INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 1, p. 387-392, 2014

RESEARCH PAPER OPEN ACCESS

Effects of different levels of copper sulfate on performance in Japanese quail (*Coturnix coturnix japonica*)

Mehdi Zahedi*, Jamshid Ghiasi Ghalehkandi, Yahya Ebrahimnezhad, Fayyaz Emami

Department of Animal Science, Shabestar Branch, Islamic Azad University, Shabestar, Iran

Key words: Copper sulfate, performance, Japanese quail.

http://dx.doi.org/10.12692/ijb/4.1.387-392 Article published on January 11, 2014

Abstract

The main purpose of the current study was to investigate possible Effects of different levels of copper sulfate on performance in Japanese quail. Four hundred, day old male Japanese quail were randomly allocated into 5 treatment groups and 4 replicates (each treatment included 20 replicate). All birds received basal diet until 7 days of old. Birds were received experimental diets from day 8 to 42 of the study. Group A (control) received no supplemented diet, whereas B, C, D and E groups were received basal diet supplemented by 50, 100, 150 and 200 mg copper sulfate, respectively. Body weight (gr), Body weight Gain (BWG) (gr), Food intake (gr) and Food Conversation Ration (FCR) were determined in three phases: phase one from days 0-7, phase two 7-21 and phase three 21-42 of the study. Carcass characteristics (Brest, Drumstick, Gizzard percent and total Intestine length (Cm) were determined at the end of the study. According to the results, there was no significant results on performance in birds fed supplemented diets with different levels of copper sulfate (50, 100, 150 and 200 mg) at any stage of the study ($p>0.05$). Furthermore, no significant results was observed on performance in Japanese quail fed diets supplemented with copper sulfate (50, 100, 150 and 200 mg) at day 42 ($p>0.05$).

* **Corresponding Author:** Mehdi Zahedi ✉ Zahedi.mehdi@yahoo.com

Introduction

Copper (Cu) is one of the most critical trace minerals in livestock. It plays a key role in variety of physiological functions e.g. haemoglobin synthesis, connective tissue maturation in the cardiovascular system and bones, appropriate Central Nervous System (CNS) function and so on (Scan, 2003). Furthermore, this element is an essential component of many enzyme systems such as cytochrome C oxidase, amino oxidase, polyphenoloxidase, ferroxidase and superoxiode dismutase (Gaetke and Chow, 2003). Copper sulfate has been used in the United States since the 1700s, and it was first registered for use in the United States in 1956. Previous studies have shown that dietary Cu alters lipid metabolism and changes fatty acid composition of depot lipids in poultry (Igbasan *et al*., 2011). Also, the metabolism of Cu in the body is characterized by its complexity. According to Abdellatif (1968) practically no other trace element exceeds Cu in the diversity of the factors which govern its absorption, excretion and utilization. Copper sulfate is a naturally-occurring inorganic salt and has been added to poultry diets in excess of its nutritional needs as an antimicrobial and growth promoter (Mehdi Zahedi *et al.,* 2013a). It is reported that pharmacological addition of Cu in swine diets is a common practice due to the resulting improvement in health and growth performance (Hill and Spears, 2001). The response of broiler chicks to higher levels of Cu supplementation is variable and in some studies, growth-suppressive effects of using higher levels of have even been reported (Karimi *et al.,* 2011). Laying hens were fed copper sulfate at concentrations of 78 ppm Cu and 1437 ppm Cu for 2 weeks. At the highest concentration, hens produced fewer eggs, consumed less feed, and developed ulcers in the gizzard and oral cavity (Gilbert *et al.,* 1996). Other studies of chickens that were fed copper sulfate reported oral lesions proportional to the dose of copper, and conflicting effects on feeding rate and weight gain (Pesti and Bakalli, 1996; Luo *et al.,* 2005; Idowu *et al.,* 2006). Although the potential use of higher levels of Cu as a possible alternative to antibiotic growth promoters has been investigated, little literatures have been published about the effects of different levels of Cu sulfate on performance in Japanese quail (Mehdi Zahedi *et al.,* 2013b). Therefore, based on former researches on effects of Cu supplemented diets in poultry, as well as to understanding possible effects of Cu in Japanese quail, our hypothesis in current study was to clarify possible effects of Cu sulfate on body weight (BW), Body weight Gain (BWG), Food intake (FI) and Food Conversation Ration (FCR); and carcass characteristics include breast, drumstick, gizzard percent and total intestine length in Japanese quail.

