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EFFECT OF HATCHING EGGS INJECTION WITH DIFFERENT CONCENTRATIONS OF NANO-SILVER ON SOME PRODUCTION TRAITS OF BROILER ROSS 308

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Abstract

This study was conducted in the poultry field of the Department of Animal Production - Faculty of Agriculture /University of Al Qassim Al-Khadra at the period from 6 of August 2017 to 9 of September 2017. One hundred sixty eight chickens were reared in cages (with dimension of 1 x 1.5 m per cage) and were randomly divided into seven treatments (three replicates per treatment and 8 chicks per replicate). Nano-silver was injected into the eggs at concentrations of 0.4 ppm, 6 ppm, 8 ppm, 10ppm, 12 ppm, and 14ppm for treatments T2, T3, T4, T5, T6, and T7 respectively. The obtained results showed that a significant superiority ($P < 0.01$) was noted in live body weight at week 5 and total weight gain for five weeks (1-5) of bird age compared to control treatment (T1). Total feed consumption and total feed conversion efficiency were significantly improved ($P < 0.01$) in treatments T2, T3, T4, T5, T6, and T7 compared with T1.

Keywords : Hatching, nano-silver, broiler, nanoparticles.

Introduction

The antimicrobial properties of silver, its compounds and its products have been known for thousands of years and these compounds have been used until the invention of antibiotics. Recently, nanotechnology, which returned to the use of these compounds in the range of nanometer (1-100 nm) as in noble metals such as silver, platinum, gold and palladium (Nel *et al*., 2006) where Nano-silver is considered to be one of the most effective substances against Bacillus strains, which are resistant to antibiotic and antigens, such as *Acinetobacter, Escherichia, Pseudomonas, Salmonella, Vibrio, Bacillus, Clostridium, Enterococcus, Listeria, Staphylococcus* and *Streptococcus* (Sawosz *et al*., 2007; Egger and Others 2009; Prabhu and Poulose 2012). Silver nanoparticles can play an important role in agriculture and animal production through the use of sterilization tools and equipment in animal buildings and packaging and storage places, whether for food or animals and because of their anti-inflammatory properties and stimulate immunity because of their anti-inflammatory properties, (Małaczewska 2014). Additionally, it can be used as an additive in poultry nutrition to improve the health of birds and thus increase growth performance. Subrat *at al*. (2015) demonstrated that injection of nano silver with amino acids, cysteine and threonine, did not improve fetal growth, but improved fetal immunity. Katarzyna *et al*. (2016) reported that nano-silver feeding at a concentration of 5 mg/kg feed resulted in an increase of 11% in the average length of the villus and 7% in the depth of the crypts, reduced the number of harmful bacteria E-coli and increased the number of beneficial bacteria Lactobacilli. The aim of this study was to investigate the effect of injecting hatching eggs at 17.5 days of embryo age with nano silver on some of the productive qualities of broilers.

Materials and Methods

The saline solution NaCl was used in the preparation of egg injection solutions and the nano silver was obtained from Nanosany Copration Company (volume 20 nm and spherical shape). One hundred sixty eight chickens were reared in cages (with dimension of 1 x 1.5 m per cage) and were randomly divided into seven treatments (three replicates per treatment and 8 chicks per replicate). Nano-silver was injected (0.25 ml/egg) at the age of 17.5 days of embryo age at concentrations of 0.4, 6, 8, 10, 12, and 14ppm for treatments T2, T3, T4, T5, T6, and T7 respectively.

Food Treatment: The chicks were fed on starter diet from 1-21 day of the age and finisher diet until the end of the fifth week. Feed and water were provided *ad libitum* and the feed component was as shown in Table 1.

Table 1: The ingredients percentage and their chemical composition of the diet

Ingredients	Starter diet %	Finisher diet %
Yellow corn	30	40
Wheat	28.25	24
Soybean	31.75	24.8
Protein concentration %	5	5
Sun flower oil	2.9	4.4
Limestone	0.9	0.6
Calcium di phosphate	0.7	0.9
Salt	0.3	0.1
Mixture of vitamins and minerals	0.2	0.2
Total	100	100
Protein %	23	20
Metabolic energy%	3027	3195.3
Lysine %	1.2	1.1
Methionine %	0.49	0.46
Cysteine %	0.36	0.32
Methionine + cysteine %	0.85	0.76
Phosphor %	0.45	0.49
C/P %	131.61	159.77

