Effct Of Addition Diffrent Levels Of Copper Sulfate and Vitamin C To The Diet on Productive Performance in Broiler Chickens.

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Abstract

The current study was designed to investigated the effect of adding different levels (0, 100, 200 and 400 mg/kg feed) of copper sulphate and (500 mg/kg feed) vitamin C to the basic diet provided to the birds on some productive characteristics of broilers. In the study. Two hundred and eighty eight day-old Ross famels broiler chicks were assigned equally into eight dietry treatments for (35) days , with three replicates of 12 chicks each. Treatments:

T1 = control treatment without additions.

T2 = addition (500 mg/kg) of vitamin C.

T3= addition (100 mg/kg) of copper sulphate.

T4 = (100 mg/kg) of copper sulfate + (500 mg/kg) of vitamin C.

T5 = (200 mg/kg) of copper sulphate.

T6 = (200 mg/kg) of copper sulphate + (500 mg/kg) of vitamin C.

T7 = (400 mg/kg) of copper sulphate.

T8= (400 mg/kg) of copper sulfate + (500 mg/kg) of Vitamin C.

The results indicated, there were significant increse ($p \leq 0.05$) in the average of body weight and Body weight gain in T3 and T4 birds compared with control treatment during the study period (35) days.No significant effect on the rate of feed intake at age (0-7) days. Significant superiority ($p \leq 0.05$) for birds of T4 in the second and fourth weeks from the study, and a significant improvement in the feed intake for T3 and T1 in the fourth week .There was a significant superiority ($p \leq 0.05$) in feed intake for T1 in the fifth week of the experiment . Significant superiority ($p \leq 0.05$) in (FCR) in treatment T3 and T4 during all the study period.

Introduction

Feed additives are any substance or group of substances added as pure or loaded to the material of the diet or mixture with diets in small quantities to meet the specific needs of it (1). Feed additives is added to the diet of birds to improve their nutritional value, and enhance the bird's performance by increasing the rate of growth by improving the efficiency of food conversion and reducing the rate of mortality in broilers by reducing the incidence of disease (2).

Poultry needs low quantities from copper sulphate ($CuSO_4$).While copper sulphate is very important because it enters into many vital and metabolic processes within the body it acting as astimulating for growth (3). Many researchers have observed that adding levels of copper sulphate (125 to 250 mg) has led to a positive response to body weight and feed conversion efficiency (4). Copper can also be added to the bird's diet under many forms as a growth activating, yet the most widely used form is the sulphate (5). As the general interest in the resistance of bacteria to antibiotics in the poultry industry has increased, attention has been paid to alternatives that have antimicrobial properties and at the same time maintain the health of the intestines. The process of using modern unusually and unconventional methods in the treatment of birds, such as the use of probiotics and use of some certain enzymes, some hormones and minerals , The US Environmental Protection Agency (EPA) approved in (2008) the use of some of useful natural alternative

therapies in the GRAS list (General Recognized As Safe) Its a list of safe substances that can be used in the usues of human nutrition and nutrition of farm animals and one of them is the copper sulphate materials the subject of our research (6). Copper gives great attention for its antimicrobial properties, which improved production performance at the same time.

Vitamin C , a water soluble vitamin, which increases the resistance of birds to certain bacterial and viral diseases and thus reduces mortality (7).

The objective of this experiment is to study the effect of the addition copper sulphate in different levels and vitamin C on some of growth performance of the broilers.

Materials and Methods

This study was carried out in the field of poultry broiler that belong to the Department of Animal Production / Agriculture College/ University of Basra, for the period from 5/9/2017 until 11/10/2017. A total of 288 birds of one-day old famels Ross broiler which were provided from aprivate Hatcheries from Baghdad province. birds were housed in (24) cages.Water and feed were provided libitum and birds reared under strict hygienic and standard management conditions.

Copper sulfate and vitamin C mixed with the food and added as:

T1 = control treatment without additions.

T2 = addition (500 mg/kg) of vitamin C.

T3= addition (100 mg/kg) of copper sulphate.

T4 = (100 mg/kg) of copper sulfate + (500 mg/kg) of vitamin C.

T5 = (200 mg/kg) of copper sulphate.