Material and methods

Birds and diets

Four hundred and twenty, day old male Japanese quail (*Coturnix coturnix japonica*) were randomly assigned into 5 treatments with 4 replicates (each replicates contain 20 birds). Before experimental procedure, Japanese quail weighed and randomly assigned into experimental groups. All experimental birds were received basal diet without copper sulfate from day 1 to 7. At day 8, experimental birds were received experimental diets: Control group (A) received basal diet, whereas B, C, D and E groups were received basal diet supplemented by 50, 100, 150 and 200 mg copper sulfate, respectively. Diets were formulated using User Friendly Feed Formulation Done Again (UFFDA) (Pesti *et al.,* 1992), according to nutritional suggestions. Chemical composition of experimental diets is presented in table 1. Body weight (gr), Body weight Gain (BWG) (gr), Food intake (gr) and Food Conversation Ration (FCR) were in three stages: stage one from days 0-7, stage two 7-21 and stage three 21-42 of the study during the study. Brest, drumstick, gizzard percent and total intestine length (Cm) were determined at day 42.

Statistical analysis

Data were analyzed by one-way analysis of variance (ANOVA) in a completely randomized design and treatment means were tested for statistical significance by Duncan's multiple range tests using SAS Statistical software (9.1.3, 2007).

Results and discussion

Results of different levels of copper sulfate on performance in Japanese quail are presented in tables 2-4. According to the results, no significant differences was observed on performance in birds fed supplemented diets with different levels of copper sulfate (50, 100, 150 and 200 mg) compared to control group at any stage of the study (p>0.05).

Table 1. Feed composition and nutrient contents of experimental diets of Japanese quails at grower period.

	Treatments				
	A	**B**	**C**	**D**	**E**
Ingredients					
copper sulfate	0	0.005	0.01	0.15	0.02
Corn grain	55	55	55	55	55
Soybean meal	33.34	33.35	33.35	33.35	33.35
Gluten meal	7	7	7	7	7
Oyster shell	1.5	1.5	1.5	1.5	1.5
DCP	0.84	0.32	0.32	0.32	0.32
Lys	0.32	0.32	0.32	0.32	0.32
Sodium bicarbonate	0.26	0.26	0.26	0.26	0.26
Soybean oil	0.11	0.12	0.12	0.12	0.12
Vit. Premixes	0.25	0.25	0.25	0.25	0.25
Min. Premixes	0.25	0.25	0.25	0.25	0.25
Salt	0.16	0.16	0.16	0.16	0.16
Nutrients (calculated)					
ME (Kcal/Kg)	2900	2900	2900	2900	2900
CP % [a]	24	24	24	24	24
Ca %	0.80	0.80	0.80	0.80	0.80
Av. P %	0.30	0.30	0.30	0.30	0.30
Met. % + Cys. %	0.81	0.81	0.81	0.81	0.81
Lys. %	1.35	1.35	1.35	1.35	1.35
Tryptophan %	0.30	0.30	0.30	0.30	0.30
Na %	0.15	0.15	0.15	0.15	0.15
K %	0.85	0.85	0.85	0.85	0.85
Cl %	0.14	0.14	0.14	0.14	0.14

DCP= Di calcium phosphate. ME = Metabolizable Energy. Lys: Lysine. Met: Methionine, Ca: Calcium, Cys: Cysteine.

Table 2. Effects of different Levels of copper sulfate on performance in Japanese quail at days 0-7.

Treatments	BW (gr)	BWG (gr)	FI (gr)	FCR
Control (A)	227.28	199.44	892.96	4.17
copper sulfate 50mg (B)	226.89	199.68	840.97	4.21
copper sulfate 100mg (C)	231.13	202.75	843.25	4.15
copper sulfate 150mg (D)	227.06	198.99	897.90	4.21
copper sulfate 200mg (E)	224.91	196.81	832.47	4.23
P value	0.6209	0.6346	0.8056	0.8819
SEM	2.759	2.635	7.548	0.056

Body weight: BW, Body weight Gain: BWG, Food intake: FI, Food Conversation Ration: FCR. SEM: Standard error mean.

It is suggested that supplementation of diet using different levels of Cu can improve growth performance in broilers cockerels. It seems, Cu has ability to promote growth (Pesti and Bakalli, 1996). The logical mechanism which suggested to acceleratory effects of Cu is that Cu may impress its effects by antimicrobial effects (Banks *et al.*, 2004 a, b). The results of our study were not in agreement with the previous studies.

Table 3. Effects of different Levels of copper sulfate on performance in Japanese quail at days 7-21.

