EFFECT OF SILVER NANOPARTICLES AS A WATER SUPPLEMENTATION ON PRODUCTIVE PERFORMANCE, CARCASS CHARACTERISTICS AND BONE MEASUREMENTS OF BROILER CHICKS.

A.M. Tammam¹, S.A. Ibrahim¹, A.A. Hemid¹, F. Abdel-Azeem¹, A.I.EI-Faham¹, Nematallah G.M. Ali¹ and W. Salem²

¹Faculty of agriculture, Ain Shams University, Cairo, Egypt
²Faculty of science, South Valley University, Qena, Egypt

SUMMARY

The aim of the study was estimated the effect of silver nanoparticles as a water supplementation in broiler chicken on productive performance, carcass characteristics and bone measurements at five weeks feeding trial. A total number of 150 (cobb 500) were divided randomly into 5 treatment (30 chicks each), each treatment replicated 3 time of 10 chicks. The experimental treatments were supplemented the drinking water with different levels of silver nanoparticles (0.0, 2.5, 5.0, 7.5 and 10 ppm). At the end of experiment 4 birds of each treatment were slaughtered to estimate carcass characteristics and bone measurements. The results showed that live body weight, daily body weight gain, daily feed intake, feed conversion ratio, performance index and European production efficiency factor weren’t affected significantly by treatments. All carcass traits and cuts also weren’t affected significantly by different levels of silver nanoparticles except breast%. There weren’t significant differences between treatment in all bone physical or chemical measurements except tibia breaking strength where it decreased significantly in all treated groups and ash% where it increased significantly in all treated groups. In conclusion, supplemented different levels of silver nanoparticles in broiler drinking water hadn’t negative effect on growth performance, carcass characteristic or bone measurements.

Keywords: Silver nanoparticle, broilers, performance, carcass, bone traits

INTRODUCTION

Silver is known since long time that it can eliminate microbial proliferation specialty antibiotic-resistant bacteria (Wadhera et al., 2005). Nanoparticles mean the size of particles that ranged between 1 to 100 nm (Loghman et al., 2012). Nanosilver is one of the most commonly used nanomaterials because of its strong disinfectant properties (Chen et al., 2007). Silver compounds seem as a potential alternative of some feed additives such as oligosaccharides, organic acids, plant extracts, etc (Kout Elkloub et al., 2015). Silver nanoparticles in low levels of silver ions promote rapid development of bacterial resistance but also use of nanosilver in high levels of silver ions causes toxicity in human and animals. Ahmadi and Rahimi (2011) studied the effect of different levels of silver nanoparticles (0, 4, 8 and 12 ppm) as supplementation in drinking water of broiler on broiler LBW at 42 days old. The results showed that significantly decreasing in LBW increase the silver nanoparticles levels. El-Faham et al. (2017) studied the effect of different levels of silver nanoparticles (0.0, 5.0 and 10 ppm/l) in poultry (broiler chicken, rabbits and Jap. quail) drinking water on performance. The results showed that LBW and BWG were affected significantly with broiler chicken, however, weren’t affected significantly with rabbits and Jap. quail. Kumar et al. (2020) supplemented the drinking water of broilers by 50 ppm (AgNPs) to study the effect of AgNPs on LBW of broilers compared to the control at 42 days. The data showed that the supplementation of AgNPs in drinking water significantly increased LBW of broilers compare with control group. Many researchers found that, there was a significant affected on some carcass characteristics with increasing nano-silver level, increase in abdominal fat (Ahmadi, 2012) or liver (Ahmadi et al., 2013) carcass% (Kout elkloub et al., 2015) and breast and thigh muscles weight (Salah and El-Magd, 2018). Therefore, a trail was conducted to investigate the supplementation of nanoparticles of silver in drinking water of broiler chicks on growth performance, carcass characteristics and bone measurement.
MATERIALS AND METHODS

