهلاك العلف ونسبة التصافي. وكان تركيز النحاس والزنك والكوبالت في كبد الحملان من المجموعة الأولى (T1) أعلى معنوياً (P<0.05) وتركيز الزنك فقط في الكلية مقارنة بالمجاميع الأخرى. بينما كان تركيز الزنك والنحاس والكوبالت للحوم الحملان من T2 أعلى معنوياً مقارنةً بالمجاميع الأخرى.

وفي الخلاصة، إن تغذية الحملان العواسي النامية 200 ملغم زنك ميثايونين/ يوم (المجموعة الأولى (T1)) أدى إلى تحسين معدل النمو والاستفادة من النحاس والزنك والكوبالت وبالتالي إلى زيادة الربحية.

الكلمـات الدالـة: الحملان العواسي، نمو، زنك ميثايونين، أنسجة ومعادن.

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