Effect of Organic and Inorganic Manganese Supplementation in Diets on Performance and Some Organ Weights of Japanese Quails (*Coturnix coturnix japonica*)

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Abstract: This study was carried out to determine the effects of diets containing different levels of inorganic and organic manganese sources on fattening performance and some organ weights of Japanese quails. In this study, 256 one day old quail chicks were fed four levels of inorganic and organic Mn in factorial arrangement design for 35 days. The dietary treatments consisted of the supplementation of the basal diet with 30, 60, 90 and 120 mg/kg Mn supplied from manganese sulphate and manganese bioplex. Dietary Mn sources as a main factor did not effect investigated parameters. But dietary Mn levels had significant effect on all parameters except for feed intake. Supplementation of 60 mg/kg Mn to diets resulted in an increase BW, BWG, liver and pancreas weights, also improved feed conversion ratio.
Keywords: Manganese, performance, Quail

Introduction

Manganese (Mn) is essential for normal bone formation, enzyme function, and amino acid metabolism in poultry (Scott et al. 1976). The utilization of Mn has become an increasing concern because of extremely rapid growth rate of commercial broiler strains (Ji et al. 2006). National Research Council (NRC, 1994) recommended 60 ppm Mn in broiler and quail chicks diet. However, under practical conditions the diets are formulated to contain higher concentrations of Mn to overcome the possibility of its deficiency. This is because of relatively low absorption of dietary Mn in birds (Sunder et al. 2006). Organic Mn sources were more bioavailable than inorganic sources. One of the possible reasons is that there are less chelating or other unwanted reactions with dietary constituent in the gastrointestinal tract for organic mineral complexes compared with those for inorganic minerals (Yan and Waldroup 2006).

Diet supplementation with trace elements of high bioavailability, also known as specific amino acid metal compounds of Mn and Zinc which bind themselves to a specific amino acid show a capacity to increase the immune response and diminish negative effects in turkey and laying hens in respect of these minerals inorganic forms (Menocal et al. 2004). However, according to some research results, the organic and inorganic Mn sources reported no difference in terms of bioavailability (Baker and Holpin 1987, Scheideler 1991).

The aim of the this study to determine the effect of diets containing different levels of inorganic and organic manganese sources on fattening performance and some organ weights of Japanese quails.

Materials and Methods

A 5-wk experiment, 256 mixed sex day-old quail chicks *(Coturnix coturnix japonica)* were used. Four replicate groups of 8 chicks were assigned to each of 8 dietary treatments. The dietary treatments consisted of the supplementation of the basal diet with 30, 60, 90 and 120 mg/kg Mn supplied from manganese sulphate ($MnSO_4$) and manganese bioplex. Dietary treatments were prepared from a corn-soybean common diet without additional Mn contained 21.52 mg/kg. All birds received feed and water *ad-libitum*. Lighting was treated as a 23

h/day. Compositions of nutrients in the diets were adjusted according to the recommendation of NRC (1994; Table 1).

In quails, body weights (BW) and feed intake (FI) were recorded on a pen basis as weekly intervals. Mortality was recorded daily. At the end of the experiment (at five weeks of age), four quails that randomly selected were slaughtered at a processing plant from each replicate and processed, and then the carcass yield were calculated to used warm carcass weight.

A general linear model (GLM) was used for the analysis of variance of the data (Minitab 2000). Significant differences among means were tested by Duncan's multiple range tests. Differences were considered as significant when *P* values were less than 0.05 (Duncan 1980).

Nutrients	***%***
Corn	53.1
Soybean meal (% 47.6 CP)*	41.3
Vegetable oil (7800 kcal/kg ME)*	2.8
Limestone	1.26
Dicalcium phosphate	0.8
Salt	0.3
Vitamin Premix[1]	0.15
Mineral Premix[2]	0.10
Methionine	0.19
TOTAL	*100.00*
Calculated nutrients	
Energy, kcal/kg ME	2901
CP, %	24.06
Calcium, %	0.80
Available phosphorus, %	0.31
Lysine, %	1.32
Methionine, %	0.51
Methionine + Cysteine, %	0.95
Crude cellulose, %	2.25
Manganese, mg/kg*	21.52

* Analyzed value. CP: Crude protein, ME: Metabolizable energy

[1] Vitamin premix (supplied the following per kg of diet): Vitamin A, 12000 I.U; Vitamin D_3, 2400 I.U; Vitamin E, 25.0mg; Vitamin K_3, 4.0 mg; Vitamin B_1, 3.0 mg; Vitamin B_2, 5.0 mg; Vitamin B_6, 8.0 mg; Vitamin B_{12}, 0.015 mg; Niacin, 25.0 mg; Calcium-D-Pantothenate, 8.0 mg, D-Biotin, 0.05 mg; Folic acid, 0.5 mg; Choline Chloride, 125.0 mg.

[2] Mineral premix (supplied the following per kg of diet): Fe, 60.0 mg; Zn, 60.0 mg; Cu, 5.0 mg; I, 1.0 mg; Co, 0.2 mg; Se, 0.15 mg.

Table 1. Composition of basal diet used in experiment (%)

Results and Discussion

The effects of diets containing different sources and levels of Mn on performances are shown in Table 2 and 3. The treatments as the main sources of inorganic and organic Mn were not significantly effect on BW, body weight gain (BWG), FI, feed conversion ratio (FCR), carcass yield, liver and pancreas weight ($P > 0.05$). The diets containing different levels of Mn had significantly effect on all parameters of quails except for feed consumption ($P < 0.05$). The best results of performance parameters, liver and pancreas percentage of BW were obtaining in quails fed with diet containing 60 mg/ kg Mn, but the lowest results of carcass yield obtaining the same diet. The interactions groups in the experiment, the diets containing different sources and levels of Mn had significantly effect on BW and BWG of quails ($P < 0.05$). The highest results of BW and BWG were obtaining fed with diet containing $MnSO_4$ x 60 mg/ kg Mn.

