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EFFECT OF RATIONS CONTAINING DIFFERENT LEVELS OF ZINC-LYSINE ON PERFORMANCE AND ZINC CONCENTRATION OF SOME TISSUES IN BROILERS

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Farklı seviyelerde çinko-lisin içeren rasyonların broylerlerde performans ve bazı dokuların çinko konsantrasyonuna etkisi

ÖZET

Bu çalışma, farklı seviyelerde çinko-lisin (ZnL) içeren rasyonların broylerlerde performans, karaciğer ve plazma Zn konsantrasyonuna etkisini tespit etmek için yapılmıştır. Toplam 160 adet Avian Farm tipi günlük civciv, 6 hafta süreyle ZnL'nin 4 seviyesi ile yemlenmiştir. Civcivler her birinde 40 civciv olacak şekilde rastgele 4 muamele grubuna ayrılmıştır. Araştırma, her birinde 10 adet broyler civcivi olmak üzere 4 tekerrürlü olarak toplam 16 alt grupta yürütülmüştür. Araştırmada temel rasyonlara (başlatma ve büyütme) 0, 20, 40 ve 60 mg/kg seviyelerinde ilave Zn sağlanacak şekilde ZnL ilave edilmiştir. Yem ve su *ad libitum* olarak verilmiştir. Araştırmanın sonunda, rasyona ZnL formunda lisin ilavesi 0-6 haftalık dönemde civcivlerin canlı ağırlık artışı ve yem tüketimlerini önemli olarak etkilemiştir ($P<0.05$). ZnL ilavesi, grupların yem değerlendirme katsayıları, plazma ve karaciğer Zn konsantrasyonları ile boyun, kanat, but ve sırt ağırlıklarını etkilememiştir. Ancak, ZnL seviyeleri karkas ve göğüs ağırlığını önemli derecede etkilemiştir ($P<0.05$).

ANAHTAR KELİMELER: Broyler, çinko konsantrasyonu, çinko-lisin, performans

SUMMARY

This study was carried out to determine the effects of diets containing different levels of zinc-lysine (ZnL) on performance, liver and plasma Zn concentration of broilers. In this study, 160 1-d of age Avian Farm broiler chicks were fed with four levels of ZnL for 6 weeks. The chicks were randomly divided into four experiment groups of forty birds in each, and each treatment was replicated four times with ten birds *per* replicate (a total of 16 subgroups). In the experiment the basal diets (starter and grower) were supplemented with at 0 (control), 20, 40 and 60 mg/kg Zn supplied from ZnL. Feed and water were given *ad libitum*. Supplemental Zn from ZnL effected body weight gain (BWG) and feed intake (FI) from 0-6 weeks of age ($P<0.05$). The supplemental Zn did not effect feed conversion ratio (FCR, feed/gain), liver and plasma Zn concentration, and neck, wing, thigh and back weights.

KEY WORDS: Broiler, performance, zinc concentration, zinc-lysine

INTRODUCTION

Zinc (Zn) is essential trace element that is required for growth, bone development, feathering, enzyme structure and function, and appetite for all poultry. The Zn is commonly added as a supplement to all formulated poultry diets. Currently, poultry nutritionists have a number of mineral sources to choose from: inorganic oxide, inorganic sulfate and complexed (organic) mineral forms. It is believed that organic mineral forms provide a source of Zn with greater biological availability than Zn from inorganic sources (Wedekind and Baker 1990; Kidd et al. 1992a). Kidd et al. (1996) also hypothesized that ZnMet has better Zn bioavailability than from inorganic sources because it is not subject to chelation by phytic acid and fiber in the lumen of the gut. After absorption, Zn from ZnMet may be metabolized differently than inorganic sources. Major portion of phosphorus in plant derived ingredient is primarily present in the form of phytic acid or phytate. The ability of chickens to utilize phytate phosphorus is

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generally considered poor, due to lack of endogenous phytase (Nelson 1967). Corn and soybean meal, the major constituents of poultry rations, are relatively low source of Zn. Furthermore, phytic acid forms insoluble complexes with di and trivalent cations, especially Zn and inhibits absorption of Zn, consequently, reduces their availability. Reabsorption of both endogenously secreted Zn and dietary Zn are impaired by the presence of phytic acid (Kidd et al. 1993).