Treatments	BW (gr)	BWG (gr)	FI (gr)	FCR
Control (A)	111.67	83.83	236.08	2.82
copper sulfate 50mg (B)	113.94	86.74	244.58	2.82
copper sulfate 100mg (C)	111.33	82.95	236.61	2.85
copper sulfate 150mg (D)	113.63	85.56	239.88	2.80
copper sulfate 200mg (E)	109.61	81.51	238.63	2.93
P value	0.516	0.371	0.261	0.768
SEM	1.934	1.932	2.805	0.079

Body weight: BW, Body weight Gain: BWG, Food intake: FI, Food Conversation Ration: FCR. SEM: Standard error mean.

Table 4. Effects of different Levels of copper sulfate on performance in Japanese quail at days 21-42.

Treatments	BW (gr)	BWG (gr)	FI (gr)	FCR
Control (A)	227.28	115.62	596.88	5.16
copper sulfate 50mg (B)	226.89	112.94	596.39	5.28
copper sulfate 100mg (C)	231.13	119.80	606.64	5.06
copper sulfate 150mg (D)	227.06	113.43	598.02	5.27
copper sulfate 200mg (E)	224.91	115.30	593.84	5.17
P value	0.620	0.419	0.726	0.620
SEM	2.758	2.656	6.801	0.108

Body weight: BW, Body weight Gain: BWG, Food intake: FI, Food Conversation Ration: FCR. SEM: Standard error mean.

In this study, no significant results was detected on performance in Japanese quail fed diets supplemented with copper sulfate (50, 100, 150 and 200 mg) compared to the control group at day 42 ($p>0.05$).

Table 5. Effects of different Levels of copper sulfate on carcass characteristics in Japanese quail (as percent of live bodyweight) at day 42.

Treatments	BW (gr)	Carcass yield	Brest	Drumstick	Gizzard	Intestine length Cm (Total)
Control (A)	226.11	61.19	25.70	14.44	2.26	74.75
copper sulfate 50mg (B)	230.47	61.92	26.59	15.24	2.26	78.01
copper sulfate 100mg (C)	225.51	61.41	25.68	14.91	2.37	76.29
copper sulfate 150mg (D)	223.70	60.91	25.15	15.33	2.28	74.80
copper sulfate 200mg (E)	225.82	61.49	25.51	14.91	2.25	74.92
P value	0.064	0.939	0.559	0.482	0.910	0.454
SEM	1.597	0.851	0.608	0.373	0.102	1.460

Body weight: BW, Cm: Centimeter. SEM: Standard error mean.

In the recent years several researches have been suggested that Cu sulfate (100-300 mg per Kg) has antimicrobial effects and increases growth rate in poultry (Karimi *et al.,* 2011). In this regard, we were not able to find article related to effects of Cu on performance in Japanese quail. Intestine microbial condition has undeniable role in biodiversity of the nutrients in animal. The effectiveness of the microbial population has positive correlation with ratio composition. Microbial population uses digested food ingredients. Recently, scientists use new strategies to increase biodiversity of the materials for animal growth. One of the strategies is using Cu sulfate to control intestine microbial condition (Aydin *et al.,* 2010). Moreover, it seems, Cu sulfate decreases lymphoid system to the disease and improves weight gain and performance in poultry (Pang *et al.,* 2009). The lack of a growth-enhancing effect of extra Cu in the present study may be related to the environmental sanitary conditions of the experimental facility and minimal environmental challenges during the experimental period. In this regard, it is reported that administration of Cu on piglet's diet leads to decrease bacterial population e.g. Coliforms and Streptococcus *Spp*. (Pang *et al.,* 2009). The feed intakes and body weights of 21- day-old chickens fed 300 or 450 mg Cu/kg diets from Tri-basic Cu chloride were increased compared to 300 or 450 mg Cu/kg levels from Cu sulfate but were similar at dietary concentrations of 150 mg/kg (Miles *et al.,* 1998). In the currents study different levels of Cu sulfate (50, 100, 150 and 200 mg) was not able to improve BW, BWG, FI and FCR in Japanese quail. Also, we were not able to find article related to effects of Cu on performance in Japanese quail. The U.S. EPA classified Cu as moderately toxic to birds based on the acute oral LD50 for bobwhite quail (*Colinus virginianus*) of 384 mg/kg Cu sulfate pentahydrate and 98 mg/kg metallic Cu. The chronic LOAEL in bobwhite quail is 289 mg/kg Cu as metallic copper. An acute oral LD50 for bobwhite quail exposed to Cu sulfate was also reported as 616 mg/kg Cu. The dietary LC50 for bobwhite quail is 1369 mg/kg Cu over 8 days (Tomlin, 1997). To our knowledge, there may be more mechanisms including in regulatory function of Cu sulfate on performance in Japanese quail which do not clarified yet. Also we recommend further researches need to identify detail of mechanism.

