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EFFECT OF SUPPLEMENTING COPPER SULFATE ON PRODUCTIVE PERFORMANCE AND CARCASS TRAITS OF PEKIN DUCKS: 1- GROWTH PERFORMANCE .

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Abstract *: A total number of 240 Pekin ducklings at 3-weeks-old Pekin ducklings were weighed, and divided into 4 groups to investigate the effect of supplementing copper sulfate at levels of 0 , 100 , 300 and 500 mg / kg diet from 3 to 13 weeks of age on some growth performance and carcass traits .The results indicated that all levels of copper sulfate supplementation produced significantly higher body weights of ducklings by about 5.46 to 9.04 % compared to the control at 12 weeks of age , but the improvement of body weights at 6 and 9 weeks of age were not significantly affected . Body weight gain of ducklings was significantly improved at periods 6– 9 , 9–12 and 3–12 weeks of age in the groups fed diets supplemented with 300 and 500 mg $CuSO_4$/ kg diet compared to the control . Feed consumption (g /duck / 21 days) was significantly decreased due to treatment by 7.9 – 8.5 % compared to the control only during the period 3 – 6 wks of age, while it was not affected at the other experimental periods . Feed conversion (g feed / g BW gain) was significantly improved due to treatment at different periods except the periods 3-6 and 9-12 wks of age in the groups fed diets supplemented with 100 mg $CuSO_4$ kg .Blood serum parameters of male or female ducklings were significantly affected by supplementation of copper sulfate to the diets .Total cholesterol in female ducklings was significantly decreased by supplementing 100 mg $CuSO_4$ /kg diet, while significantly increased by supplementing 500 mg $Cuso_4$ / kg diet. Serum HDL cholesterol was significantly increased in male and female ducklings with supplementing 300 mg $CuSO_4$/ kg diet .Serum triglycerides were significantly decreased in female ducklings with all levels of copper sulfate supplementation, and in male ducklings with supplementing 300 mg $CuSO_4$ / kg diet only . Serum total protein was significantly increased with supplementing 100 and 300 mg $CuSO_4$ / kg diet in female ducklings . Serum GOT and GPT in male ducklings were significantly increased with supplementing 100 and 500 mg $CuSO_4$/ kg diet , while , significantly decreased*

with supplementing 100 and 300 mg CuSO4/ kg diet in female ducklings . Carcass traits were not significantly affected by treatment. The edible parts and dressed carcass percentages were improved, while abdominal fat was decreased by about 22.7 % by using 500 mg $CuSO_4$ / kg diet compared to the control .Chemical analyses of carcasses meat were not significantly affected by treatment, however dry matter ,ether extract and ash were numerically decreased and total moisture and protein were increased by increasing copper sulfate levels . These results indicated that copper sulfate could be supplemented to starter and grower duck diets up to 500 mg / kg without any adverse effects on their growth performance. and it may reduced abdominal fat and improved dressed carcass and edible parts percentages..

INTRODUCTION

Copper sulfate is a naturally-occurring inorganic salt and copper is an essential trace element in animal nutrition (*Davis and Mertz, 1987*). Traditionally, the source of copper has been copper sulfate pentahydrate due to cost and commercial availability. Copper sulfate may interfere with the use of antibiotics, arsenicals, and histomoniastats in poultry diets (*Carlson et al., 1979*).The broiler chick's nutritional requirement for copper is approximately 8 mg/kg (*NRC 1994*). Copper (Cu) is usually fed commercially at much higher pharmacological levels (100 to 300 mg/kg diet) because of its growth promoting properties (*Wang et al., 1987; Bakalli et al., 1995; Pesti and Bakalli,1996*). Dietary copper, when fed at physiological as well as pharmacological levels, has been demonstrated to alter the lipid metabolism of chickens (*Bakalli, et al., 1995*). Metabolic changes resulting from dietary copper include: changes in the rate of cholesterol biosynthesis and hepatic glutathione concentrations (*Kim et al., 1992*); and the relative distributions of various fatty acids in porcine fat deposit (*Amer and Elliot, 1973*). Copper may also have some antibiotic properties , acting in some way to reduce bacterial toxin production , may also affect intestinal microflora (*Johnson et al., 1985).Lei (1991*) suggested that hypercholesterolemia, induced by copper deficiency. If blood glutathione is critical, in regulating cholesterol biosynthesis as a result of dietary copper deficiency, it was speculated that cholesterol synthesis and concentration might vary over a wide range of copper intakes, not just as a symptom of copper deficiency disease. *Pettit et al.,(1998*) reported that copper sulfate pentahydrate, cupric citrate, and copper oxychloride are valid options for growth promotion , moreover, average body weights were