T6 = (200 mg/kg) of copper sulphate + (500 mg/kg) of vitamin C.

T7 = (400 mg/kg) of copper sulphate.

T8= (400 mg/kg) of copper sulfate + (500 mg/kg) of Vitamin C.

The birds were weighed at the beginning of the experiment collectively, and their weight was repeated weekly until the end of the experiment (at the age of 35 days). body weight , body weight gain , rate of feed intake (9) and food conversion efficiency were calculated (10).

Contents	Starter diet (1–19) days	grower diet (20–35) days
Metabolizable energy (kcal / kg)	2995	3190
Crude protein (%)	23.16	20.08
Calcium (%)	1	0.95
Available phosphorus (%)	0.61	0.65

The experimental data were analyzed using CRD SPSS 2012 Version 19(56).

Results and discussion

Table (1) shows the effect of the addition of copper sulphate and vitamin C on live body weight at different ages of broilers. The table showed significant effect ($p \leq 0.05$) to add copper sulphate and vitamin C to the live weights of birds in different treatments. T3 and T4 were significantly higher compared to the control diet and those other diets during the study period (7, 14, 21, 28 and 35 days). T4 recorded (165.23, 444.96, 866.99, 1413.00 and 1891.3) g/bird respectively , T3 recorded (449.13, 876.66, 1417.00 and 1889.00) g/bird respectively. While the lowest was recorded in T7 during the same trial period Which was not significantly different from the performance of treatments T1,T2,T8. treatment T7 recorded the weights (155.33, 388.90, 767.33, 1270.00 and 1702.66) g / birds, respectively. These results are agreed with (3) and (11).

The increase in body weight in T3 and T4 (100 mg / kg/diet copper sulphate with or without adding (500 mg) of vitamin C may be attributed to the addition of copper sulphate, which has a positive effect on increasing nutrients intake and It also improves the metabolism of carbohydrates and metabolism of proteins in the body and affirmative of body weight has been attributed to the relationship between copper and growth hormone (12).Copper has been instrumental in increasing the production of growth hormone (12) which is very important in metabolizing amino acids, building proteins, increasing muscle mass and then increasing growth rate by increasing the concentration of amino acids within cells which will increases the process of protein synthesis (13).While some researchers attributed this improvement in the productivity performance to the improvement in digestion in general (14).The results of this experiment were agreed with what was found by (15), which indicated a significant increase in the weight of birds fed on diets containing copper sulphate compared to control birds through the role of copper sulphate in reducing the impact of stress by providing a harmonious environment in the digestive system, which reflected positively on the general health of birds and thus increase weight gain which confirmed by (4).These combined or non-combined factors may be responsible for the significant improvement in the weight of the birds.

Vitamin C has a positive effect on improving the weight of the body (16). Vitamin C has an important role in improving metabolic processes in the body of birds, Which leads to an increase in the weight of birds, Just as vitamin C raises the basic metabolic rate and thus increases body weight. (17). Vitamin C also plays an important role in the representation of amino acids, phenylalanine and tyrosine, which are essential substances in the synthesis of thyroid hormones which are essential hormones in the natural growth process and their absence leads to a decrease in the concentration of growth hormone as it has an important impact in the maintenance of growth hormone (18). The growth definition is an increase in the number and size of cells and thus due to the vitamin role in the increase of the building of the body cells, including the muscular system and these results confirm what was found by **Shoeib (1996)** (19) And (20) and others who observed an

improvement in body weight of broilers when adding vitamin C to their diets. It was also consistent with the results of **Ghazi (2015)** (21) which showed a significant improvement in the weights broilers fed on a diet containing 500-200 mg from vitamin C.

