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EFFECT OF DIFFERENT LEVELS OF DRINKING WATER IRON AND COPPER ON SOME PRODUCTIVE TRAITS OF BROILERS

Hamza Gh. Habib, Ali H. Kh. Al-Hilali and Jassim K.M. Al-Gharawi

Department of Animal Production, Agriculture College, University of Al-Muthanna, Iraq.

Abstract

A total of 405 one day old of broiler chicks Ross 308 were used, randomly distributed to nine treatments by 45 chicks per treatment with three replicates (15 chicks per replicate) in the batteries containing the cage dimensions of (1.5 × 1.0 m). The treatments were as follows,T1: control treatment without addition. T2: added 150 ppm iron powder/ liter of drinking water. T3: Added 200 ppm iron powder/ liter of drinking water. T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water. T6: Added a mixture (Fe 150 ppm + Cu 25 ppm) / liter of drinking water. T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water. T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water. T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water. The results showed that was significant increase ($p \leq 0.05$) on some productive performance (body weight, weight gain, feed intake, and feed conversion ratio) of the treatments in which iron was added in its different levels as compared to control treatment. There was significant increase ($p \leq 0.05$) on some productive performance (body weight, weight gain, feed intake, and feed conversion ratio) of the treatments in which copper was added in its different levels as compared to control treatment.

***Key words*:** Drinking Water, Iron, Copper, Productive traits, Broilers.

Introduction

The addition of mineral elements is a necessity for the growth of the chickens, where they share many physiological and biologic processes of the digestive system of poultry, it also acts as a catalyst for enzymes or coenzyme, and has an effect on the central metabolism of food and hormone secretion pathways (Świątkiewicz *et al*., 2014).These elements were divided into two parts in terms of the bird's need, the first elements are needed by the birds in large quantities and therefore added in percentages when the composition of the relationship and the requirements for the maintenance and growth of meat breeds such as calcium, phosphorus and potassium (Proszkowiec and Angel, 2013), the second is the elements that are needed in very small quantities and are measured as part of a million and are called rare elements, these rare elements are essential ingredients in the composition of the bush such as iron, copper and chrome (Toor *et al*., 2007). Despite the low proportion of the components of the bush and with that percentage, its impact on the production of animals in general and poultry in particular cannot be ignored (Drinceanu *et al*., 2010). Copper is a rare element and at the same time has immunological properties and a very high impact on the bird's immune system and iron metabolism, as well as inserts into various tissue structures (Berwanger *et al*., 2018), had an important role in maintaining the proportion of copper in the blood, heart and liver of poultry, which helps in the formation and transport of iron component of blood hemoglobin (Fisher *et al*., 2007). Iron has an essential role to play in the body's tissues, it is a major component of hemoglobin in the blood and myoglobin found in muscle cells and is essential for the cells function (Bao *et al*., 2007). The aim of the study to determine the effect of adding iron and copper elements in some of the production traits of broilers.

Material and Methods

This experiment was conducted in the poultry field, the research station and agricultural experiments, Agriculture College, Al-Muthanna University from 5/10/2018 to 10/11/2018. A total of 405 one day old Ross 308 broilers, 40 g mean weight were used at the research, the chicks were reared inside a hall 40 x 10 m (four-storey batteries), each floor contained a 1.5 x 1 m cage, the chicks were randomly distributed to nine experimental treatments with 45 brooders per treatment and three recurrences of treatment (15 chick / replicate). The treatments were as follows, T1: control treatment without addition. T2: added 150 ppm iron powder/ liter of drinking water. T3:Added200 ppm iron powder/ liter of drinking water. T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water. T6: Added a mixture (Fe150 ppm + Cu 25 ppm) / liter of drinking water. T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water. T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water. T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water.

FeO, commonly known as iron oxide, was used by the company US Research Nanomaterials, Inc., USA, with a capacity of 1000 mg of nanowire.

CuO, commonly known as Copper Oxide, is used by US Research Nanomaterials, Inc., and is one gram of 1000 nm copper. It is characterized by the fact that it is fast soluble with diluted acid. Therefore, copper is diluted with a small amount of citric acid (20-10ml) to dissolve in acid and then add directly To the water to be homogenized with him.