Organic Zn supplementation of different avian species diets has been the focus of many scientific investigations (Hempe and Savage 1990; Deyhim et al. 1991; McNaughton and Schugel 1991; Pimental et al. 1991; Kidd et al. 1992a;b; Wedekind et al. 1992; Aoyagi and Baker 1993; Kidd et al. 1994). Kidd et al. (1993) observed that ZnMet had the greatest effect on improving feed efficiency. Recent researches conducted at Colorado Quality Research demonstrated that ZnL and Zn-Amino acid complexes improved the performance of broiler chickens and found to be as effective as ZnMet (Ferket and Kidd 1997). In this study, the cheaper Zn-Amino acid complex even resulted in better feed conversion ratio and lower mortality rate than the other sources of Zn. Other organic forms of Zn may be or may not be as effective as Zn complex forms, but the value of these other organic zinc supplements is not adequately evaluated in refereed scientific journals.

The objective of the present study was to determine the effects of rations containing different levels of Zn from ZnL on performance and Zn concentration of some tissues in broilers.

MATERIAL and METHODS

In the study, a total of 160 Avian Farm broiler chicks at 1-d of age were placed floor pens to provide a density of .15m^2 *per* bird. The chicks were randomly divided into four experiment groups of forty birds each, and each treatment was replicated four times with ten birds *per* replicate pen. House temperatures, maintained by whole house brooding, were controlled at 32 ^oC the first week and then reduced by 2^oC weekly until room temperature was reached in all brooding units. Photoperiod in the broiler house was provided by a combination of natural daylight and supplemental light consisting of 23 h of light from 0 to 6 weeks of age. Plastic feeders and waterers were used to minimize environmental zinc contamination. Diets and water were consumed *ad libitum* by the birds.

In the study, starter diets (21.75% CP, 3009 kcal/kg ME) were fed from hatch to 3 weeks of age and grower diets (19.01% CP, 3203 kcal/kg ME) from 4 to 6 weeks of age. The starter and grower diets (Table 1) without additional Zn (provided only from ingredients and mineral-vitamin premix) contained 88 and 93 mg/kg Zn, respectively. The dietary treatments consisted of the supplementation of the basal diets (starter and grower) with 0 (control), 20, 40 and 60 mg/kg Zn supplied from ZnL. Composition and nutrient analysis for starter and grower diets are included in Table 1.

Initial weights of the birds were recorded at the beginning of the study. Body weight (BW) and feed intake (FI) were measured weekly, for each pen, and then body weight gain (BWG) *per* pen was calculated. Feed conversion ratio (FCR) was also calculated weekly as kg of FI *per* kg of BWG. Mortality was recorded daily. On the last day of the trial, five birds of mixed sex chosen from each treatments, and then blood samples were obtained by heart puncture to determine plasma Zn concentrations (Wedekind et al. 1992). Plasma were separated by centrifugation of blood at 2500 rpm for 10 min and was then frozen (-20^oC) for analysis. Also five birds of mixed sex in each replicate were slaughtered for determination of carcass characteristics at the end of the trial. The diets and liver were analyzed for Zn after wet ashing with HNO_3 as described by Wedekind et al. (1992). The zinc in plasma samples, diets and liver was determined by atomic absorption spectrophotometry (Model GBC 902).