increased for all forms of copper supplementation at 35 and 56 d of age. Dietary Cu enhances performance in poultry and swine when fed over the NRC minimum requirements (*Hill et al., 2000; Skrivan et al., 2000)* . *Waldroup et al.,(2003)* showed that no significant effects were observed on mortality, dressing percentage, or parts yield of broiler by using diets containing 250 mg copper sulfate/kg. *Luo et al.,* (2005) showed that chicks fed diet supplemented with 450 mg Cu / kg as copper sulfate had significantly lower average daily feed intake and average daily gain than those consumed other diets supplemented with 0 , 150, 300 mg Cu /kg . Feeding chickens supra normal levels of copper for 35 and 42 d resulted in decreases of plasma and breast muscle cholesterol and plasma triacylglycerols (*Pesti et al., 1994; Bakalli et al.,1995; Pesti and Bakalli, 1996*). *Arias and Koutsos (2006*) reported that carcass weight of chickens increased by supplementation of dietary copper sulfate (CuSO4) to a basal diet at 188 mg Cu/kg .

The objectives of the present study were to assess if the supplementation of copper sulfate (0, 100, 300 and 500 mg/kg) to the diet of Pekin ducklings affects on growth performance parameters , serum constituents , chemical analysis of meat and carcass yield during the growth period from 3 to 13 weeks of age .

MATERIALS AND METHODS

This study was carried out at El – Serw Water Fowl Research Station , Animal Production Research Institute , Agricultural Research Center, Ministry of Agriculture ,Egypt. It was started in October 2006 and terminated in January 2007. Two hundred and forty unsexed Pekin ducklings at 3-weeks old were weighed and distributed into four experimental groups without significant differences in average weight . Each group contained 60 ducklings and equally subdivided into 3 replicates .Ducklings in each replicate were housed as 4 birds /m^2. They were reared under similar hygienic and managerial conditions . The ducklings were brooded in well ventilated brooding pens (3.4 x 8.6 m) from day-old up to 4 weeks of age , at the end of brooding period the ducklings were permitted to go out for yards . Wheat straw was used as a litter throughout the experimental period . Throughout the experimental period , feed and fresh water were available all the time .Ducklings were fed layer-starter diet up to 8 weeks and a layer-grower diet during 9 - 13 weeks of age ,the composition and calculated analysis of the basal diets are shown in (Table 1). Four experimental diets were prepared as the basal diets were supplemented

with graded levels of copper sulfate (0 , 100 , 300 and 500 mg / kg diet) and fed to ducklings from the end of 3 weeks until 13 weeks of age .

Parameters estimated and data collection :

1- Growth traits: Body weight of ducklings was recorded at 3 , 6 ,9 and 12 weeks of age. Body weight gain , feed consumption and feed conversion were calculated through the periods 3– 6 , 6–9 , 9–12 and 3–12 weeks of age.

2- Blood biochemical analysis : At 12 weeks of age , blood samples were collected in centrifugation tubes from the wing vein from (3 males and 3 females) of each treatment without anticoagulant and kept at room temperature for one hour to clot. The centrifugation tubes were then centrifuged at 3000rpm for 15minutes to separate clear serum . After that ,serum total protein , triglycerides , total cholesterol , HDL cholesterol and transaminase enzymes activities (GPT and GOT) were determined calorimetrically using available commercial Kits.

3- Slaughter traits : At 13 weeks of age, three male ducklings from each treatment group were randomly chosen for slaughter test. Ducklings were fasted for 12 hours before slaughtering and individually weighed pre and after slaughtering and complete bleeding .Presently after scalding , feather picking and evisceration were performed and different body parts , organs and abdominal fat were dissected and weighed . Then , samples of breast and thigh meat with skin were taken , dried, ground and used for chemical analysis . Proximate analysis of both breast and thigh dried meat was carried out according to the official methods *(A.O.A.C,1980).*

4- Statistical analysis **:** Data were analyzed by the analysis of variance according to *Snedecor and Cochran (1982)* . Significant differences among means were detected by the Duncan's Multiple Range Test (*Duncan , 1955*).

