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EFFECTS OF DIFFERENT LEVELS OF COPPER ON BROILER PERFORMANCE

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ABSTRACT

Two hundreds and forty, one day old chicks were allocated randomly into 4 copper treatments (60 chicks each)in three replicates (20 chicks\replicate. They were housed in 12 pens. each pen was considered as experimental replicate . Copper levels, used as copper sulfate (Cu_2SO_4) were 0, 100, 200 and 300 mg/ kg diets. The criteria of response were body weight, weight gain, feed conversion, tibia measurements and mineralization and carcass traits.The experimental period was 35 days .

The results indicated that copper supplemented groups were recorded significantly higher values during the 4th and 5th week for body weight and during the grower and overall periods for body weight gain compared with the control group which recorded the lowest value for the same parameters and periods mentioned above. However, there were no significant differences in body weight and body weight gain during the 2nd week of the experiment among the different groups. On the other hand, there were no significant differences among tested groups for feed intake and feed conversion ratio for all experimental periods except the grower period where birds in the highest two level groups of copper supplementation consumed more feed compared with the other groups. Broiler groups fed diets supplemented with 100 and 300 ppm Cu gave the best values of feed conversion ratio compared with either 0 or 200 ppm Cu groups. No significant effects were detected in relative weights of carcass, liver, gizzard, heart, spleen, edible parts, inedible parts, fat and tibia due to feeding diets containing different levels of Cu supplementation. Also, there were no significant differences between groups fed different levels of Cu supplementation in all tibia measurements and mineralization except for group fed 300ppm Cu which recorded a significant decrease in Ca and P concentrations compared with the other groups.

It could be concluded from results obtained that copper sulfate supplementation up to 200 ppm to broiler diets had beneficial effect on growth performance under this study and without any adverse effects on carcass traits

Keywords: Poultry, copper, performance, carcass traits, tibia measurements and mineralization.

INTRODUCTION

With the increasing public concern of bacterial resistance to antibiotics, animal production industries are looking at alternatives that have antimicrobial properties, maintain intestinal health, and allow for optimal growth.

The copper requirement of broiler chickens is 8 mg/Kg diet (NRC, 1994). Copper (Cu) is an essential nutrient and it has been reported that sulfate form is more effective than oxide one (Cromwell *et al.*, 1989). A level of 125 to 250ppm Cu was reported to improve growth and feed efficiency in

broiler (Choi and Paik, 1989; Baker *et al.*, 1991). However, its excess in the diet depresses growth and feed efficiency in broilers (Baker et al , 1991), damage both gizzard (Robbins and Baker,1980) and liver functions (Chen *et al.*, 1996, 1997 a, b).

Chiou *et al.* (1999) demonstrated that high Cu (500 mg kg) in diet have damaged duodenal villi, therefore, it has an impact on nutrient absorption, depress food intake resulting in poor growth performance of broiler chickens. Inclusion of 500 mg kg of Cu in the diet did not disturb normal protein metabolism of broiler chicken (Chiou *et al.*, 1999).

Therefore, this experiment was designed to monitor the effect of copper sulfate supplementation on the performance, carcass traits and tibia measurements and mineralization of broiler chickens.

MATERIALS AND METHODS

The present study was carried out at Nutrition Farm and Laboratories, Poultry Production Department, Faculty of Agriculture, Ain Shams University, Shoubra El-khima, Egypt during the period from December 2007 to January 2008. Two hundreds and forty chicks, one day old were allocated randomly into 12 pens (20 chicks / pen). Each pen was considered as experimental replicate which were assigned to 4 copper treatments with three replicates each (60 chicks / treatment) for 35 days. At the beginning of this trial, the chicks in each pen were weighed and body weights were recorded .

The chicks were housed in floor pens with about 5 cm thick layer of wood-shaving. The pen density was 10 birds / m^2. The house was supplied with controlled ventilation system. The chicks were exposed to 24 h/day constant light. Feed and water were provided ad-libitum during the experimental period (35 days). Body weights (BW) and feed intake (FI) per replicate were recorded weekly and weight gain and feed conversion (g feed consumed / g weight gain) were calculated.