It is possible that the superiority of the treatments T3 and T4 copper sulfate (100 mg/kg) feed with or without vitamin C(500 mg/kg) feed may be attributed to the synergistic effect of both copper sulphate and vitamin C (22). Copper sulphate has a positive effect on lipid metabolism ,energy, improves protein metabolism carbohydrate and increased absorption of nutrients in the body of birds (3). As well as the role of vitamin C which increases the efficiency of the immune system of birds and the important role in the processes of oxidation and reduction, it has a key role in the metabolism of many essential minerals such as iron, selenium and vitamin E (23), which improves the health and physical health of birds and contribute to weight gain This agreed with (24) who used dietry supplements with level of (250 mg/kg) of copper sulphate on broilers for (6) weeks and found improving growth performance,including increase in body weight gain. While the significant decrease in birds weight of treatments T7 and T8 copper sulfate (400 mg/kg) fed with or wothout vitamin C (500 mg/kg) feed may be due to the low feed intake rate in this treatment, which resulted in a decrease in growth rate which was not consistent with (25) his study indicated that the addition of (400 mg/kg) fed recorded an increase in the live body weight of birds at age (21 - 42 days) compared with the other treatments used in his experiment (100 and 200 mg copper sulphate mg/kg feed) at the same ages above. Low weight who recorded at the high levels of addition Copper sulphate maybe refers to its negative effect on low glutathione (GSH), which reduced the stimulation of HMG-CoA reduction activity (26) which confirmed by (27).

Table (1) Effect of addition of copper sulphate and vitamin C on live body weight at ages 7, 14, 21, 28 and 35 days for broilers (M g/bird ± SE)

Age weeks / Treatments	(0-7) days	(7-14) days	(14-21) days	(21-28) days	(28-35) days
T1	156.40^{c} ± 1.68	405.50^{c} ± 6.04	798.33^{c} ± 2.90	1319.33^{c} ± 4.66	1779.66^{c} ± 7.57
T2	157.03^{c} ± 0.93	420.96^{b} ± 1.41	801.33^{c} ± 4.25	1330.33^{c} ± 6.00	1797.50^{b} ± 4.40
T3	162.86^{ab} ± 2.67	449.13^{a} ± 2.07	876.66^{a} ± 5.78	1417.00^{a} ± 6.42	1889.00^{a} ± 4.93
T4	165.23^{a} ± 1.38	444.96^{a} ± 2.82	866.99^{a} ± 9.71	1413.00^{a} ± 9.84	1891.33^{a} ± 18.94
T5	159.73^{b} ± 1.72	424.96^{b} ± 1.72	826.66^{b} ± 4.40	1350.33^{b} ± 9.26	1801.33^{b} ± 11.97
T6	160.50^{b} ± 1.04	422.90^{b} ± 3.11	829.33^{b} ± 9.33	1345.33^{b} ± 5.89	1804.00^{b} ± 8.88
T7	155.33^{c} ± 1.12	388.90^{d} ± 4.90	767.33^{d} ± 2.96	1270.00^{e} ± 2.51	1702.66^{e} ± 13.54
T8	155.56^{c} ±2.22	417.56^{b} ± 2.93	790.66^{c} ± 3.78	1299.32^{d} ± 8.68	1739.98^{d} ± 11.55
significant	*	*	*	*	*

N.S: None Significant

*: Significant (different letters vertically represent significant differences at the level of ($P \leq 0.05$).

T1 = control treatment without additions , T2= Add vitamin C 500 mg/kg feed , T3= Add copper sulphate 100 mg/kg feed, T4= copper sulfate 100 mg/kg feed + vitamin C 500 mg/kg feed, T5= Add copper sulphate 200 mg/kg feed, T6= copper sulfate 200 mg/kg feed + vitamin C 500 mg/kg feed, T7= Add copper sulphate 400 mg/kg feed, T8= copper sulfate 400 mg/kg feed + vitamin C 500 mg/kg feed.

In Table (2) shows the effect of the addition of copper sulphate with different concentrations and vitamin C to the diet provided to the birds on the weight gain of birds at different ages.The statistical analysis showed a significant superiority ($p \leq 0.05$) for additive treatments compared with the control treatment for weight gain. The highest rates were recorded in T3 and T4 treatments throughout all the experiment compared with those feed other diets. During the ages (7, 14, 21, 28 and 35) days, T4 birds recorded the following weight gain rates (120.23,279.73, 422.03, 565.00 and 478.66) g/bird respectively. Which did not differ significantly from the performance of T3 birds which recorded for the same periods (117.86, 286.26, 427.53, 540.33 and 472.00) g/bird respectively. While T7 and T8 treatments recorded the lowest value in the rate of weight gain during the experiment period compared the control diet. Significant decrease was observed in the treatment T7 for ages (7, 14, 28 and 35) days which recorded the following rates (110.33, 233.56, 502.66 and 432.66) g/bird At the third week the lowest rate was found in T8 (373.10) g/bird which was not significantly different from T2 and T7 for the same period.