Quail studies on this subject with a limited number of studies but the results are in broilers. Quails and broilers are similar in terms of requirements of Mn (NRC 1994). The results of the experiment, supplemental Mn sources (inorganic and organic) there were no differences. The similar result, Berta et al. (2004) reported that the same level of supplementation of the two Mn sources there were no differences between the Mn concentrations of organs and tissue in broiler chicks. Additionally, these researchers stated that a corn-soybean diet supplemental with levels of 0, 30, 60 and 240 mg/kg Mn from organic and inorganic sources did not significant effect on the BW, FCR in broiler chicks. Collins and Moran (1999) reported that body weight and feed

efficiency were not influenced by supplementary Mn (180 ppm). Also, supplemental Mn did not alter processed carcass weights, yield, or percentage abdominal fat in broilers. Gajula et al. (2010) stated that Mn (60 ppm) as recommended by NRC (1994) was sufficient for broiler performance and bone parameters. The results of this study with the contradiction between the results of previously conducted studies may be due to different Mn levels and animal material.

It is concluded that, 60 mg/kg supplementation Mn to diet is suitable in growing Japanese quails. The number of research interest in this subject is very limited. Therefore, many studies are needed.

Diets	BW, g/bird	BWG, g/bird	FI, g/bird	FCR, Feed/ Gain
Sources				
$MnSO_4$	169.3±2.75	161.0±2.39	524.3±06.41	3.26±0.042
Mn Bioplex	170.1±1.36	161.9±1.36	522.3±05.54	3.23±0.032
Mn levels, mg/kg				
30	$164.4±1.84^{B}$	$156.2±1.79^{B}$	519.5±06.39	$3.33±0.043^{A}$
60	$179.5±3.20^{A}$	$169.3±2.33^{A}$	520.5±07.62	$3.08±0.040^{B}$
90	$166.9±1.87^{B}$	$158.8±1.86^{B}$	519.1±11.57	$3.27±0.055^{A}$
120	$167.9±1.98^{B}$	$161.4±2.55^{B}$	534.0±07.32	$3.31±0.045^{A}$
Sources x levels				
$MnSO_4$ x 30	$160.3±0.73^{C}$	$152.2±0.68^{D}$	515.7±08.77	3.39±0.041
$MnSO_4$ x 60	$185.9±3.71^{A}$	$173.7±2.45^{A}$	532.2±13.16	3.06±0.063
$MnSO_4$ x 90	$163.9±2.36^{BC}$	$155.9±2.37^{CD}$	516.6±16.38	3.31±0.080
$MnSO_4$ x 120	$167.3±1.15^{BC}$	$162.4±3.58^{BC}$	532.9±14.57	3.28±0.058
Mn Bioplex x 30	$168.6±1.96^{BC}$	$160.3±1.84^{BCD}$	523.4±10.35	3.27±0.067
Mn Bioplex x 60	$173.2±2.63^{B}$	$165.0±2.63^{B}$	508.9±10.29	3.09±0.058
Mn Bioplex x 90	$170.0±2.17^{BC}$	$161.8±2.14^{BC}$	521.6±18.77	3.22±0.079
Mn Bioplex x 120	$168.5±4.10^{BC}$	$160.4±4.12^{BCD}$	535.2±06.10	3.34±0.074

$^{A-D}$: Means within a column with unlike superscript differ significantly ($P< 0.05$).

Table 2. Effect of the experimental diets on performance of Japanese quails

Diets	Carcass yield, % of BW	Liver, % of BW	Pancreas, % of BW
Sources			
$MnSO_4$	63.25±0.41	2.05±0.087	0.24±0.019
Mn Bioplex	62.64±0.23	2.02±0.103	0.25±0.009
Mn levels, mg/kg			
30	$64.02±0.37^{A}$	$1.98±0.085^{AB}$	$0.23±0.009^{B}$
60	$61.79±0.37^{B}$	$2.32±0.104^{A}$	$0.29±0.012^{A}$
90	$63.28±0.50^{A}$	$2.01±0.070^{AB}$	$0.24±0.009^{B}$
120	$62.70±0.33^{AB}$	$1.82±0.040^{B}$	$0.23±0.009^{B}$
Sources x levels			
$MnSO_4$ x 30	64.86±0.20	2.00±0.175	0.22±0.005
$MnSO_4$ x 60	61.26±0.56	2.35±0.218	0.29±0.010
$MnSO_4$ x 90	63.58±0.77	2.07±0.111	0.22±0.006
$MnSO_4$ x 120	63.30±0.44	1.78±0.062	0.24±0.019
Mn Bioplex x 30	63.18±0.34	1.97±0.055	0.25±0.016
Mn Bioplex x 60	62.31±0.37	2.30±0.048	0.28±0.023
Mn Bioplex x 90	62.97±0.70	1.95±0.091	0.26±0.016
Mn Bioplex x 120	62.10±0.27	1.86±0.048	0.23±0.009

$^{A-B}$: Means within a column with unlike superscript differ significantly ($P< 0.05$).

Table 3. Effect of the experimental diets on some organ weights of Japanese quails

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