A total number of 150 one-day old of unsexed broiler chicks (Cobb 500) were randomly distributed over five treatments of 30 birds each in 3 replicates (10 birds per replicate). Birds were reared in electrically-heated batteries under similar conditions of managements till 35 days of age. The experimental treatments were as follow, different levels of SNaPs at 4 levels (0.0 – 2.5 – 5.0 – 7.5 – 10.0 ppm) supplemented to drinking water to get 5 treatments in each experiment. Diets were formulated to meet requirements based on manual guide of Cobb 500 strain. The composition and nutrient content of basal diet according to NRC (1994) were presented in table (1). Live body weight (LBW) of each replicate was recorded weekly till 35 days of age in the early morning before feeding. Daily feed intake (DFI) and weight gain (DWG) of each replicate were also recorded and feed conversion ratio (FCR) was calculated. Performance index (PI) and European production efficiency factor (EPEF) were calculated at 35 days of age.

At the end of experiment (35 days of age), four birds of each treatment were taken randomly and slaughtered to estimate carcass characteristics, and some bone measurement.

Statistical analysis of data obtained from the present study was conducted using the general linear model (GLM) procedure of SAS® (SAS, 2004). By applying test using one-way ANOVA. Means were compared using Duncan’s range test (Duncan, 1955) where the level of significance was set at minimum ($P \leq 0.05$), and the statistical model was performed as follows:

$$Y_{ij} = \mu + T_i + E_{ij}$$

Where: $Y_{ij}$ is the effect of the observation, $\mu$= overall mean, $T_i$ = the effect of $i^{th}$ treatments and $E_{ij}$= random error

Table (1): Composition and calculated chemical analysis of basal diets.

| Ingredients                      | Starter* | Grower* | Finisher* |
|----------------------------------|----------|---------|-----------|
| Yellow corn grains               | 55.76    | 59.70   | 63.70     |
| Soybean meal 48%                 | 37.84    | 33.10   | 28.22     |
| Soybean oil                      | 2.44     | 3.40    | 4.42      |
| Bone meal                        | 2.91     | 2.60    | 2.26      |
| Limestone                        | 0.24     | 0.35    | 0.50      |
| HCL Lysine                       | 0.00     | 0.04    | 0.08      |
| DL Methionine (99%)              | 0.21     | 0.21    | 0.22      |
| Salt (NaCl)                      | 0.30     | 0.30    | 0.30      |
| Premix**                         | 0.30     | 0.30    | 0.30      |
| Total                            | 100.00   | 100.00  | 100.00    |

Calculated chemical analysis***

| Crude protein (%)                | 23.01    | 21.04   | 18.99     |
| M E (Kcal / Kg)                  | 3003     | 3102    | 3204      |
| C / P ratio                      | 130      | 147     | 168       |
| Calcium (%)                      | 1.00     | 0.95    | 0.90      |
| Available phosphorus (%)         | 0.50     | 0.45    | 0.40      |
| Methionine (%)                   | 0.63     | 0.60    | 0.58      |
| Methionine + cysteine (%)        | 0.95     | 0.90    | 0.85      |
| Lysine (%)                       | 1.35     | 1.25    | 1.15      |

* Starter (1-14 day old), Grower (15-28 day old) and finisher (29-35 day old); ** Each 3 kg contains: Vit A 12 000 000 IU, Vit D3 2 000 000 IU, Vit E 1g, Vit K3 2 g, Vit B1 1 g, Vit B2 5 g, Vit B6 1.5 g, Vit B12 10 mg, Nicotinic acid 30 g, Pantothenic acid 10 g, Folic acid 1 g, Biotin 50 mg Choline chloride 250 g, Iron 30 g, Copper 10 g, Zinc 50 g, Manganese 60 g, Iodine 1 g, Selenium 0.1 g, Cobalt 0.1 g and carrier (CaCO3) to 3 kg; *** Calculated analysis chemical according to NRC (1994).
RESULTS AND DISSCUSSION

Productive performance

The data in table 2 showed the effect of silver nanoparticles as water supplementation on LBW, DBWG, DFI, FCR, PI and EPEF.