Table 1. The composition and calculated nutrient content of the experimental diets

Ingredients (%)	**Starter[1]**	**Grower[2]**
Yellow corn	43.90	51.30
Barley	8.00	6.70
Soybean meal	30.00	24.00
Sunflower meal	5.50	4.70
Fish meal	4.00	3.00
Vegetable oil	5.00	6.70
Ground limestone		1.20
Dicalcium phosphate	1.25	1.25
Sodium choloride	0.35	0.35
Vitamin premix[3]	0.25	0.25
Mineral premix[3]	0.10	0.10
DL-methionine	0.25	0.25
L-lysine HCl	0.20	0.20
Total	100.00	100.00
Calculated nutrient content		
ME, kcal/kg	3009	3203
Crude protein, %	22.05	19.07
Crude fat, %	5.88	7.29
Calcium, %	1.02	0.86
Total phosphorus, %	0.98	1.05
Available phosphorus, %	0.37	0.40
Methionine, %	0.59	0.66
Lysine, %	1.20	1.26
Analyzed content		
Crude protein, %	21.75	19.01
Crude fat, %	6.10	7.63
Calcium, %	1.22	0.77
Total phosphorus, %	1.25	1.43
Zinc, mg/kg	88	93

1: Starter diets was fed from hatch to 3 weeks of age; 2: Grower diets was fed from 4 to 6 weeks of age; 3: The premixes provided sufficient vitamins and minerals or exceeded NRC (1994) nutrient recommendations.

Table 2. Effects of supplemental ZnL on body weight gain, feed intake and feed conversion ratio of chicks

ZnL level (mg/kg)	Weeks		
	0-3	4-6	0-6
	Body weight gain (g)		
L_0	602.71±9.71	1261.16±27.53	1863.87±30.23[a]
L_1	592.20±10.64	1189.95±20.05	1782.15±45.69[b]
L_2	621.15±7.57	1255.26±19.89	1876.41±39.46[a]
L_3	645.33±8.75	1272.84±14.65	1918.17±33.40[a]
	Feed intake (g)		
L_0	976.38±12.34	2797.79±17.87	3774.17±45.11[b]
L_1	960.42±15.33	2848.19±23.53	3808.61±59.43[a]
L_2	1002.48±17.33	2879.65±32.92	3882.13±56.12[a]
L_3	1065.95±36.77	2886.98±27.50	3952.93±47.13[a]
	Feed conversion ratio (kg/kg)		
L_0	1.62±0.05	2.22±0.16	2.03±0.03
L_1	1.62±0.13	2.39±0.16	2.14±0.11
L_2	1.61±0.06	2.29±0.13	2.07±0.09
L_3	1.65±0.06	2.27±0.11	2.06±0.06

a-b: Means in column with no common superscript differ significantly (P<0.5)

Table 3. Effect of supplemental ZnL on carcass characteristics of unsexed broiler chicks

ZnL level (mg/kg)	Carcass parameters		
	Carcass (g)	Neck (g)	Wing (g)
L_0	1279.60±64.52[a]	55.08±2.67	159.67±6.65
L_1	1153.70±29.65[b]	49.75±2.78	145.92±3.44
L_2	1286.00±53.52[a]	53.00±4.69	161.75±7.72
L_3	1252.10±42.70[a]	55.17±2.94	159.17±4.77
	Thigh (g)	Breast (g)	Back (g)
L_0	506.00±25.74	394.92±17.77[a]	171.42±11.79
L_1	451.83±12.04	359.58±13.57[b]	152.83±8.91
L_2	511.75±23.07	336.67±17.23[b]	159.25±11.20
L_3	498.50±23.67	376.33±14.69[ab]	170.17±5.29

a-b: Means in column with no common superscript differ significantly (P<0.5)

Data obtained from the trial were analyzed by a one way analysis of variance for the level of supplemental Zn in the diet (Minitab Reference Manual, Release 10.1, 1990). Those response variables resulting in a significant F test were further analyzed using Duncan's multiple range test (Duncan 1955).

RESULTS and DISCUSSION

Data on BWG, FI and FCR were shown in Table 2. Supplementation of Zn from ZnL did not effect BWG at 0-3 and 4-6 weeks of age (P>0.05). But supplemental Zn effected BWG at the 0-6 week period (P<0.05). There were significantly differences between L_0, L_2 and L_3 groups and L_1 group for BWG. Mean BWG were significantly smaller for 0-6 weeks of age for broiler fed 20 mg/kg added Zn (L_1), when compared with the other groups.