RESULTS

Growth performance :

The effect of copper sulfate supplementation on some growth performance parameters of Pekin ducklings at different ages are shown in Table (2) .The data indicated insignificant differences in body weights at 6 and 9 weeks of age. All levels of copper sulfate supplementation significantly caused higher body weight of ducklings by about 5.46 to 9.04 % compared to the

control (unsupplemented) at 12 weeks of age , but body weighs at 6 and 9 weeks of age was not significantly affected by treatments . Body weight gain of ducklings was not significantly affected during the first period 3-6 weeks of age, while it was significantly improved ($p \geq 0.05$) during the periods 6–9 , 9–12 and 3–12 weeks of age by about 16.04 ,11.57 , 26.30 , 24.02 , 11.95 and 11.78 % in the groups fed diets supplemented with 300 and 500 mg $CuSO_4$ / kg diet compared to the control , respectively . Also , body weight gain of group fed diet supplemented with 100 mg $CuSO_4$/kg diet was improved by 11.24 and 6.45 % during the periods 9-12 and 3–12 weeks of age compared to the control. Feed consumption (g /duck / 21 days) was significantly decreased by using copper sulfate supplementation by about 7.9 – 8.5 % compared to the control only during the period 3 – 6 weeks of age. Feed conversion was significantly improved by copper sulfate supplementation at different periods except the periods 3-6 and 9-12 wks in the groups fed diets supplemented with 100 mg $CuSO_4$/ kg .

Blood serum parameters

Blood serum parameters of Pekin ducklings at 12 weeks of age are presented in Table (3) . All studied blood serum parameters of male or female ducklings were significantly affected by copper sulfate supplementation to the diets except total cholesterol and protein of male ducklings. Serum total cholesterol in female ducklings was significantly decreased by about 6.48 % with supplementing 100 mg $CuSO_4$/kg diet, while, significantly increased by 13.59 % with supplementing 500 mg $CuSO_4$/ kg to the diets compared to the control . Serum HDL cholesterol was significantly increased by 15.84 and 15.68 % in male and female ducklings with supplementing 300 mg $CuSO_4$/ kg to the diets compared to the control. Serum triglycerides were significantly decreased in male ducklings by about 21.89 % with supplementing 300 mg $CuSO_4$ / kg to the diets, and , 12.94 ,21.23 and 30.35 % in female ducklings with supplementing 100 , 300 and 500 mg $CuSO_4$/kg to the diets compared to the control , respectively . Serum total protein of male ducklings was decreased due to treatment , while in female ducklings was significantly increased by about 14.3 and 16.67 % with supplementing 100 and 300 mg $CuSO_4$/ kg to the diets compared to the control ,respectively. Serum GOT and GPT of male ducklings were significantly increased compared to the control due to treatments except GPT in the group fed diet supplemented with 300 mg $CuSO_4$

/ kg diet , while significantly decreased by supplementing 100 and 300 mg $CuSO_4$/ kg to the diets of female ducklings compared to the control .

Carcass yield and other slaughter traits :

Effect of copper sulfate supplementation to the diets on relative weight of some carcass traits of Pekin male ducklings at 13 weeks of age are presented in Table 4 . All traits of male Pekin duckling carcasses were not significantly affected by the treatment. However, dressed carcass percentage values were 65.52 , 66.60 , 67.90 and 67.43 % of the groups fed diets supplemented with 0.0 , 100 , 300 and 500 mg $CuSO_4$ / kg diet , respectively , it was improved by about 1.65 ,3.63 and 2.92 % compared to the control , respectively. Edible part percentage values were 75.50,76.18,76.89 and 76.57 % of the groups fed diets supplemented with 0.0 , 100 , 300 and 500 mg $CuSO_4$ / kg diet , respectively , it was improved by about 1.01 ,1.84 and 1.42 % compared to the control , respectively. Whereas , unedible parts percentages were decreased by about 2.8, 5.67 and 4.37 % of the groups fed diets supplemented with 100 , 300 and 500 mg $CuSO_4$ / kg diet compared to the control , respectively . It is worthy to note that abdominal fat was decreased by about 22.7 % by using 500 mg $CuSO_4$/ kg diet compared to the control .