A basal diet was formulated to meet the nutrient requirements according to the nutritional recommendation of NRC (1994). The starter diet was used during the first two weeks from 0–2 wks which contained 23 % crude protein and 2900 kcal ME/kg diet, followed by grower diet from 2-4 wks which contained 21% crude protein and 3100 kcal ME/kg diet then, at the last week, finisher diet was used till the end of the study. The finisher diet contained 19 % crude protein and 3200 kcal ME/kg diet. Copper sulfate (Cu_2SO_4) was added to the basal diets to give four levels of copper (0, 100, 200 and 300 mg/ kg diets).

The diets composition and their chemical analysis are shown in (Table 1). Dry matter, crude protein, crude fiber and ether extract were analyzed according to the standard method of Association of Official Analytical Chemists (AOAC, 1995).

Table (1): Composition and calculated analysis of the experimental diets

Ingredients (%)	Starter (0 -2 weeks)	Grower (2 – 4 weeks)	Finisher (4 -5 weeks)
Yellow corn	50	54.5	58.8
Soya bean meal (44%)	39.9	33.1	23.5
Extruded Full Fat soybean (37%)	5.3	7	12.5
Vegetable oil	0.5	1.7	1.8
Mono calcium phosphate	1.4	1.2	1
Calcium carbonate (limestone)	1.7	1.5	1.5
Sodium chloride (salt)	0.3	0.3	0.3
Sodium bicarbonate	0.1	0.1	0.1
Vitamin & Mineral Premix	0.3	0.3	0.3
Methionine hydroxyl analogue (liquid)	0.4	0.3	0.2
L-lysine	0.1	0.03	0
Choline Chloride (60%)	0.02	0.02	0.02
Chemical and calculated analysis			
Dry matter (%)	87.98	87.8	87.64
Crude protein (%)	23	21	19
Crude fat (%)	4.76	5.98	6.32
Crude fiber (%)	3.61	3.58	3.40
Ash (%)	5.8	6.24	6.07
M E (kcal / kg)	3010	3150	3200
Calcium (%)	1	0.90	0.85
Phosphorus available (%)	0.5	0.45	0.42
Methionine (%)	0.51	0.45	0.39
Methionine + Cystine (%)	1.09	0.97	0.83
Lysine (%)	1.44	1.25	1.05
Sodium (%)	0.16	0.16	0.16

*** Composition of vitamin and minerals premix. Each 3 kg of vitamin and minerals mixture contain: 12000000 IU vitamin A; 2000000 IU D3; 10g E ; 1g K ; 1 g B1 ; 5g B2; 1500mg B6 ; 10mg B12 ;10g Pantothenic acid ; 20g Nicotinic acid ; 1g Folic acid ; 50mg Biotin ; 500 g choline chloride ;4 g copper ; 300 mg iodine ; 30g iron ;60 g Manganese; 50g Zinc; and 100mg selenium**

Four experimental treatments were used in this study. The first group was fed the basal diet without copper supplementation and considered as control while the other experimental diets were supplemented with different levels of Copper sulfate (100, 200 and 300 mg/ kg diets).

At the end of the trial, slaughter trial was conducted. Six chicks were taken randomly from each treatment (two chicks from each replicates) to determine the slaughter parameters. The weights of carcass, liver, heart, bursa, spleen and tibia were recorded to the nearest gram and the relative weights were calculated as percentages of live body weights. Tibia of both legs was removed, cleaned of flesh and all soft tissues. Dry tibia weight (DTW) and tibia length (TL) and width (TW) were measured using a caliper. Individual tibia weights were recorded and calculated as percentage of live body weight. Tibia bone was oven dried at 80^{o}C even a constant weight to determine the dry tibia weight, ground, dried at 105^{o}C even constant weight and ashed in a muffle furnace at 600 ^{o}C for 6-h then used for the chemical analysis. Tibia ash was calculated as percentage of dry tibia weight.