* Protein Concentrate BROCON-5 SPECIAL W: Chinese origin, each containing 40% raw protein, 3.5% fat, 1% fiber, 6% calcium, 3% phosphorus available, 3.25% lysine, 3.90% methionine + cysteine , 2,250 sodium, 2,100 kg / kg of energy represented, 20000 IU Vitamin A, 40000 IU Vitamin D3, 500 mg Vitamin E, 30 mg Vitamin K3, 15 mg Vitamin B1 + B2, 150 mg B3, 20 mg B6,300 B12 mg, 10 mg folic acid, 100 µg biotin, 1 mg iron, 100 mg copper, 1.2 mg manganese, 800 mg zinc, 15 mg iodine, 2 mg selenium, 6 mg cobalt, 900 mg.** According to the chemical analysis of the suit according to NRC (1994)

The Studied Attributes

1. **Live body weight and weight increase**: The average of live body weight was calculated at the end of each week and for (1 - 5 weeks) by weighting all birds for one replicate. The live body weight was calculated as follows:

   Live weight (g) = Total live weight of birds at the end of the week (g)/ Number of birds at the end of the week

   The weekly increase rate (g/rep) = Average of live body weight at the end of week (gm) – Average of live body weight at the beginning of the week (gm).

2. **Feed consumption:** The weekly feed consumption rate for each replicate and for weeks (1 - 5) was calculated by weight of feed given earlier in the week minus the remaining feed weight at the end of the week.

3. **The efficiency of food conversion:** The efficiency of food conversion was calculated according to the formula referred to by Fayadh and Naji (1989)

   Food Conversion Efficiency Weekly= Average amount of feed consumed (g) within a week/Average weight increase (g) within a week

4. **Total mortality rate %:** Total mortality rate were recorded from the start of the experiment until the end of the fifth week and were calculated as follows.

   Mortality rate% = (Number of dead birds during the experiment/ Total number of birds) × 100

5. **Statistical analysis:** Statistical Analysis System (SAS) (2012) was used in data analysis to study the effect of different treatments in the studied traits in full randomized design (CRD). The differences between the averages were compared by Duncan (1955) multidimensional test.

Mathematical model:

$$Yij = \mu + Ti + eij$$

Results and Discussion

Body weight (gm)

The effect of injection into hatching eggs on the average of body weight for different weeks (1-5) of bird age was observed in Table (2). In the first week, a significant superiority (P <0.01) for T6, T1 on the other treatments as well as treatment T3, T5, T7 on treatment T2, T4 and significant superiority for T4 on T2. The second week showed that T3 was significantly superior (P <0.01) on the other treatments in addition to the superiority of treatments T1, T2, T4, T5, and T6 on T7 and there was no significant difference between treatments T1, T2, T4, T5 and T6 while in the third week, T3 was superior on the other treatments as well as T6 followed by T2 on T1, T4, T5 and T6. T4 was superior on T1, T5, T7 and T5 and T7 were superior on T1. The fourth week showed significant superiority (P <0.01) for T5, followed by T3, T2 and T4 respectively, on T1, T6, T7. Moreover, T6 was superior on T1 and T7 as well as T7 were superior to T1. In the fifth week of the experiment, T4 was significantly higher (P <0.01) than the other treatment whereas T2 was superior on T1, T3, T5, T6, and T7. In addition, T3 and T6 were also superior to T1, T5 and T7 while T7, T5 were superior on T1.

Weekly weight increase (g)

Table (3) showed the effect of egg injection with nano-silver on the weekly increase rate for weeks (1-5) of bird age. In the first week, a significant superiority (P<0.01) for T1, T5, T6 and T7 was observed on T2, T3, T4 as well as T3 was superior on T2, T4 while there was no significant difference between treatments T2 and T4. In the second week, T3 was significantly superior on the other treatments as well as T1, T2, T4, T5 and T6 were superior on T7 while there was insignificant difference between treatments T1, T2, T4, T5 and T6. In the third week, the treatments of T2, T3 and T6 were significantly superior on the other treatments as well as T4 and T7 were higher than T1 and T5 while T5 was superior on T1. The fourth week showed that T5 had a significant superiority (P<0.01) followed by T4 on the other treatments as well as T2 was significantly superior on treatments T1, T3, T6, T7. Furthermore, T3, T6 were superior on T1 and T7 as well as T7 was superior to T1 whereas in the fifth week T4 was significantly higher (P <0.01) followed by T6 and T2 respectively compared to T3, T5 and T7. Moreover, T3 and T7 were superior to T1 and T5 as well as T1 was higher than T5. Regarding total weight increase, T4 was superior to the other treatments while T2 was superior to T1, T3, T5, T6 and T7. Similarly, T3 and T6 was superior to T1, T5 and T7 in addition to a significant superiority was noted for T5 and T7 on T1.