Live body weight and daily body weight gain

The results in Table 2 showed that LBW and DBWG have improved numerically in treated groups compare with control, but this improvement failed to be significant. It is agreement with what found by Ahmadi et al. (2010) who showed that silver nanoparticles (Ag-NPs) in different levels (0, 5, 15, and 25 ppm) hadn’t significant effect on LBW, BWG, of broilers at 42 days.

Daily feed intake and Feed conversion ratio

As showed in Table 2, DFI and FCR were not affected by different levels of silver nanoparticles. The same effects found by Pineda et al. (2012) who recorded that the different levels of AgNano haven’t significant effects on FI or FCR of broiler chicks. Also Ibrahim et al. (2017) showed that FCR hasn’t affected significantly by different levels.

Table (2): Effect of silver nanoparticles in broiler drinking water on Productive performance

| Items                        | Treatments | MSE | Sig. |
|------------------------------|------------|-----|------|
| 0 day-old Live body weight (g) | 0          | 44.16 |      |
|                              | 2.5        | 43.93 |      |
|                              | 5          | 44.33 |      |
|                              | 7.5        | 43.23 |      |
|                              | 10         | 44.43 |      |
|                              | MSE        | 1.04  | NS   |
|                              | Sig.       | NS    |      |
| 35 day-old Daily body weight gain (g) | 0          | 1837.62 | 79.11 |
|                              | 2.5        | 1892.17 | 79.11 |
|                              | 5          | 1834.46 | 78.82 |
|                              | 7.5        | 1789.86 | 76.67 |
|                              | 10         | 1834.07 | 77.29 |
|                              | MSE        | 45.18 | NS   |
|                              | Sig.       | NS    |      |
| 0-35 day-old Feed intake (g) | 0          | 50.00 |      |
|                              | 2.5        | 51.30 |      |
|                              | 5          | 51.85 |      |
|                              | 7.5        | 49.55 |      |
|                              | 10         | 51.04 |      |
|                              | MSE        | 1.27  | NS   |
|                              | Sig.       | NS    |      |
| 0-35 day-old Daily feed conversion ratio (g .feed/g .gain) | 0          | 77.04 |      |
|                              | 2.5        | 79.11 |      |
|                              | 5          | 78.82 |      |
|                              | 7.5        | 76.67 |      |
|                              | 10         | 77.29 |      |
|                              | MSE        | 2.26  | NS   |
|                              | Sig.       | NS    |      |
| 0-35 day-old Performance index | 0          | 1.53  |      |
|                              | 2.5        | 1.49  |      |
|                              | 5          | 1.54  |      |
|                              | 7.5        | 1.53  |      |
|                              | 10         | 1.49  |      |
|                              | MSE        | 0.03  | NS   |
|                              | Sig.       | NS    |      |
| 0-35 day-old European production efficiency factor | 0          | 119.700 |      |
|                              | 2.5        | 126.60 |      |
|                              | 5          | 119.01 |      |
|                              | 7.5        | 116.74 |      |
|                              | 10         | 122.90 |      |
|                              | MSE        | 3.95  | NS   |
|                              | Sig.       | NS    |      |
| 0-35 day-old European production efficiency factor | 0          | 333.77 |      |
|                              | 2.5        | 353.330 |      |
|                              | 5          | 331.81 |      |
|                              | 7.5        | 325.50 |      |
|                              | 10         | 342.65 |      |
|                              | MSE        | 11.07 | NS   |
|                              | Sig.       | NS    |      |

*Means in the same row with the same letters are not significantly different. MSE: Mean standard error NS: Non-significant **: (P≤0.01).

Performance index and European production efficiency factor

Table (2) showed insignificant improvement in PI and EPEF in treated groups compare with control. These results might be related to that LBW, BWG and FCR haven’t affected significantly by treatments. Also, chicks received water containing 2.5 ppm silver nanoparticles gave the best figures (126.60 and 353.33, respectively) compare with other treatments, however, difference among treatments were insignificant.