It is possible to note that the addition of copper sulphate has led to an increase in the rate of weight gain. This feature is an important target for breeders in the poultry industry because of its importance and great economic feasibility. The reason may be that copper sulphate enters strongly in the functions of some of the major enzymes such as (Ceruloplasmin). This compound which acts as a co- enzyme for the oxidation of minerals, especially iron and also enzyme (dismutase / SOD superoxid) and this enzyme has an important role in protecting and release the body of free radicals which cause great damage to cell membranes and thus provides protection against the catabolism reactions in the body. Anti-oxidant systems protects the body from free radicals, which cause huge damages to the cell membrane and amino acids , then block the building of proteins in the body (28) , (29) and (30).

Copper also works to increase muscle mass in the body (3) through clear mechanisms as the copper regulates the balance of nitrogen in the body and increase the availability of amino acids for absorption in the intestines (31) which is essential in the process of building protein inside the cells and the result of increasing the amount of muscle in the body will positively reflected on body weight (32), as it has an important role in the oxidation of lysine. This result was consistent with what was mentioned by a number of researchers (33), (34) and (35). Copper sulfate is highly effective in regulating the preparation of beneficial intestinal bacteria (intestinal flora) and reducing the incidence of bacterial infections, which leads to increased villus area and thus increase the absorption of nutrients will leads to increased growth, which referred by (3) and agreed with results of (36) and adopted (11). Another factor is the effect of copper on the increase the level of factors that stimulate the mitosis of the blood serum (26), (37), (38) and (39). The addition of copper sulphate (100 mg/kg diet + 500 mg/kg) vitamin C may be attributed to the synergistic effect of both copper sulfate and vitamin C which have positive effect on improving metabolic processes in bird bodies, The synergistic effect of copper sulfate and vitamin on stress reduction and a number of cytoplasmic enzymes in the blood may has a positive effect on weight gain. The results of the present study are consistent with what was found by (40).

Table (2) Effect of addition of copper sulphate and vitamin C on the rate of weight gain at ages (7, 14, 21, 28 and 35) days for broilers (M g/bird ± SE).

Age weeks / treatments	(0-7) days	(7-14) days	(14-21) days	(21-28) days	(28-35) days
T1	111.40^{c} ± 1.68	249.10^{c} ± 4.37	392.83^{b} ± 3.28	521.00^{b} ± 7.02	460.33^{b} ± 12.91
T2	112.03^{c} ± 0.93	263.93^{b} ± 0.94	375.37^{c} ± 4.76	524.00^{b} ± 5.19	462.16^{b} ± 7.63
T3	117.86^{ab} ± 2.67	286.26^{a} ± 4.05	427.53^{a} ± 5.25	540.33^{a} ± 11.05	472.00^{a} ± 4.58
T4	120.23^{a} ± 1.38	279.73^{a} ± 1.71	422.03^{a} ± 11.08	565.00^{a} ± 5.50	478.66^{a} ± 12.81
T5	114.73^{b} ± 1.72	265.23^{b} ± 3.32	403.43^{b} ± 2.28	523.66^{b} ± 13.56	451.00^{b} ± 3.60
T6	115.50^{b} ± 1.04	262.40^{b} ± 3.81	406.43^{b} ± 6.26	516.00^{b} ± 6.80	459.66^{b} ± 11.05
T7	110.33^{c} ± 1.12	233.56^{d} ± 4.22	379.43^{c} ± 4.96	502.66^{c} ± 4.48	432.66^{c} ± 12.00
T8	110.56^{c} ± 2.22	262.00^{b} ± 4.04	373.10^{c} ± 2.26	508.66^{bc} ± 4.91	440.66^{c} ± 17.34
significant	*	*	*	*	*

N.S: None Significant

* Significant different letters vertically represent significant differences at the level of ($P \leq 0.05$).