Chemical analysis of meat :

Effect of copper sulfate supplementation to the diets on some chemical analysis of Pekin male ducklings meat at 13 week of age are presented in Table 5 . All studied chemical analysis were not significantly affected by the dietary treatment .However ,dry matter and ether extract of breast and thigh meat of Pekin male ducklings were numerically decreased by increasing copper sulfate level in the diet , while , moisture and crude protein tend to increase for the groups fed diet supplemented with 100 and 500 mg $CuSO_4$ / kg diet compared to the control . Ash of breast meat was decreased , while it increased in thigh meat due to treatment. Ether extract decreased by about 9.56 ,11.49 % of breast and thigh meat by using 500 mg $CuSO_4$/ kg in the diet compared to the control .On the other hand , crud protein increased by about 8.88 and 7.95 % by using the same level compared also to the control

DISCUSSION

Copper is required for the activity of enzymes associated with iron metabolism ,elastin and collagen formation and the integrity of the central

nervous system .It is required for normal blood cell formation, maximum immune response is also dependent on copper as indicated by depressed titers in deficient animals. Evidence indicates that liver copper regulates cholesterol biosynthesis by reducing hepatic glutathione concentrations (*Kim et al., 1992*). Glutathione is known to regulate cholesterol biosynthesis through the stimulation of the enzyme 3-hydroxy-3 methylglutaryl- coenzyme A (HMG-CoA) reductase (*Valsala and Kurup, 1987*). The HMG-CoA reductase activity is the rate-limiting step of mevalonate and, ultimately, cholesterol biosynthesis. The effects of copper sulfate supplementation on some growth performance parameters in this study indicated that live body weight was significantly increased due to treatment by levels 100,300 and 500 mg $CuSO_4$/kg diet at 12 weeks of age , body weight gain was significantly improved due to treatment with 300 and 500 mg $CuSO_4$/kg diet during periods 6-9,9-12 and 3-12 weeks of age . Feed consumption was significantly decreased during the first period 3-6 weeks of age , while, not affected during the other experimental periods .Whereas , feed conversion was significantly improved by treatment with 300 and 500 mg $CuSO_4$/kg diet during the different experimental periods except the periods 3-6 and 9-12 wks of age in the group fed diet supplemented with 100 mg $CuSO_4$/ kg compared to the control .These results agreed with those obtained by *Harms and Buresh (1987), Pesti and Bakalli (1996), Leeson et al.,(1997*), *Pettit et al.,(1998), Hill et al.,(2000) , Skrivan et al.,(2000) , Luo et al.,(2005) and Arias and Koutsos ,(2006*). All studied blood serum constituents in female ducklings were significantly decreased by supplementing copper sulfate to the diet such as total cholesterol (100 mg $CuSO_4$/kg) , serum triglycerides (100,300 or 500 mg $CuSO_4$/kg) and serum GOT and GPT (100 or 300 mg $CuSO_4$/kg) ,while , significantly increased total protein (100 or 300 mg/ $CuSO_4$kg) .Also, all studied blood serum constituents in male ducklings were significantly increased by supplementing copper sulfate to the diet such as HDL cholesterol (300 mg $CuSO_4$/kg) , serum GOT (100,300 or 500 mg $CuSO_4$/kg) and serum GPT (100 or 500 mg $CuSO_4$/kg) ,while , significantly decreased serum triglycerides (300 mg/kg) compared to the control ,these results are on line of those obtained by *Pesti et al., (1994), Bakalli et al., (1995) and Konjufca et al., (1997)***.** All studied carcass traits of Pekin male ducklings were not significantly affected by the treatment , edible parts and dressed carcass percentages were improved , whereas , giblets and unedible parts percentages as well as abdominal fat percentage were decreased. These

results are in agreement with those obtained by *Bakalli et al., (1995*), and *Arias and Koutsos (2006*).