Carcass characteristics

The effect of supplementing drinking water by different levels of silver nanoparticles in broiler drinking water on carcass characteristics of birds can be show in Table (3). The data in table showed that there haven’t significant effects of different levels of silver nanoparticles on relative weight of carcass, liver, gizzard, heart, abdominal fat, spleen and bursa. These results might be related to that LBW hasn’t affected by treatments. The same results found by Ahmed and Rahimi (2011) who reported that silver nanoparticles have non-significant effect on liver and gizzard %. In addition, Ibrahim et al. (2017) showed that dressing % and the relative weight of carcass, heart and spleen weren’t affected significantly by different levels.
Table (3): Effect of silver nanoparticles in broiler drinking water on carcass characteristics.

| Items                | Treatments | MSE | Sig. |
|----------------------|------------|-----|------|
| Carcass characteristics % | 0     | 2.5 | 5    | 7.5 | 10   |
| Carcass              | 68.84     | 67.58 | 68.90 | 68.93 | 69.84 | 4.09 | NS |
| Liver                | 2.33      | 2.54  | 2.35  | 2.51  | 2.40  | 0.34 | NS |
| Gizzard              | 1.29      | 1.37  | 1.46  | 1.47  | 1.64  | 0.20 | NS |
| Heart                | 0.53      | 0.47  | 0.50  | 0.46  | 0.53  | 0.08 | NS |
| Giblets              | 4.16      | 4.39  | 4.32  | 4.45  | 4.58  | 0.43 | NS |
| Total edible parts   | 73.01     | 71.97 | 73.23 | 73.38 | 74.42 | 4.26 | NS |
| Abdominal fat        | 1.17      | 1.37  | 0.99  | 1.11  | 1.16  | 0.30 | NS |
| Spleen               | 0.13      | 0.11  | 0.11  | 0.13  | 0.10  | 0.03 | NS |
| Bursa                | 0.05      | 0.05  | 0.05  | 0.04  | 0.04  | 0.01 | NS |

**a,b:** Means in the same row with the same letters are not significantly different. MSE: Mean standard error NS: Non-significant **: (P ≤ 0.01).

Percentage of carcass cuts

The effect of supplementing drinking water by different levels of silver nanoparticles in broiler drinking water on carcass cuts of birds can be show in Table (4). The results showed that percentages of thigh, drumstick wing and nick haven’t affected significantly by different levels of silver nanoparticles. However, percentage of breast differed significantly by different levels of silver nanoparticles. It is worth to note that the chicks in control group or received 5.0 ppm silver nanoparticles reflected the highest significant breast% compared with other treatment. Ibrahim *et al.* (2015) agree with these results where showed that there weren’t significant differences in all cuts percentages.

Table (4): Effect of silver nanoparticles in broiler drinking water on carcass cuts.

| Items     | Treatments | MSE | Sig. |
|-----------|------------|-----|------|
| Breast    |            |     |      |
| 29.25     | 23.43b     | 28.07ab | 27.20ab | 1.26 * |
| Thigh     | 17.51      | 18.21 | 18.62 | 1.91 NS |
| Drumstick | 8.91       | 9.04  | 8.96  | 1.01 NS |
| Wing      | 6.56       | 7.06  | 5.54  | 0.99 NS |
| Nick      | 4.63       | 4.09  | 4.51  | 0.55 NS |

**a,b:** Means in the same row with the same letters are not significantly different. MSE: Mean standard error NS: Non-significant **: (P ≤ 0.01).

Bone traits

The effect of supplementing drinking water by different levels of silver nanoparticles in broiler drinking water on bone physical and chemical measurements of birds can be show in Table (5). Physical measurements: Table 5 has showed insignificant differences between treatments in wet tibia weight, dry tibia weight, tibia length, tibia width and seedor index. On the other hand, tibia breaking strength decreased significantly in all treated groups compare with control.