The data of body weight, body weight gain, feed consumption, feed conversion efficiency, slaughter test and tibia parameters were statistically analyzed using one–way analysis of variance using SAS computer program (SAS, 1996).

The data were analyzed by the following model:

$Yij = \mu + T i + eij$

μ = General mean

T i = random effect of treatments levels (i= 1,2,3and 4).

eij = a random error.

Significant differences among treatments means were determined by Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance

The results indicated that copper supplemented groups were recorded significantly higher values during the 4th and 5th week for body weight during the grower and overall periods for body weight gain compared with the control group which recorded the lowest value for the same parameter and periods mentioned above (Table 2). However, there were no significant differences for body weight and body weight gain during the 2nd week of the experiment between the groups fed diets supplemented with copper and those fed control diet.

Table (2): Effect of feeding different levels of Cu on productive performance of broilers

Items	Cont.	100	200	300	Sig.
Initial weight	53.17 ± 0.79	48.41 ± 0.79	49.21 ± 0.79	52.38 ± 0.80	
Live body weight (g) at:					
2 weeks	706.70 ± 19.25	691.00± 9.46	709.67 ± 9.85	705.10 ± 22.29	NS
4 weeks	1515.07^{b}± 35.78	1650.67^{a} ± 9.66	1626.33^{a} ± 13.53	1645.50^{a} ± 23.40	**
5 weeks	1828.6^{b} ± 32.12	1951.10^{a} ± 9.70	1956.67^{a} ± 28.96	1958.33^{a} ± 16.58	*
Body weight gain (g) at:					
0-2 weeks	653.53 ± 18.57	642.59 ± 9.44	660.46 ± 10.63	652.72 ± 22.29	NS
2-4 weeks	808.37^{b} ± 26.93	959.67^{a} ± 16.57	916.67^{a} ± 20.46	940.40^{a} ± 5.20	*
4-5 weeks	313.60 ± 6.06	300.43 ± 0.43	330.33 ± 16.33	312.83 ± 7.66	NS
0-5 weeks	1775.49^{b} ± 32.07	1902.69^{a} ± 9.08	1907.46^{a} ± 28.91	1905.95^{a} ± 16.58	**
Feed intake (g) at:					
0-2 weeks	706.70 ± 19.25	711.63 ± 10.55	720.47 ± 16.18	725.67 ± 7.31	NS
2-4 weeks	1349.32^{b} ± 28.25	1374.97^{b} ± 18.66	1461.60^{a}± 30.98	1419.51^{ab}± 31.16	*
4-5 weeks	1091.91 ± 7.45	1026.17 ± 1.39	1058.64± 18.50	1025.91 ± 4.86	NS
0-5 weeks	3147.93 ± 35.09	3112.77 ± 24.88	3240.70 ± 33.87	3171.09 ± 36.85	NS
Feed conversion ratio at					
0-2 weeks	1.08 ± 0.00	1.11 ± 0.03	1.09 ± 0.03	1.12 ± 0.03	NS
2-4 weeks	1.67^{a} ± 0.08	1.43^{b} ± 0.04	1.60^{b} ± 0.05	1.51^{b} ± 0.03	**
4-5 weeks	3.48 ± 0.05	3.42 ± 0.01	3.22 ± 0.13	3.28 ± 0.08	NS
0-5 weeks	1.77 ± 0.05	1.64 ± 0.02	1.70 ± 0.02	1.66 ± 0.01	NS

$^{a, b}$ Means within the same row with different superscripts are significant1y different, NS= Non Significant, * (P≤0.05), ** (P≤0.01).

