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

**A.M. Tammam[1], S.A. Ibrahim[1], A.A. Hemid[1], F. Abdel-Azeem[1], A.I.El-Faham[1], Nematallah G.M. Ali[1] and W. Salem[2]**

[1]*Faculty of agriculture, Ain Shams University, Cairo, Egypt*

[2]*Faculty 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 trail. 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. Ahmedi 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 a.l*, 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:

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

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 | Experimental Diets | | |
|---|---|---|---|
| | 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, Iodine1 g, Selenium 0.1 g, Cobalt 0.1 g and carrier (CaCO3) to 3 kg: *** Calculated analysis chemical according to NRC (1994).*

## RESULTS AND DISSCUSION

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

***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 Ahmedi 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. |
|---|---|---|---|---|---|---|---|
| | 0 | 2.5 | 5 | 7.5 | 10 | | |
| Carcass characteristics % | | | | | | | |
| 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 | 0.05 | 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. |
|---|---|---|---|---|---|---|---|
| | 0 | 2.5 | 5 | 7.5 | 10 | | |
| Carcass cuts % | | | | | | | |
| Breast | $29.25^{a}$ | $23.43^{b}$ | $31.61^{a}$ | $28.07^{ab}$ | $27.20^{ab}$ | 1.26 | * |
| Thigh | 17.51 | 17.43 | 18.21 | 18.06 | 18.62 | 1.91 | NS |
| Drumstick | 8.91 | 9.47 | 10.05 | 9.04 | 8.96 | 1.01 | NS |
| Wing | 6.56 | 6.10 | 7.06 | 5.54 | 5.70 | 0.99 | NS |
| Nick | 4.63 | 4.26 | 4.09 | 4.51 | 4.94 | 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. |
|---|---|---|---|---|---|---|---|
| | 0 | 2.5 | 5 | 7.5 | 10 | | |
| 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/cm$^2$) | $37.58^{a}$ | $34.07^{ab}$ | $36.35^{a}$ | $35.51^{a}$ | $31.17^{b}$ | 0.96 | ** |
| Ash % | $40.54^{b}$ | $44.23^{ab}$ | $46.90^{a}$ | $46.76^{a}$ | $47.70^{a}$ | 1.85 | ** |
| Organic matter % | 58.88 | 55.04 | 53.18 | 52.85 | 53.65 | 2.04 | NS |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Calcium % | 15.89 | 15.46 | 15.89 | 14.91 | 16.11 | 1.03 | NS |
| Phosphorus % | 9.49 | 8.80 | 8.66 | 8.87 | 9.00 | 1.07 | 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).*

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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## تاثير اضافة النانو فضة الي ماء الشرب على الاداء الانتاجى وصفات الذبيحة والعظم لبداري التسمين

**أحمد محمد تمام[1]، سيد عبد الرحمن ابراهيم[1]، علاء الدين عبد السلام[1]، فتحي عبد العظيم[1]، احمد ابراهيم الفحام[1]، نعمة الله جمال الدين[1] و وسام سالم[2]**

***قسم انتاج الدواجن - كلية الزراعة - جامعة عين شمس – مصر***

***كلية العلوم – جامعة جنوب الوادى – قنا - مصر***

أجريت تجربة لدراسة تاثير اضافة جزيئات النانو فضة فى ماء شرب بداري التسمين على الاداء الانتاجي وصفات الذبيحة والقطعيات وصفات العظم لمدة 5 اسابيع. واستخدم فى التجربة 150 كتكوت غير مجنس من عمر يوم من سلالة كب 500 وتم تقسيمها الى 5 معاملات كل معاملة احتوت على 30 طائر (3 مكرر × 10 طيور). اضيف النانو فضة لماء الشرب بمعدل (0.0 , 2.5 , 5.0 , 7.5 و 10.0) جزء فى المليون/لتر ماء شرب وفي نهاية التجربة (35 يوم) ذبحت 4 طيور من كل معامله لدراسة صفات الذبيحة والعظم.

كانت النتائج كالتالى:

1. لم يتاثر الوزن الحي للطيور والوزن المكتسب يوميا واستهلاك اليومي للعلف ومعامل التحويل الغذائى ودليل الانتاج ومعامل الكفاءة الاوربي معنويا بالمعاملات المختلفة.
2. لم تتاثر صفات الذبيحة والقطعيات بالمعاملات المختلفة بينما % للصدر تاثر معنويا وسجلت معاملات الكنترول و 5.0 اعلى قيم معنوية.
3. لم تتاثر صفات وقياسات العظم الظاهرية والكيميائية بالمعاملات المختلفة بينما قوة الكسر و%للرماد تاثرت معنويا وسجلت مجموعة الكنترول اعلى قيم فى قوة الكسر واقل قيم فى %للرماد بالمقارنة بالمعاملات المختلفة.

**الخلاصة**

اضافة مستويات مختلفة من النانوفضة فى ماء الشرب لبدراي التسمين لم يكن له تاثير سلبي على الاداء الانتاجى وصفات الذبيحة والعظم.