T1 = control treatment without additions , T2= Add vitamin C 500 mg/kg feed , T3= Add copper sulphate 100 mg/kg feed, T4= copper sulfate 100 mg/kg feed + vitamin C 500 mg/kg feed, T5= Add copper sulphate 200 mg/kg feed, T6= copper sulfate 200 mg/kg feed + vitamin C 500 mg/kg feed, T7= Add copper sulphate 400 mg/kg feed, T8= copper sulfate 400 mg/kg feed + vitamin C 500 mg/kg feed.

Table (3) shows the effect of the addition of copper sulphate with different concentrations and vitamin C to the diet fed to the birds on the food intake in different ages. Dietry supplements had no significant impact on the feed intake at first week.At the age of 14 days, the birds of T3 and T4 recorded the higher rates for feed intake (356.36 and 352.40 g) while tratment T7 was significantly lower (305.96 g) at the same age compared with control. In the third week T1 and T6 were recorded Significant increase (574.47 and 566.11 g) respectively compared with other treatments, these results were agreed with (41) who used the laying chicken (lalghorn) in his study and used (3) levels from copper sulphate (no addition, 250 mg and 500 mg/kg feed) the addition of 500 mg was given the lowest rate of food consumption compared with the other treatments. While at the age of (21) days the lowest rate of feed intake in treatment T2 which gave (525.71) and did not notice any significant differences with T8 which amounted (533.53 g.) and the treatment T1 (control) significantly increased ($p \leq 0.05$) for food intake rate at the age of 28 days and reached (881.63 g) , Which did not differ significantly from the T4 treatment that achieved (870.81 g) , the lowest food consumption rate at 28 days was recorded in T6 (815.28 g) and at 35 days the highest rate (868.14 g) which was significantly similar with T2 while the lowest consumption of food was in T7 (796.09 g), which did not differ significantly from T5 and T8, who recorded (813.19 and 806.41 g.)

The results of the analysis of variance above showed that there was a difference in the quantities of food consumetion between different treatments during all the experiment period. T3 and T4 given (copper sulphate 100 mg/kg with or without 500 mg/kg vitamin C) recorded The highest rate of food consumetion at age (14) days and this superiority is linked to a large correlation with both the body weight and body weight gain the table (1) and Table (2) we note the superiority of the same treatment above for these two character. The increase in weight is an increase in growth and its high weighting will increases food needs for maintaining and growth. The increase in feed consumption led to the supplies of more essential nutrients for birds who confirmed by (25).The level (100 mg/kg copper sulphate) had a positive

effect on increasing feed consumption by improving the metabolism of proteins and carbohydrates and also increasing the utilization of cellulose available in the diet due to the increased activity of bile enzymes (3) and confirmed by (43) Adding that supplementation with concentrations of 80-110 mg/kg is sufficient to improve the function of mitochondria and respiratory activity. At age (21 and 35) days, T1 control birds were superior to feed consumption ratio (41) as for the feed consumption at age 28, we note the superiority of the treatment of control (without additions) and the treatment of T4 (addition of 100 mg/kg of copper sulphate + 500 mg/kg vitamin C feed) on the rest of the treatments. This finding is an agreement with the previous study that indicated that the addition of copper sulphate at levels of (180 - 250 mg) led to an increase in feed consumption due to the higher growth lead to a higher increase in feed consumption, as confirmed by (3) and agreed with (41) and (45).

The decrease in the performance of the birds given 400 mg copper sulphate agreed with (46) and (47) which indicated that birds giving diets containing copper sulphate at levels of 300-500 mg/kg feed has a negative effect on the feed consumption rate which may have an effect on composition of birds gastrointestinal tract.

From the above results, the addition of copper sulphate and vitamin C did not have an significant effect at the first 7 days at feed intake. The reason behind that that the digestive system of the chicks is not sufficiently developed to be more benefit from the addition of sulfur and the vitamin C (22), because birds at early ages are more affected with environmental variables and conditions around them (48). While the reason for the superior treatment T4 (100 mg/kg copper sulfate + 500 mg/kg vitamin C) at the second week and T5 (200 mg/kg copper sulfate + 500 mg/kg vitamin C) at the third week from the study can be attributed for positive synergistic effect both copper sulfate and vitamin C have been shown to improve the health and growth of birds as they can help reduce disease challenges and enhance immune function (49).