References

Abdellatif AMM. 1968. Conditioned hypocuprosis: some effects of diet on copper storage in ruminants. Verslagen van l-andbouv'kundige Onderzoekingen **709**. Wageningen.

Aydin A, Pekel AY, Issa G, Demirel G, Patterson PH. 2010. Effect of dietary copper, citric acid and microbial phytase on digesta pH and ileal and carcass microbiota of broiler chickens fed a low available phosphorus diet. Journal of Applied Poultry Research **19,** 422-431.

Banks KM, Thompson KL, Jaynes P, Applegate TJ. 2004a. The effects of copper on the efficacy of phytase, growth, and phosphorus retention in broiler chicks. Journal of Poultry Science **83,** 1335-1341.

Banks KM, Thompson KL, Rush JK, Applegate TJ. 2004b. Effects of copper source on phosphorus retention in broiler chicks and laying hens. Journal of Poultry Science **83,** 990-996.

Gaetke LM, Chow CK. 2003. Copper toxicity, oxidative stress, and antioxidant nutrients.

Gilbert RW, Sander JE, Brown TP. 1996. Copper sulfate toxicosis in commercial laying hens. Avian Disease **40 (1),** 236-239.

Idowu OMO, Laniyan TF, Kuye OA, Oladele-Ojo VO, Eruvbetine D. 2006. Effect of Copper 41. Salts on Performance, Cholesterol, Residues in Liver, Eggs and Excreta Of Laying Hens. Achieve Zootechnology. **55 (212),** 327-338.

Igbasan FA, Akinsanmi SK, Onibi GE, Adu OA. 2011. The effects of dietary supplementation of copper source and level on the oxidative stability of broiler meat assessed after refrigerated storage.

International Journal of Agriculture: Research and Review **1(2),** 53-58.

Karimi A, Sadeghi G, Vaziry A. 2011. The effect of copper in excess of the requirement during the starter period on subsequent performance of broiler chicks. Journal of Applied Poultry Research **20,** 203-209.
http://dx.doi.org/10.3382/japr.2010-00290.

Kornegay ET, Verstegen MWA. 2001. Swine nutrition and environmental pollution and odor control. In: A. J. Lewis and L. L. Southern (ed.) Swine Nutrition 611 p. CRC Press, Boca Raton, FL.

Luo XG, Ji F, Lin YX, Steward FA, Lu L, Liu B, Yu SX. 2005. Effects of dietary supplementation with copper sulfate or tribasic copper chloride on broiler performance, relative copper bioavailability, and oxidation stability of vitamin E in feed. Journal of Poultry Science **84(6),** 888-893.

Miles RD, O'Keefe SF, Henry PR, Ammerman CB, Luo XG. 1998. The effect of dietary supplementation with copper sulfate or tribasic copper chloride on broiler performance, relative copper bioavailability, and dietary prooxidant activity. Journal of Poultry Science **77,** 416-425.

Pang Y, Patterson JA, Applegate TJ. 2009. The influence of copper concentration and source on ileal microbial. Journal of Poultry Science **88,** 586-592.

Pesti GM, Bakalli RI. 1996. Studies on the feeding of cupric sulfate pentahydrate and cupric citrate to broiler chickens. Journal of Poultry Science **75,** 1086-1091.

SAS Inc. 2007. SAS OnlineDoc® 9.1.3. Cary, NC, USA.

Scan. 2003. Scientific Committee for Animal Nutrition: Opinion on the use of copper in Feeding stuff, European Commission publication.

Tomlin, CDS. 1997. The Pesticide Manual, A World Compendium, 15th ed.; British Crop Protection Council: Surrey, UK. 646-649 p. Toxicology **189,** 147-163.

Zahedi M, Ghiasi Ghalehkandi J, Ebrahimnezhad Y. 2013a. Effects of different Levels of copper sulfate on small on Intestinal Physiology in Japanese quail (*Coturnix coturnix japonica*). International Journal of Biosciences. In press.

Zahedi M, Ghiasi Ghalehkandi J, Ebrahimnezhad Y. 2013b. Effects of different Levels of copper sulfate on blood biochemical traits in Japanese quail (Coturnix *coturnix japonica*). International Journal of Biosciences. In press.