Table (5): Effect of silver nanoparticles in broiler drinking water on bone traits.

| Items                  | Treatments | MSE | Sig. |
|------------------------|------------|-----|------|
| Wet Tibia Weight (g)   |            |     |      |
| 13.75  | 16.50  | 17.75 | 19.25 | 15.75 | 2.96 NS |
| Dry Tibia Weight (g)   | 6.69      | 7.70  | 8.15  | 8.53  | 7.23  | 1.57 NS |
| Tibia length (mm)      | 84.72     | 86.61 | 86.55 | 86.32 | 86.40 | 4.19 NS |
| Tibia Width (mm)       | 7.29      | 6.90  | 6.79  | 7.17  | 7.14  | 1.02 NS |
| Seedor index           | 0.08      | 0.08  | 0.09  | 0.09  | 0.08  | 0.01 NS |
| Tibia Breaking Strength(Kg/cm²) | 37.58a | 34.07ab | 36.35a | 35.51a | 31.17b | 0.96 ** |
| Ash %                  | 40.54     | 44.23ab | 46.90a | 46.76b | 47.70a | 1.85 ** |
| Organic matter %       | 58.88     | 55.04 | 53.18 | 52.85 | 53.65 | 2.04 NS |
Chemical measurements: Table (5) has showed insignificant differences between treatments in percentages of organic matter, calcium and phosphor. On the other hand, ash percentage increased significantly in all treated groups compare with control. In the same order, the highest of ash percentage indicated significant differences between chicks consume water containing silver nanoparticle (5.0, 7.5 and 10.0 ppm) compared with those in control group. The highest ash percentage was detected for the chicks in 10.0 ppm silver nanoparticles being (47.70%) versus (40.45%) control group.

**CONCLUSION**

In conclusion, broiler chicks consumed drinking water with different levels of silver nanoparticles would haven’t any adverse effects on productive performance, carcass characteristics or bone measurements.

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تأثیر اضافه النانو فضه الى ماء الشرب على الاداء الانتاجي وصفات الذبحة والعظم لبداري التسمين

أحمد محمد تمامة، سيد عبد الرحمن إبراهيم، علاء الدين عبد السلام، فتحي عبد العظيم، أحمد إبراهيم الحمام، نعمة الله
جمال الدين، و وسام سالم
قسم التخمير الدواجن، كلية الزراعة - جامعة عين شمس - مصر
كلية العلوم - جامعة جنوب الوادي - قنا - مصر

أجريت تجربة لدراسة تأثير إضافة جزيئات النانو فضه الى ماء شرب بداري التسمين على الاداء الانتاجي وصفات الذبحة والعظمات وصفات الجسم لمدة 5 أسابيع. واستخدم في التجربة 150 كتوك من جنس من عمر يوم من سلالة كب 500 وتم تقسيمها إلى 5 معاملات كل معاملة تحتوي على 30 طائر (3 مكرر × 10 طائر). اضيف النانو فضه الى ماء الشرب بمعدل (0.0، 2.5، 5.0، 7.5 و 10.0) جزء في المليون/لتر ماء شرب وفي نهاية التجربة (35 يوم) ذُبحت 4 طيور من كل معاملة لدراسة صفات الذبحة والعظم.

النتائج كالتالي:

1. لم يتثر وزن الطيور اليومي واستهلاك الديموم والعمليات التحولية والانتاج والعامل الكفاءة الأربي معنوية بالمعاملات المختلفة.
2. لم تتأثر صفات الذبحة والعظمات بالمعاملات المختلفة بينما % للصفرة تأثر معنوية وسجلت معاملات الكنترول 5.0 و 4.0 أعلى قيم معنوية.
3. لم تتأثر صفات وقياسات العظم الطاهرية والكيميائية بالمعاملات المختلفة بينما قوة الكسر و%الرماد تتأثر معنوية وسجلت مجموعة الكنترول أعلى قيم في قوة الكسر وأقل قيم في %الرماد بالمقارنة مع معاملات المختلفة.

الخاتمة

اضافة مستويات مختلفة من النانو فضه الى ماء الشرب لبداري التسمين لم يكن له تأثير سلبي على الاداء الانتاجي وصفات الذبحة والعظم.