Also our results agreed with (35) that mentioned the influence of copper sulphate as an effective antioxidant against fat oxidation,vitamins and amino acids that dissolve in fat in birds diets and feed products, which have a negative impact on the quality of feed and its consumption and lately reduce its consumption and adverse effect of the situation (50) and (34).

Table (3) The effect of addition of copper sulphate and vitamin C on the feed intake rate at age (7, 14, 21, 28 and 35) days for broilers (M g. ± SE)

Age weeks / Treatments	(0-7) days	(7-14) days	(14-21) days	(21-28) days	(28-35) days
T1	149.33 ± 2.02	336.63^{c} ± 0.95	585.70^{a} ± 8.00	881.63^{a} ± 13.53	868.14^{a} ± 16.40
T2	148.66 ± 0.88	340.66^{b} ± 2.60	525.71^{c} ± 9.18	839.31^{b} ± 11.40	853.46^{a} ± 9.04
T3	146.08 ± 1.52	356.36^{a} ± 0.73	574.47^{ab} ± 13.24	842.49^{b} ± 18.42	831.37^{b} ± 13.25
T4	149.66 ± 0.88	352.40^{a} ± 0.60	561.30^{b} ± 19.28	870.81^{a} ± 15.96	837.66^{b} ± 15.39
T5	149.00 ± 1.52	342.15^{b} ± 2.01	564.80^{b} ± 8.23	843.09^{b} ± 27.23	813. 19^{c} ± 3.17
T6	150.00 ± 2.08	335.87^{c} ± 1.66	566.11^{ab} ± 2.97	815.28^{b} ± 9.14	822.79^{bc} ± 22.59
T7	148.66 ± 1.45	305.96^{d} ± 2.14	557.76^{b} ± 5.01	822.72^{b} ± 2.46	796.09^{d} ± 18.41
T8	147.63 ± 1.15	337.98^{c} ± 3.94	533.53^{c} ± 2.93	829.12^{b} ± 11.84	806.41^{cd} ± 28.39
Significant	N.S	*	*	*	*

N.S: None Significant

* Significant different letters vertically represent significant differences at the level of ($P \leq 0.05$).

T1 = control treatment without additions , T2= Add vitamin C 500 mg/kg feed , T3= Add copper sulphate 100 mg/kg feed, T4= copper sulfate 100 mg/kg feed + vitamin C 500 mg/kg feed, T5= Add copper sulphate 200 mg/kg feed, T6= copper sulfate 200 mg/kg feed + vitamin C 500 mg/kg feed, T7= Add copper sulphate 400 mg/kg feed, T8= copper sulfate 400 mg/kg feed + vitamin C 500 mg/kg feed.

The effect of dietry supplementaion of cooper sulphate with deffrent levels and vitamin C on (FCR) feed Conversion ratio in birds is as shown in table (4).The table shows a significant increase ($p \leq 0.05$) for adding copper sulphate in all duration of the experiment was significantly ($p \leq 0.05$) higher for T4 and T3 birds during the trial period (7, 14, 21, 28 and 35 days) T3 recorded (1.24, 1.24, 1.34, 1.56 and 1.76) respectively , T4 birds recorded (1.24, 1.26, 1.33, 1.54 and 1.75) respectively.This improvement in feed conversion ratio continued until end of the experiment. At the first week of this study asignificant decrease ($p \leq 0.05$) was recorded in the (FCR) of T1 and T7 birds recorded (1.34) which did not differ significantly from the performance of T2 and T8 birds. At the ages of (14, 21, 28 and 35 days) the T1 (control) recorded the lowest rates of feed conversion ratio (1.35, 1.49, 1.69 and 1.88) respectively. Table 4 shows that T1 (control) and T7 treatment recorded the lowest rates of feed conversion ratio from the first week to the end of the experiment age of marketing (35) days , however when we comparing the performance of birds with the addition of high copper sulphate treatments T7 and T8 (addition of 400 mg/ kg feed) we will observe that the performance of birds with the high addition of copper sulphate was better the performance of T1 (control) birds without addition.