CONCLUSION

The results of the present study indicated that copper sulfate could be supplemented to starter and grower duck diets up to 500 mg / kg without any adverse effects on their growth performance. besides it may reduced abdominal fat and improved dressed carcass and edible parts percentages

Table (1) : Composition and calculated analysis of the basal diets fed to pekin ducks throughout the experimental periods

Ingredients %	Starter (3–8 wks)	Grower (9–13 wks)
Yellow corn	65.00	63.00
Soya bean meal (44 %)	30.45	15.50
wheat bran	0.65	17.75
Dicalcium phosphate	1.80	1.25
limestone	1.40	1.80
Vit & Min. premix *	0.30	0.30
Salt (NaCl)	0.30	0.30
DL. Methionin	0.10	0.10
Total	**100.0**	**100.0**
Calculated analysis **		
Crude protein %	19.12	15.04
ME (Kcal / kg)	2865	2687
Total calcium (%)	1.029	1.041
Total phosphorus (%)	0.72	0.71
Vit A IU / kg	4000	3900
Vit E mg / kg	20.8	21.65
Vit D IU / kg	500	500

Contents per 3 kg premix vit A 2 miu , vit D3 0.5 miu, vit E 5 g , vit K3 1 g , vit B1 1 g , vit B2 4 g , vit B6 1.5 g , Niacin .acid 20 g , Pentathonic acid 10 g , Folic acid 1 g , Biotin 50 g , Choline 50 g , Zinc 45 g , Copper 3 g , Iodine 0.3 g , Iron 30 g , Selenium 0.1 g , Manganese 40 g and carrier $CaCo_3$ to 3000 g . ** According to NRC (1994)

Table (2) Effect of copper sulfate supplementation to Pekin duck diets (mg/kg) on their growth performance at different ages.

Age wks	Copper sulfate level				Sig
	0.0	100	300	500	
Body weight (g/duck)					
3	492.7 ± 2.3	505.7 ± 12.5	487.2 ± 2.5	490.2 ± 7.7	NS
6	1249.2± 20.5	1243.2± 24.0	1241.2± 33.4	1283.5 ± 33.0	NS
9	1972.5± 65.8	2056.8± 60.5	2081.0± 38.0	2090.5 ± 35.0	NS
12	2375.5± 94.4^{b}	2505.2± 45.5^{a}	2589.0± 54.7^{a}	2590.3 ± 82.1^{a}	0.05
B. W. gain (g/ duck / 21days)					
3 - 6	756.5 ± 8.2	737.5 ± 12.6	754.5 ± 32.0	789.0 ± 28.0	NS
6 - 9	723.3±45.3^{b}	813.7 ± 60.0^{a}	839.8 ± 9.8^{a}	807.0 ± 4.8^{a}	0.05
9 - 12	403.0±28.6^{b}	448.3 ±18.5^{ab}	509.0 ± 17.7^{a}	499.8 ± 52.4^{a}	0.05
3 - 12	1878.3±92.1^{b}	1999.5±50.4^{ab}	2101.8± 52.8^{a}	2099.5 ±76.3^{a}	0.05
Feed consumption (g /duck/21 days)					
3 - 6	2750. ±129.9^{a}	2516.5±38.2^{b}	2533.0±28.9^{b}	2533. ± 76.4^{b}	0.05
6 - 9	3475.0±114.6	3525.0±139.2	3500.0±114.6	3391.5 ± 87.8	NS
9 - 12	3158.3±118.1	3391.7±180.9	3341.7± 38.2	3500. ± 139.2	NS
3 - 12	9383.3±359.1	9433.0± 28.9	9366.7± 80.4	9425.0 ± 50.0	NS
Feed conversion (g .feed /g B.W.gain)					
3 - 6	3.63 ± 0.09^{b}	3.42 ± 0.10^{ab}	3.36 ± 0.11^{a}	3.19 ± 0.21b^{a}	0.05
6 - 9	4.81 ± 0.16^{b}	4.34 ± 0.21^{a}	4.16 ± 0.10^{a}	4.20 ± 0.13^{a}	0.01
9 - 12	7.85 ± 0.029^{c}	7.57 ± 0.57^{bc}	6.57 ± 0.24^{a}	7.03 ± 0.49^{ab}	0.05
3 - 12	4.99 ± 0.07^{c}	4.71 ± 0.11^{b}	4.45 ± 0.10^{a}	4.49 ±.0.17^{a}	0.01

a,b,c :means in the same row bearing different superscripts are significantly different ($p \leq 0.05$).
BW =body weight
Ns= non significant

Table (3) Effect of copper sulfate supplementation to the diets (mg/kg) on blood serum parameters of Pekin ducklings at 12 weeks of age .