The studied production characteristics are the weekly mean weight, weekly weight gain, weekly feed consumption and feed conversion.

Completely Randomized Design (CRD) was used to study the effect of different coefficients on the studied traits, comparison of the mean differences between the means of the Duncan (1955) multiples test under a significant level of 0.05 and 0.01, SAS (2001) was used in statistical analysis.

Results and Discussions

Table 1 shows no significant differences in the first week of bird life in all treatments, a significantly increased (P≤0.05) in the second week for treatment T9 Fe 200 + Cu 50 ppm / L) compared to T8 (Fe 200 + Cu 25 ppm / L), which was significantly higher (P≤0.05) on T7 (Fe150), T3 (Fe150 + Cu25), T6 (Fe150 + Cu50), which a significantly increased (P≤0.05) on the treatment T4 Cu 25 ppm / L) which in turn was significantly higher (P≤0.05) at the expense of the control treatment. In the third week, T9 was significantly higher (P≤0.05) than T8and T7, which significantly higher (P≤0.05) than T3 and T3 (P≤0.05). While in the fourth week of the age of birds, the mental superiority (P≤0.05) in treatment T9 compared to the treatment T8, which a significantly exceeded (P≤0.05) on the treatment T7 on T6, which significantly exceeded (P≤0.05) on T3, which significantly exceeded (P≤0.05) on T5, T2, and T4 significantly higher than control treatment. In the fifth week, the treatments were also significantly different. Moral improvement in the highest percentages of copper and iron powder was combined with the higher and lower levels. Which was also significantly higher (P≤0.05) compared to T7, which significantly higher (P≤0.05) on T6, which significantly exceeded (P≤0.05) on T5, T3 control treatment.

This is explained by the fact that the addition of iron to poultry diets, including meat breeds, leads to increased body weight and weight gain due to the positive role played by iron as a catalyst for growth (Dakdoka *et al*., 2012). For copper, it is due to the catalytic role that helps increase absorption, metabolism of proteins and carbohydrates in the bird's body, and thus a significant increase in bird growth and augmentation (Bakalli *et al*., 2006)

Table 1 : Effect of adding iron and copper to drinking water in the weekly body weight (g) of broilers.

Treatments	**Age (week)**				
	1	**2**	**3**	**4**	**5**
T1	2.93± 157.76	^{g}3. 75 ±343.66	4.72±734.00^{g}	^{g} 9.86 ±1235.00	^{g} 17.6 ±1896.66
T2	± 158.902.20	^{ef}2.60±370.33	3.48± 820.66^{e}	^{f} 8.14 ±1324.00	^{f} 6.00 ±2191.66
T3	2.94± 158.87	4.48±381.33^{cd}	3.52± 839.66^{d}	^{e}6.06±1355.33	^{e}5.45 ±2233.33
T4	.96 ±164.332	2. 88±365.00^{f}	^{f} 4.04 ±804.00	^{f} 6.35 ±1319.33	^{f} 3.38 ±2197.33
T5	2.10±160.90	^{de}2.33 ±375.66	^{ef}2.02 ±813.33	^{f} 5.85 ±1331.00	^{e} 4.93 ±2241.00
T6	5.10 ±153.33	^{c} 1.45 ±384.33	^{d} 3.48 ±846.33	^{d} 2.60 ±1390.33	^{d} 2.02 ±2280.33
T7	1.10 ±157.80	^{c} 1.15 ±388.00	^{c} 1.76 ±857.33	^{c} 3.52 ±1417.66	^{c} 4.16 ±2305.00
T8	4.66±157.65	^{b} 1.76 ±396.66	^{b} 1.52 ±867.00	^{b} 2.33 ±1440.66	^{b} 6.50 ±2333.00
T9	2.23±157.77	^{a} 1.85 ±409.66	^{a} 2.90 ±884.66	^{a} 4.66 ±1470.00	^{a} 2.96 ±2375.66
Sig.	N.S	*	*	*	*

T1: control treatment without addition.T2: added 150 ppm iron powder/ liter of drinking water.T3:Added200 ppm iron powder/ liter of drinking water.T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water.T6: Added a mixture (Fe150 ppm + Cu 25 ppm) / liter of drinking water.T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water.T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water.T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water. **N.S** no significant differences.*The different letters within the same column indicate significant differences between the totals at the probability level of 0.05.