The significant improvements of the treatment given to the dose (100 mg) of copper sulphate in the values of the feed conversion ratio on the rest of the treatments and even the treatments given the vitamin C indicates for the effectiveness of copper sulphate, which is confirmed by the apparent improvement in the level of metabolic and absorbent processes in the bodies of birds (51) and confirmed by (52). As well as the important effect of copper in the maintenance and improvement of metabolic processes of proteins and carbohydrates and fats, which lead to increased growth (11) as the efficiency of feed conversion is a good indicator to the extent of the use of the bird body of the nutrients consumed and converted to the units of building mass body and these results were consistent with the results of (53) , (51) and (4). also agreed with (54) and (55) who refered that the use of copper at levels ranging from 75-250 mg with laying chicken diets enhances and improves the Food conversion efficiency rates.

It can be said that at levels of (100−250) mg, from copper sulfate has no unhealthy effects on the food conversion factor, which confirms the body's ability to adapt with it and invest in vital activities of the body (51) confirmed by (4) and (35).

The results indicated that the addition of copper sulphate at level of (100 mg/kg) feed significantly improved the efficiency of food conversion for birds compared with control treatment, which did not have copper and also the rest of the treatments.Also the improving in feed conversion raio in vitamin−containing treatments with diet could also be attributed to the positive role of vitamin C in raising metabolic activity in bird bodies and thus improving the weight gain that improves dietary conversion efficiency(17).

Table (4) Effect of addition of copper sulphate and vitamin C on the rate of feed conversion ratio at age (7, 14, 21, 28 and 35) days for broilers (M ± SE).

Age weeks / Treatments	(0–7) days	(7–14) days	(14–21) days	(21–28) days	(28-35) days
T1	1.34^{c} ± 0.032	1.35^{d} ± 0.027	1.49^{d} ± 0.008	1.69^{d} ± 0.011	1.88^{d} ± 0.014
T2	1.33^{c} ± 0.005	1.29^{b} ± 0.005	1.40^{b} ± 0.008	1.60^{b} ± 0.012	1.85^{c} ± 0.008
T3	1.24^{a} ± 0.025	1.24^{a} ± 0.015	1.34^{a} ± 0.014	1.56^{ab} ± 0.015	1.76^{a} ± 0.015
T4	1.24^{a} ± 0.010	1.26^{ab} ± 0.006	1.33^{a} ± 0.011	1.54^{a} ± 0.015	1.75^{a} ± 0.014
T5	1.30^{b} ± 0.005	1.29^{bc} ± 0.024	1.40^{b} ± 0.012	1.61^{bc} ± 0.012	1.80^{b} ± 0.008
T6	1.30^{b} ± 0.019	1.28^{b} ± 0.012	1.39^{b} ± 0.014	1.58^{b} ± 0.008	1.79^{b} ± 0.008
T7	1.34^{c} ± 0.004	1.31^{c} ± 0.021	1.47^{d} ± 0.012	1.64^{c} ± 0.011	1.84^{c} ± 0.008
T8	1.33^{c} ± 0.021	1.29^{bc} ± 0.030	1.43^{c} ± 0.008	1.63^{c} ± 0.011	1.83^{c} ± 0.005
Significant	*	*	*	*	*

N.S: None Significant

* Significant different letters vertically represent significant differences at the level of ($P \leq 0.05$).

T1 = control treatment without additions , T2= Add vitamin C 500 mg/kg feed , T3= Add copper sulphate 100 mg/kg feed, T4= copper sulfate 100 mg/kg feed + vitamin C 500 mg/kg feed, T5= Add copper sulphate 200 mg/kg feed, T6= copper sulfate 200 mg/kg feed + vitamin C 500 mg/kg feed, T7= Add copper sulphate 400 mg/kg feed, T8= copper sulfate 400 mg/kg feed + vitamin C 500 mg/kg feed.

Conclusion

In general, it can be concluded from this study that the addition of copper sulphate to broiler had a positive effect, which led to improve production performance such as body weight and weight gain rates.It also had an effective and beneficial effect on food consumption and food conversion ratio. Copper sulphate at level of (100 mg/kg) feed significantly superior on the rest of the treatments .Vitamin C has the ability to reduce the negative impact of using copper sulphate with level 400 mg/kg feed.

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