Sex	Copper sulfate level				Sig
	0.0	100	300	500	
Total cholesterol (mg/dl)					
♂	175.0 ± 1.0	175.0 ± 6.2	173.0± 2.0	180.0± 10.0	NS
♀	174.3± 4.5^{b}	163.0± 3.0^{c}	179.0± 3.0^{b}	198.0± 4.0^{a}	0.01
Overall	174.6±0.5	169.0±8.5	176.0±4.2	189.0±12.7	
HDL cholesterol (mg/dl)					
♂	48.6± 4.0^{bc}	46.0±2.0^{c}	56.3±1.5^{a}	51.6±3.5^{ab}	0.05
♀	53.6± 4.0^{ab}	51.0± 3.0^{b}	59.0± 3.0^{a}	47.3± 3.5^{b}	0.05
Overall	51.1±3.5	48.5±3.5	57.7±1.9	49.5±3.0	
Total Protein (mg/dl)					
♂	4.7± 0.2	4.4± 0.6	4.3± 0.4	3.8± 0.2	NS
♀	4.2±0.1^{b}	4.8±0.2^{a}	4.9±0.1^{a}	4.2±0.2^{b}	0.01
overall	4.5±0.4	4.6±0.3	4.6±0.4	4.0±0.3	
G p T (U/ml)					
♂	35.6± 2.0^{b}	39.0± 2.0^{a}	37.0± 3.0^{b}	43.0± 2.0^{a}	0.05
♀	72.0± 2.0^{a}	59.3± 2.5^{b}	58.6± 4.0^{b}	71.0± 4.0^{a}	0.01
overall	53.8±25.7	49.2±14.4	47.8±15.3	57.0±19.8	
G O T (U/ml)					
♂	28.0± 3.0^{c}	51.0± 3.0^{a}	42.0± 2.0^{b}	50.0± 5.0^{a}	0.01
♀	56.0± 2.0^{a}	42.0±3.0^{b}	29.0±3.0^{c}	59.0±3.6^{a}	0.01
overall	42.0±19.8	46.5±6.4	35.5±9.2	54.5±6.4	

a,b,c :means in the same row bearing different superscripts are significantly different ($p \leq 0.05$).
Ns= non significant

Table (4) Effect of copper sulfate supplementation to diets (mg/kg) on relative weight of carcass parts of male Pekin ducklings at 13 week of age

Items	Copper sulfate level				Sig
	0.0	100	300	500	
L.B.W. (g)	2483.3±76.3	2583.3±152.	2676.6±50.3	2596.6±18.	NS
%					
Head	3.95±0.30	4.09±0.18	3.62±0.60	4.08±0.12	NS
Abdominal fat	0.66±0.11	0.75±0.32	0.67±0.30	0.51±0.12	NS
Liver	2.09 ±0.32	1.71±0.27	1.68±0.04	1.68±0.07	NS
Gizzard	3.16±0.33	3.10±0.49	3.19±0.40	2.77±0.11	NS
Heart	0.76 ±0.10	0.67±0.02	0.71±0.07	0.61±0.07	NS
Giblets	6.01±0.56	5.72±1.22	5.36±0.54	5.06±0.16	NS
Dressed carcass	65.52±1.24	66.60±0.23	67.90±1.52	67.43±0.68	NS
Edible parts	75.50±0.43	76.18±0.35	76.89±1.0	76.57±0.73	NS
Bill crop	0.17±0.02	0.14±0.02	0.21±0.06	0.15±0.07	NS
Un edible .parts	24.50±0.43	23.82±0.35	23.11±1.00	23.43±0.73	NS

NS = not significant
L.B.W = live body weight
Giblets % = liver % + gizzard % + heart %
Dressed carcass %= total carcass (without head , legs, abdominal fat, viscera and lunges) as percent of live body weight
Edible parts % = dressed carcass % + giblets % + head %

Table (5) Effect of copper sulfate supplementation to duck diets (mg/kg) on some chemical analysis of Pekin male ducklings meat at 13 week of age.