Table 2 shows no significant differences during the first week of weight gain among the different experimental treatments, in the second week there were significant differences (P≤0.05) for treatment T9 on treatment T8, which was significantly higher (P≤0.05) on T3, T7 and T6, significantly decreased (P≤0.05) compared with T4 and T2respectively, which significantly decreased (P≤0.05) compared with control. During the third week, T9 was significantly higher (P≤0.05) compared with T7 and T8, which was significantly higher (P≤0.05) compared with T2 and T3, which was significantly higher (P≤0.05) compare with copper treatments T4 and T5 and superior to the control treatment. During the fourth and fifth weeks, the significantly superiority ($P \leq 0.05$) for T9, T8, T7, compared to T6, which was significantly higher ($P \leq 0.05$) compare with T2, T4, and control. Table 2 indicates that significantly superiority ($P \leq 0.05$) was found in body gain cumulative in the duration of the experiment (35 days) in T9 compared to T6, T7 and T8, which surpassed each other in order (iron + copper from top to bottom), which significantly higher ($P \leq 0.05$) compare iron treatments, which turn significantly exceeded ($P \leq 0.05$) on copper treatments compared to control treatment. This improvement in the increase in weight was explained by increased growth due to the use of these elements, especially copper, which leads to the cellulose digestion as found in the mixture, may explain part of the copper action in stimulating growth due to increased digestive enzymes with the bile gland (Baker, 1991), in addition to the immune properties of copper, which activates the active compounds, which play a large role as an antimicrobial disease, increased immune response in broilers, which is positively reflected on the overall health of birds (Wang *et al*., 2011). An increase in the level of enzymes as a result of the increase in the level of copper in chicken food and thus obtain a better production performance compared to groups of birds fed on the free of these elements as well as the role of iron in the metabolism of proteins (Pearce et al., 1983).

Table 2 : Effect of adding iron and copper to drinking water in the weekly body gain (g) of broilers.

Treatments	Age (week)					Total
	1	2	3	4	5	
T1	2.9±117.76	^{g} 1.11±185.90	^{f} 1.20±390.33	^{d} 5.56±501.00	^{d} 24.6±661.66	^{g}17.6±1856.66
T2	2.20±118.9	^{e} 4.59±211.43	^{d} 0.88±450.33	^{cd} 4.66±503.33	^{C} 13.4±867.66	^{f}6.00±2151.66
T3	2.94±118.87	^{cd} 2.25±222.46	^{cd} 5.89±458.33	^{cd} 4.70±515.66	^{bc}7.3±878.00	^{e}5.45±2193.33
T4	2.96±124.33	^{f}2.33±200.660	^{e} 3.60±439.00	^{cd} 5.78±515.33	^{bc}6.8±885.67	^{f}3.38±2157.33
T5	2.10±120.90	^{de}1.46±214. 76	^{e} 3.84±437.67	^{c} 5.67±517.66	^{ab} 5.13±910.00	^{e} 4.93±2201.00
T6	5.10±113.3	^{c}6.36±231.000	^{bc} 4.58±462.00	^{b} 3.05±544.00	^{abc} 0.57±890.00	^{d}2.02±2240.33
T7	1.10±117.80	^{c} 1.60±230.20	^{abc}2.66±469.33	^{a} 5.20±560.33	^{abc} 2.40±887.33	^{c} 4.16±2265.00
T8	1.13±115.56	^{b}1.17±241.10	^{a} 2.72±470.33	^{a} 3.17±573.67	^{abc} 6.48±892.33	^{b} 6.50±2293.00
T9	2.23±117.77	^{a} 3.38±251.90	^{a} 4.58±475.00	^{a} 2.00±574.00	^{a} 3.00±917.00	^{a}2.96±2335.66
Sig.	N.S	*	*	*	*	*

T1: control treatment without addition.T2: added 150 ppm iron powder/ liter of drinking water.T3:Added200 ppm iron powder/ liter of drinking water.T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water.T6: Added a mixture (Fe150 ppm + Cu 25 ppm) / liter of drinking water.T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water.T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water.T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water. N.S no significant differences.*The different letters within the same column indicate significant differences between the totals at the probability level of 0.05.