Feed consumption (g)

The effect of Nano-silver injection in hatching eggs on feed consumption during five weeks (1-5) of the birds' age was revealed (Table 4). The first week showed a significant superiority (P <0.01) for T6 on the rest of the treatments as well as a significant superiority for T1, T3, T5 and T7 on T2 and T4. In the second week T3 was significantly higher (P <0.01) than the other treatments as well as T2, T5, T6 were superior on T1, T4, T7. Furthermore, T4 was superior on T1, T7 and similarly T1 on T7. However, in the third week T1 was significantly higher compared with the other treatments as well as T5, T6 were significantly superior compared to T2, T3, T4 and T7. Additionally, T3 was significantly higher than T2, T4, T7 and T4 was superior on T2, T7 while T2 indicated a significant superiority on T7. In the fourth week, the results of the statistical analysis showed a significant superiority (P <0.01) for T6 followed by T1 on the rest of the treatments as well as T4 was superior on T2, T3, T5, T7 in addition T3 was superior followed by T2, T7 and T5 respectively. In the fifth week, a significant superiority (P <0.01) was detected in T1 followed by T6 and T3 while T2, T5, T4 were superior on (T4, T5 and T7), (T7 and T4), (T7) respectively. As for total feed consumption, T1 was significantly superior (P <0.01) on the rest of the transactions followed by T7, T2, T4, T5, T3 and T6 respectively.

Feed conversion efficiency (kg /kg meat/bird)

Table (5) showed the effect of injection of Nano-silver on the dietary conversion efficiency for five weeks (1-5 weeks) of bird age. A significant improvement (P <0.01) for T1, T2, T3, T4, T5, T7 compared with T6 while in the second week, T7 showed a significant (P<0.01) improvement compared to the other treatments as well as an improvement in Feed conversion efficiency for birds of T1, T4 compared to T2,T3, T5 and T6. In the third week, T7 was significantly improved compared to the other treatments followed by T2 while T4 and T3 were improved compared to (T1, T3, T5,

T6) and (T1, T5, T6) respectively. Also, a significant improvement was noted in T5 and T6 compared to T1. In the fourth week, T5 was significantly improved (P <0.01) compared with the rest of the treatments as well as T2 was improved compared to T1, T3, T4, T6 and T7. Significantly, T7 was improved and followed by T3 and T4 compared to T6, T1. Moreover, a significant improvement was found in T6 compared with T1. The fifth week showed a significant improvement (P<0.01) in T4, T7 followed by T2 compared to the other treatments as well as an improvement in T6, T3 and T1 compared to the treatments (T1, T3, T5), (T1, T5) and (T5). Regarding total feed conversion efficiency, the obtained result showed that T7 continued with the best conversion efficiency followed by T2, T4, T5, T6, T3 and T1, respectively.

Mortality rate %

The effect of injection of fertilized eggs with Nano-silver on the total mortality rate during the experiment period was revealed (Table 6). There was no significant differences between the experimental treatments. The superiority of live body weight, weight gain, and improve the efficiency of feed conversion may be due to the nano-silver antibacterial properties (sondy, 2004) that resulted in improving the intestinal environment and increased absorption of nutrients (Güllüce *et al*., 2003) which confirmed that nano-silver improved the growth of birds as a powerful antibacterial and antioxidant. The obtained result was inconsistent with Andi *et al*., 2011; Pineda *et al*., 2012; Sawosz, 2012; Katarzyna *et al*., 2016 who detected that Nano-silver did not affect growth, but improved the performance of the hatched chicks and its immune system. Ahmadi (2011) noted that nano-silver reduced feed conversion efficiency but significantly increased (P <0.05) weight of small intestine and abdominal fat in broilers compared to control group. This effect may be due to nano-silver effect in intestinal bacteria as nano-silver is an effective antimicrobial agent against a wide spectrum of gram-negative bacteria (Burrell *et al*., 1999; Yin *et al*., 1999) in addition to antibiotic resistant strains (Wright *et al*., 2002; Percival, 2007) which include gram-negative bacteria species such as *Acinetobacter*, *Escherichia* , *Pseudomonas*, *Salmonella* and *Vibrio*. This was based on studies that showed that nano-silver particles destroys the cell wall of gram negative bacteria (Sondi, 2004; Morones *et al*., 2005). The reduction in mortality rate in the injected treatments may be due to the inhibition of the growth of pathogenic microorganisms and the reduction of their activity by nano-silver, thus contributing effectively to reduce the incidence of pathological injury (Burrell *et al*., 1999; Yin *et al*., 1999; Lansdown, 2004; Ovington, 2004), thus reducing mortality rate which was confirmed by Katarzyna *et al*., 2016. This study concludes that the injection of hatching eggs with nano-silver improved the productive characteristics of the birds. Additionally, the present study recommend injecting eggs with higher concentrations of nano-silver and into eggs of other birds.