There were no significant differences in BWG between 0, 40 and 60 mg/kg supplemental Zn during 0-6 weeks of age. Ration ZnL levels had not significant effect on FI at 0-3 and 4-6 weeks of age (P>0.05). But supplemental Zn from ZnL significantly effected cumulative FI (0-6 weeks of age). There were significantly differences between L_0 with L_1, L_2 and L_3 groups for FI. Mean FI of broiler fed control diet were significantly smaller during 0-6 weeks of age, when compared with 20, 40 and 60 mg Zn/kg diets. There were no significant differences in FI between 20, 40 and 60 mg/kg supplemental Zn. The supplemental Zn did not effect FCR during experimental period (P>0.05). Kidd et al.(1994) reported that there were no treatments effects on BWG (Experiment 1 but, ZnMet supplementation increased BWG by over 6% (Experiment 2). Ferket et al. (1992) observed that turkey toms fed diets supplemented with ZnMet had improved FCR without affecting BWG. McNaughton and Schugel (1991) reported a similar observation for FCR and breast meat yield with broiler. Pimental et al.

(1991) reported that the source of zinc (ZnMet or ZnO) effected liver Zn concentrations but did not affect growth. McNaughton (1991) reported that feeding a combination of ZnMet and MnM complexes gave significantly better FCR at both 21 and 46 days of age as compared inorganic trace minerals from oxide sources. Also, feeding ZnMet and MnM in the starter ration alone did not improved performance at 46 days of age. Kidd et al. (1992a) reported that the addition of supplemental Zn in the hen or chick diets with either ZnMet or ZnO resulted in no significant differences in FCR or average BW. The results of the present study indicate that supplementation to diets with varying levels from 0 to 60 mg/kg Zn from ZnL did no effect BWG, FI and FCR (0-6 weeks of age). These results agree with previous works in which no significant differences were found BWG (McNaughton 1991; Pimental et al. 1991; Kidd et al. 1992b; Kidd et al. 1994), FI and FCR (Pimental et al. 1991; Kidd et al. 1992a; Kidd et al. 1994) between control diet and those receiving Zn supplemented diets during the trial. Discrepancies between present study and McNaughton and Schugel (1991) and Ferket et al. (1992) may be related to the manner in which the birds were raised during of the study, members of replicate pens, the number of birds *per* pen, sources of Zn and levels of Zn.

The effect of ZnL on carcass characteristics was presented in Table 3. Supplementation of Zn from ZnL did not effect neck, wing, thigh and back weights at the end of the experiment. However ZnL levels were significantly effect carcass and breast weights ($P<0.05$).

The means of carcass weights of broiler fed L_1 ration were significantly lower than the L_0, L_2 and L_3 groups. There were no significant differences in carcass weights between these groups. The breast weight is the most important piece of carcass in broiler production. In this study, the breast weight decreased as dietary ZnL levels increased. Supplemental Zn from ZnL effected breast weight of groups. There were significant differences between L_0 with L_1 and L_2 groups for breast weight. The means of breast weights were significantly lower for broiler fed L_1 and L_2 when compared to the other diets. Our observations are in accordance with McNaughton and Schugel (1991).

Table 4. Effect of supplemental ZnL on Zn concentration of liver and plasma in broiler chicks

ZnL level (mg/kg)	Liver Zn (mg/kg)	Plasma Zn (mg/kg)
L_0	114.04±11.42	2.88±0.33
L_1	103.07±9.62	3.06±0.34
L_2	104.76±7.96	3.40±0.24
L_3	114.94±8.08	3.50±0.20

Table 4 shows the average Zn concentration in liver and plasma of chicks fed supplemental ZnL. Addition of Zn from ZnL did not significantly effect liver and plasma Zn concentration ($P>0.05$). Our observations are in accordance with results given by Wedekind et al. (1992) but were disagree with the given by Hempe and Savage (1990).

In conclusion, supplementing the basal diets used in this study from 0 to 60 mg/kg Zn in the form of ZnL had minimal effect on performance of broilers. However, authors suggested that further researches are needed in order to determine the effect of ZnL on performance of broilers.

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