Table 3 shows no significant differences during the first week in feed consumption rates among all experimental treatments, in the second week a significantly decreased ($P \leq 0.05$) in T3, T6, T8, T5, T4 compare with T9, T7 and control, at the third week of the birds' age, T2, T3, T6, T8, T7 and T9 showed a significant difference ($P \leq 0.05$) in feed consumption compared to T4 which was significantly superior ($P \leq 0.05$) on control, at week 4 and 5, no significant differences were found between T3, T9, T6, T4 and T5, there were also no significant differences between T8, T7, T2, T3, T9 and T6, all these treatments were significantly superior ($P \leq 0.05$) to the control treatment. In the total consumer feed all the added copper and iron transactions exceeded the control treatment, No significant differences were found among T3, T4, T2, T7, T9, T6, T5 and T8, indicates that there are no significant differences between the combined iron and copper interactions combined with high or low concentrations, especially between T9 and T7 during the fifth week, significant improvement ($P \leq 0.05$) was in all iron and copper supplementation with higher concentration than iron and copper treatments alone with their lower concentrations and control treatment, it may be because all the birds that were given the water added to copper and iron alone or together at the end of the second week are not yet accustomed to the taste and color of water, the control treatment was therefore superior to feed consumption because of the significant positive correlation between the amount of feed consumed and the amount of water discharged (Williams *et al*., 2013),and explained the increase in the rate of feed consumed significantly in favor of water-supplied transactions with copper and iron combined at different levels because of the synergistic work of the two elements as copper works to maintain the balance of proper microbiological digestive system (Makaraski *et al*., 2014). The addition of iron powder and copper combined into the water prompted the birds to eat more feed than the bird groups control group, in the case of the addition of iron and copper elements alone, each element worked with a different effect in proportion to the function of the element and its relationship with the other elements found in the mixture and the nature of the source of the element in food (Abdallah *et al*., 2009).

Table 3 : Effect of adding iron and copper to drinking water in the weekly feed consumption (g) of broilers.

Treatments	Age (week)					Total
	1	2	3	4	5	
T1	1.15±127.00	e2.33±278.33	d 2.18±637.330	d 10.40±895.00	c 43.23±1361.66	b46.18±3299.33
T2	0.88±122.330	a 3.52±355.66	ab 1.45±728.33	d 10.13±886.60	b 25.16±1720.0	a 12.52±3813. 00
T3	1.85±127.33	cd 16.64±316.0	a 9.84±736.000	d 8.08±901.000	14.67±1727.6ab	a 3.51±3808. 000
T4	2.64±125.00	ab15.7±332.33	c 9.90±707.330	d 9.93±909.330	ab 6.22±1737.60	a6.11±3811.6600
T5	2.08±123.00	ab 7.21±331.33	bc 6.11±712.00	cd13.86±914.33	a 8.81±1786.600	a 10.47±3867. 30
T6	2.33±122.66	abc12.7±324.6	a 7.31±740.330	bc 4.58±939.00	ab 3.92 ±1732.3	a17.78±3859.000
T7	34.04±96.00	de 10.9±296.00	a 4.84±749.660	ab 8.45±961.66	b 4.40±1711.600	a35.52±3815.000
T8	2.02±123.66	abc 7.8±325.00	a 4.84±744.660	a 4.40±976.660	b 9.83±1703.600	a11.69±3873.000
T9	0.333±123.33	e 4.62±280.33	a 7.21±749.660	a 3.33±966.660	ab 11.53±1729.0	a 11.37±3849.000
Sig.	N.S	*	*	*	*	*

T1: control treatment without addition.T2: added 150 ppm iron powder/ liter of drinking water.T3:Added200 ppm iron powder/ liter of drinking water.T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water.T6: Added a mixture (Fe150 ppm + Cu 25 ppm) / liter of drinking water.T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water.T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water.T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water. N.S no significant differences.*The different letters within the same column indicate significant differences between the totals at the probability level of 0.05.