Table 2 : Effect of studied treatments on body weight (gm) for different weeks

Treatments	Average ± Standard Error (g)				
	Week 1	Week 2	Week 3	Week 4	Week 5
T1	1.55± 179.05**ab**	2.50± 419.30**b**	1.30± 755.00**g**	1.00± 1205.00**f**	5.85± 1816.25**e**
T2	1.95± 159.95**e**	1.40± 412.90**b**	1.45± 829.75**c**	2.00± 1356.00**c**	3.05± 2054.85**b**
T3	1.35± 173.65**c**	2.10± 443.90**a**	1.75± 860.75**a**	4.00± 1347.00**c**	11.50± 1985.00**c**
T4	1.00± 165.60**d**	4.15± 451.45**b**	1.80± 821.00**d**	3.00± 1371.00**b**	3.70± 2130.50**a**
T5	1.10± 173.20**c**	1.15± 416.15**b**	1.00± 766.60**f**	1.00± 1450.00**a**	6.35± 1897.45**d**
T6	1.55± 180.55**a**	6.80± 423.70**b**	2.40± 839.10**b**	5.50± 1315.50**d**	9.25± 1998.25**c**
T7	1.55± 175.35**bc**	0.00± 396.20**c**	2.70± 793.10**e**	1.50± 1256.5**e**	2.10± 1905.90**d**
Significance level	**	**	**	**	**

The averages with different letters within the same column vary significantly between them. T1 without injection control treatment. T2 injection with nano-silver at a concentration of 4 ppm. T3 injection with nano-silver at a concentration of 6 ppm. T4 injection with nano-silver at a concentration of 8 ppm. T5 injection with nano-silver at a concentration of 10 ppm. T6 injection with nano-silver at a concentration of 12 ppm. T7 injection with nano-silver at a concentration of 14 ppm.

Table 3 : Effect of the studied treatments on the rate of weight increase (g) for different weeks

Treatments	Average ± Standard Error (g)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Total weight increase
T1	1.63 ± 137.24**a**	4.05± 240.25**b**	3.80± 335.70**d**	2.30± 450.00**f**	6.85± 611.25**d**	5.93± 1774.45**e**
T2	1.92± 119.06**c**	0.56± 252.96**b**	0.05± 416.85**a**	3.45± 526.25**c**	1.05± 698.85**b**	3.10± 2013.98**b**
T3	1.38± 131.43**b**	0.75± 270.25**a**	3.85± 416.85**a**	5.75± 486.25**d**	15.50± 638.00**c**	11.47± 1942.78**c**
T4	1.09± 122.94**c**	3.15± 249.85**b**	2.35± 405.55**b**	1.20± 550.00**b**	6.70± 759.50**a**	3.61± 2087.84**a**
T5	1.09± 132.45**ab**	2.25± 242.95**b**	2.55± 350.45**c**	2.40± 683.40**a**	5.35± 447.45**e**	6.36± 1856.70**d**
T6	1.45± 137.00**a**	8.35± 243.15**b**	0.00± 419.80**a**	3.10± 476.40**d**	3.75± 682.75**b**	13.75± 1959.10**c**
T7	1.52± 132.23**ab**	1.55± 220.85**c**	2.70± 396.90**b**	1.20± 463.40**e**	3.60± 649.40**c**	2.13± 1862.78**d**
Significance level	**	**	**	**	**	**

The averages with different letters within the same column vary significantly between them, T1: without injection control treatment, T2: injection with nano-silver at a concentration of 4 ppm, T3: injection with nano-silver at a concentration of 6 ppm. T4 injection with nano-silver at a concentration of 8 ppm, T5: injection with nano-silver at a concentration of 10 ppm, T6: injection with nano-silver at a concentration of 12 ppm, T7: injection with nano-silver at a concentration of 14 ppm

Table 4 : Effect of the studied treatments on the feed consumption (g/bird) for different weeks