The results indicated also that there were no significant differences among tested groups for feed intake and feed conversion ratio for all experimental periods except the grower period where the highest two levels of copper supplementation which consumed more feed compared with the other groups. On the other hand groups fed diet supplemented with 100 and 300 ppm Cu gave the best values of feed conversion ratio compared with either 0 or 200 ppm Cu groups. These results agree with the findings of Choi and Paik (1989) and Baker *et al.* (1991) who reported that copper supplementation at the levels of 125 to 250ppm improves growth and feed efficiency in broiler. Similar results were reported by Ward *et. al.* (1995).

Carcass traits:

Results concerning the effect of different levels of Cu supplementation on carcass traits are presented in Table 3and 4. No significant effects (P>0.05) were detected in relative weights of carcass, liver, gizzard, heart, spleen, edible parts, inedible parts, fat and tibia due to feeding diets containing different levels of Cu supplementation.

Table (3): Effect of different levels of Cu on carcass traits of broilers

Items	Cont.	100 Cu	200 Cu	300 Cu	Sig.
Hot carcass weight	1659.00 ± 11.36	1808.00 ± 35.02	1808.00 ± 76.13	1717.00 ± 85.75	NS
Liver weight	61.67 ± 6.49	55.34 ± 0.24	58.33 ± 2.40	56.00 ± 6.43	NS
Gizzard weight	32.33 ± 2.96	34.30 ± 0.89	28.40 ± 2.66	32.77 ± 4.41	NS
Spleen weight	3.17 ± 0.33	3.15 ± 0.48	2.97 ± 0.52	3.23 ± 0.45	NS
Heart weight	11.47 ± 1.88	13.22 ± 0.62	13.33 ± 0.33	12.27 ± 1.41	NS
Edible offal weight	108.63 ± 11.59	106.02 ± 0.65	103.03 ± 4.56	104.27 ± 12.31	NS
Total edible parts weight	1756.17 ± 1.93	1900.80 ± 35.26	1897.70 ± 74.51	1809.00 ± 96.09	NS
Bursa weight	4.00 ± 1.10	5.33 ± 0.38	5.03 ± 0.75	3.50 ± 0.67	NS
Abdominal weight	31.20 ± 1.91	30.67 ± 3.38	34.90 ± 9.51	40.67 ± 3.76	NS

NS= Non Significant.

Table (4): Effect of different levels of Cu on carcass traits percentage of broilers.

Item	Cont.	100 Cu	200 Cu	300 Cu	Sig.
Hot carcass weight %	66.18 ± 2.17	68.47 ± 0.76	69.62 ± 5.26	68.29± 1.08	NS
Liver weight %	2.45 ± 0.19	2.10 ± 0.04	2.24 ± 0.10	2.21 ± 0.16	NS
Gizzard weight %	1.28 ± 0.08	1.30 ± 0.06	1.09 ± 0.08	1.29 ± 0.13	NS
Spleen weight %	0.13 ± 0.01	0.12 ± 0.02	0.11 ± 0.02	0.13 ± 0.01	NS
Bursa weight %	0.16 ± 0.05	0.20 ± 0.02	0.19 ± 0.03	0.14 ± 0.02	NS
Fat weight %	1.25 ± 0.09	1.16 ± 0.11	1.36 ± 0.42	1.61 ± 0.08	NS
Heart weight %	0.45 ± 0.06	0.50 ± 0.01	0.51 ± 0.03	0.48 ± 0.04	NS
Tibia weight %	1.82 ± 0.07	1.84 ± 0.16	1.85 ± 0.14	2.08 ± 0.11	NS
Edible offal weight %	4.31 ± 0.34	4.02 ± 0.08	3.95 ± 0.14	4.12 ± 0.31	NS
Total edible parts weight %	70.48 ± 1.83	72.48 ± 0.82	73.57 ± 5.30	72.41± 1.15	NS

NS= Non Significant

Tibia measurements and mineralization:

The results of tibia measurements and mineralization are shown in table 5. The results indicated that there were no significant differences between groups fed different levels of Cu supplementation in all tibia

measurements and mineralization except for groups fed 300ppm Cu which recorded significant decrease in Ca and P concentrations compared with the other groups.