Table 4 shows no significant differences during the first week of rearing between all experimental treatments, during the second week significant improvement (P≤0.05) in T2 (Fe 200 ppm) compared to T4 (Cu 25 ppm) and T5 (Cu 50 ppm) and control, in the third week, the table showed a significant improvement (P≤0.05) for T9 and T8 compared with T6, T7 and T3 significantly best (P≤0.05) on T5 and control treatment, in the fourth week there was a significant improvement (P≤0.05) in T9 on T8, which was significantly higher (P≤0.05) on T6 and T7, which were significantly best (P≤0.05) on T3, significantly best (P≤0.05) compare T5, T4, T2 are superior to the control. In the fifth week, there was a significant improvement (P≤0.05) between the iron and copper supplementation alone or combined, which all surpassed the control treatment, while at the time of marketing at the age of 35 days, no significant differences were found between all the coefficients of the two components, either individually or in combination, and at different levels, all of which showed significant improvement (P≤0.05) compare with control treatment. Food conversion was interpreted as a confirmation of the apparent improvement in the level of metabolic and absorption processes in the bird body (Karimi *et al.*, 2011). Once absorbed from the intestine, the copper is released back into the digestive tract through the bile for its effect on microbiological colonies, which acts as an antimicrobial agent. This has led to an increase in the immune response of the bird and thus positively reflected on the general health of the birds and improved production performance, copper helps maintain a healthy microbial balance in the digestive system (Makaraski *et al.*, 2014). As well as the presence of iron as a strong catalyst for growth and then increase the growth associated with the improvement in the digestive efficiency of food and as a result shows the moral improvement of the productive qualities of broiler, including food conversion coefficients, while some researchers went on to explain the need to add iron and copper to feed or drinking water because of their great importance because of the strong properties of the immune and catalytic elements (Świątkiewicz *et al.*, 2014).

Table 4 : Effect of adding iron and copper to drinking water in the weekly feed conversion (g diet/ g weight gain) of broilers.

Treatments	Age (week)					Total
	1	2	3	4	5	
T1	0.03±1.09	b 0.003±1.53	0.008±1.63f	f 0.008±1.79	0.022±2.06f	b 0.011±1.81
T2	0.01±1.03	0.003±1.51ab	0.002±1.61de	0.004±1.76e	0.002±1.98e	a 0.008±1.71
T3	0.03±1.07	0.006±1.44a	0.003±1.60bcd	0.004±1.75d	de0.004±1.96	1a 0.002±1.7
T4	0.02±1.05	0.001±1.52b	0.012±1.61cd	0.008±1.71e	0.003±1.98e	a 0.003±1.70
T5	0.05±1.10	b 0.008±1.51	ef 0.002±1.63	0.001±1.77e	0.002±1. 96de	a 0.009±1.69
T6	0.03±1.11	ab 0.004±1.51	bc 0.001±1.60	c0.001±1.73	0.005±1.95cd	a 0.006±1.70
T7	0.02±1.10	ab 0.001±1.50	b 0.001±1.49	c0.001±1.72	0.005±1.93bc	a 0.004±1.72
T8	0.002±1.09	ab 0.001±1.49	a 0.003±1.58	b 0.003±1.70	0.003±1.91b	a 0.005±1.71
T9	0.02±1.04	ab 0.002±1.48	a 0.001±1.58	a 0.006±1.68	0.003±1.89a	a 0.003±1.71
Sig.	N.S	*	*	*	*	*

T1: control treatment without addition.T2: added 150 ppm iron powder/ liter of drinking water.T3:Added200 ppm iron powder/ liter of drinking water.T4: Added 25 ppm copper powder/ liter of drinking water. T5: Added 50 ppm copper powder/ liter of drinking water.T6: Added a mixture (Fe150 ppm + Cu 25 ppm) / liter of drinking water.T7: Added a mixture (Fe150 ppm + Cu 50 ppm) / liter of drinking water.T8: Added a mixture (Fe 200ppm + Cu 25ppm) / liter of drinking water.T9: Added a mixture (Fe 200 ppm + Cu50ppm) / liter of drinking water. **N.S** no significant differences.*The different letters within the same column indicate significant differences between the totals at the probability level of 0.05.

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