Parts of carcass	Copper sulfate level				Sig
	0.0	100	300	500	
Moisture %					
Breast	61.97 ± 4.79	63.66 ± 1.28	61.38± 2.15	63.28 ± 0.34	NS
Thigh	66.83 ±4.15	67.99 ±5.90	65.24±4.99	66.99±1.96	NS
Dry matter %					
Breast	38.03 ±4.79	36.17 ±1.02	38.62 ±2.15	36.71 ±0.33	NS
Thigh	33.17 ±4.15	32.01 ±5.89	34.76 ±4.99	33.01 ±1.96	NS
Ether extract %					
Breast	19.61 ±4.93	18.22 ± 1.39	20.22 ±3.06	17.73 ± 0.77	NS
Thigh	15.01 ±4.10	12.42 ±3.68	18.63 ±4.27	13.49 ±2.80	NS
Crude Protein %					
Breast	16.76 ±2.22	16.61 ± 0.86	16.92 ±2.45	17.53 ± 0.38	NS
Thigh	16.99 ± 0.40	18.32 ± 2.30	14.82 ±2.33	18.34 ± 1.41	NS
Ash %					
Breast	1.66 ± 0.18	1.34 ± 0.06	1.48 ± 0.07	1.44 ± 0.08	NS
Thigh	1.17 ± 0.03	1.26 ± 0.37	1.30 ± 0.18	1.16 ±0.07	NS

NS = not significant .

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الملخص العربي

تأثير إضافة كبريتات النحاس على الأداء الانتاجى وصفات الذبيحة في البط البكينى 1- آداء النمو

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أجرى هذا البحث لدراسة تأثير إضافة مستويات متدرجة (صفر ، 100 ، 300 ، 500 مجم / كجم عليقة) من كبريتات النحاس إلى علائق البط البكينى خلال فترة النمو على مظاهر النمو وبعض مكونات سيرم الدم وصفات الذبيحة. تم استخدام عدد 240 كتكوت بط بكيني عمر ثلاثة أسابيع قسمت إلى أربعة مجاميع تجريبية بكل منها 60 كتكوت في ثلاثة مكررات متساوية . استخدم في الدراسة أربعة علائق بادئ بياض متساوية البروتين والطاقة(19 % بروتين خام ، 2865 كيلو كالورى/ كجم) من 3-8 أسابيع وأربعة علائق نامي بياض متساوية البروتين والطاقة (15% بروتين خام ، 2687 كيلو كالورى /كجم) من 9- 13أسبوع وتم تقديمها للمجموعات التجريبية الأربعة خلال فترة النمو . تم وزن الطيور على فترات كل ثلاثة أسابيع من 3 إلى 12 أسبوع من العمر وتم تسجيل استهلاك العليقة وحساب الزيادة المكتسبة في وزن الجسم وكذلك التحويل الغذائي لكل فترة وكذلك خلال الفترة التجريبية الكلية ، عند عمر 12 أسبوع تم أخذ عينات دم من الطيور الحية ذكور وإناث لتقدير محتوي سيرم الدم من البروتين الكلى والجلسريدات الثلاثية والكولسترول الكلى و HDL كولسترول وإنزيمات التراتس أمينيز GOT,GPT وعند عمر 13 أسبوع تم عمل اختبار ذبح لتقدير قياسات الذبيحة في الذكور.

من التحليل الاحصائى أتضح وجود تحسن معنوي نتيجة المعاملات التجريبية في نتائج وزن الجسم عند 12 أسبوع ، الزيادة المكتسبة في وزن الجسم في كل الفترات ما عدا 3-6 أسبوع ، معدل التحويل الغذائي بينما لم يتأثر استهلاك العليقة معنويا بالمعاملات . تأثرت كل مكونات الدم المدروسة معنويا بالمعاملات ولم تتأثر قياسات الذبيحة المدروسة معنويا بالمعاملات وان كان دهن البطن انخفض بمقدار 22.7% باستخدام 500 مجم كبريتات نحاس /كجم عليقة بينما لم تتأثر التحليلات الكيميائية للحم بالمعاملات المختلفة .

يستنتج من الدراسة قدرة البط البكينى على الاستفادة من كبريتات النحاس حتى مستوى 500 مجم / كجم عليقة دون أي تأثير ضار على النمو فضلا عن انخفاض دهن البطن وتحسن نسبة التصافي ولأجزاء المأكولة من الذبيحة .