Treatments	Average ± Standard Error (g)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Total feed consumption
T1	2.60± 142.80**b**	1.50± 409.30**d**	4.95± 747.75**a**	2.50± 882.50**b**	2.75± 1015.35**a**	3.60± 3197.70**a**
T2	1.25± 125.05**d**	3.10± 451.40**b**	0.30± 522.60**e**	5.10± 637.60**g**	9.10± 869.50**c**	18.25± 2606.15**f**
T3	3.70± 141.70**b**	6.15± 478.85**a**	9.75± 619.75**c**	1.15± 758.85**d**	5.25± 923.75**b**	3.20± 2922.90**c**
T4	2.35± 131.45**cd**	2.35± 425.55**c**	1.95± 573.55**d**	3.60± 839.40**c**	1.75± 794.45**e**	7.30± 2764.40**e**
T5	1.80± 138.60**bc**	1.40± 443.60**b**	3.55± 655.85**b**	3.45± 732.95**e**	3.40± 829.40**d**	3.20± 2800.40**d**
T6	1.35± 171.35**a**	2.50± 440.00**b**	2.50± 657.70**b**	1.30± 904.80**a**	1.40± 922.10**b**	2.45± 3095.95**b**
T7	1.15± 138.85**bc**	5.00± 363.40**e**	3.85± 468.85**f**	3.80± 650.80**f**	2.85± 717.85**f**	6.57± 2339.75**g**
Significance level	**	**	**	**	**	**

The averages with different letters within the same column vary significantly between them, T1: without injection control treatment, T2: injection with nano-silver at a concentration of 4 ppm, T3: injection with nano-silver at a concentration of 6 ppm. T4 injection with nano-silver at a concentration of 8 ppm, T5: injection with nano-silver at a concentration of 10 ppm, T6: injection with nano-silver at a concentration of 12 ppm, T7: injection with nano-silver at a concentration of 14 ppm

Table 5 : Effect of studied treatments on feed conversion efficiency (kg/fed/kg meat/bird) for different weeks

Treatments	Average ± Standard Error (g)					
	Week 1	Week 2	Week 3	Week 4	Week 5	Average
T1	0.006±1.039**b**	0.02± 1.705**bc**	**2.227** 0.04±**a**	0.004± 1.960**a**	0.01± 1.661**b**	0.003± 1.718**a**
T2	0.01± 1.049**b**	0.02± 1.784**ab**	0.001± 1.253**f**	0.02± 1.211**e**	0.02± 1.244**e**	0.01± 1.308**e**
T3	0.04± 1.078**b**	0.02± 1.771**ab**	0.01± 1.486**d**	0.02± 1.560**c**	0.04± 1.448**c**	0.02± 1.468**c**
T4	0.03± 1.069**b**	0.01± 1.703**bc**	0.003± 1.413**e**	0.01± 1.526**c**	0.01± 1.046**f**	0.02± 1.351**d**
T5	0.01± 1.046**b**	0.01± 1.825**a**	0.02± 1.871**b**	0.001± 1.072**f**	0.03± 2.077**a**	0.01± 1.578**b**
T6	0.003± 1.250**a**	0.05± 1.811**a**	0.01± 1.566**c**	0.01± 1.898**b**	0.01± 1.350**d**	0.01± 1.575**b**
T7	0.003± 1.049**b**	0.01± 1.645**c**	0.02± 1.181**g**	0.01± 1.404**d**	0.002± 1.105**f**	0.02± 1.276**f**
Significance level	**	**	**	**	**	**

The averages with different letters within the same column vary significantly between them, T1: without injection control treatment, T2: injection with nano-silver at a concentration of 4 ppm, T3: injection with nano-silver at a concentration of 6 ppm. T4 injection with nano-silver at a concentration of 8 ppm, T5: injection with nano-silver at a concentration of 10 ppm, T6: injection with nano-silver at a concentration of 12 ppm, T7: injection with nano-silver at a concentration of 14 ppm

Table 6 : Effect of injection of hatching eggs with nono-silver on the percentage of total mortality rate

Treatments	Average ± Standard Error (g)
	Total mortality rate %
T1	0.15 ± 1.00
T2	0.00 ± 0.00
T3	0.10 ± 0.50
T4	0.00 ± 0.00
T5	0.00 ± 0.00
T6	0.00 ± 0.00
T7	0.00 ± 0.00
Significance level	NS

The averages with different letters within the same column vary significantly between them, T1: without injection control treatment, T2: injection with nano-silver at a concentration of 4 ppm, T3: injection with nano-silver at a concentration of 6 ppm. T4 injection with nano-silver at a concentration of 8 ppm, T5: injection with nano-silver at a concentration of 10 ppm, T6: injection with nano-silver at a concentration of 12 ppm, T7: injection with nano-silver at a concentration of 14 ppm

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