Table (5): Effect of feeding different levels of Cu on tibia traits of broilers

Item	Cont.	100 Cu	200 Cu	300 Cu	Sig.
Tibia weight	9.07 ± 0.07	9.67 ± 0.67	9.27 ± 0.41	10.73 ± 0.84	NS
Tibia length	100.07 ± 0.28	103.83 ± 1.42	101.47 ± 2.85	103.00 ± 1.53	NS
Tibia width	8.37 ± 0.70	7.80 ± 0.70	8.13 ± 0.73	7.33 ± 0.28	NS
Tibia calcium	11.85 [a] ± 0.13	11.88 [a] ± 0.28	11.85 [a] ± 0.35	7.35 [b] ± 1.51	**
Tibia phosphorus	5.67 [a] ± 0.07	5.73 [a] ± 0.10	6.16 [a] ± 0.60	3.58 [b] ± 0.75	*
Tibia copper	2.87 ± 0.39	3.65 ± 0.24	3.14 ± 0.02	2.75 ± 0.18	NS

[a, b] Means within the same row with different superscripts are significant1y different, NS= Non Significant, * (P≤0.05), ** (P≤0.01).

It could be concluded that copper sulfate can be added to growing poultry diets effectively under the same hygienic condition without any adverse effects on growth performance, carcass traits and animal health in general.

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تأثير مستويات مختلفة من النحاس على اداء كتاكيت التسمين

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تم استخدام عدد 240 كتكوت تسمين عمر يوم وتم تقسيمها عشوائياً على 12 عشه ارضية تحتوي على 8 مجموعات بكل منها 20 طائر. وتمت التغذية على عليقة أساسية أو عليقة أساسية مضافاً إليها كبريتات نحاس بثلاثة مستويات (100 أو 200 أو 300 مجم/كجم عليقة). وكانت الصفات محل الدراسة هي وزن الجسم ومعدل الزيادة في وزن الجسم ومعامل تحويل الغذاءوصفات الذبيحة ومقايس عظمة الساق والتحليل الكيماوي .

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

هناك فروق معنوية بين المجموعات بالنسبة لوزن الجسم الحي خلال الأسبوع الرابع والخامس حيث كانت مجموعة الكنترول هي الأقل مقارنة ببقية المجموعات.أما بالنسبة لمعدل الزيادة في وزن الجسم فقد كانت هناك فروق معنوية بين المجموعات خلال الأسبوع الثاني وكامل فترة التجربة. أوضحت دراسة معدل الأستهلاك الغذائى و التحويل الغذائى عدم وجود فروق معنوية بين المجموعات المختلفة خلال فترات التجربة بأستثناء مرحلة النامى حيث سجلت الطيور المغذاه على أعلى تركيزين من النحاس (200و300 مجم/كجم عليقة) معدلات استهلاك غذائى مرتفعة معنويا مقارنا ببقية المجموعات.

لم تكن هناك أي فروق معنوية بين المجموعات المختلفة في كافة الصفات محل الدراسة وقد أخذت النسبة المئوية بين صفات الذبيحة المختلفة ووزن الجسم الحي نفس الاتجاه.

لم تكن هناك اختلافات معنوية بين المجموعات المختلفة في مقاييس عظمة الساق أو تركيز العناصر المعدنية بها ماعدا تلك التي تغذت على اعلي تركيز من النحاس حيث سجلت انخفاضا معنويا لنسب الكالسيوم و الفوسفور بعظمة الساق.

وتوضح نتائج هذا البحث أن إضافة عنصر النحاس بمستويات حتى 200 مجم/كجم عليقه كان له تأثيرا ايجابيا على الأداء الإنتاجي لكتاكيت اللحم وبدون أي تأثيرات سلبية على صفات الذبيحة أو عظمة الساق كذلك تركيزات العناصر المعدنية لعظمة الساق

قام بتحكيم البحث

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