THE EFFECTS OF DIETARY SILVER AND GRAPHENE NANOPARTICLES ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKS

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(Received 30/8/2025, accepted 10/10/2025)

SUMMARY

Three hundred and sixty unsexed day-old chicks of Indian River (IR) broiler chicks were used to study the effect of using different types and levels of nanoparticles (silver and graphene) in broiler diets on performance, and carcass characteristics. This experiment contained 9 treatments and 40 chicks for each treatment. The experiment lasted from 1 to 35 days of age and contained three dietary phases (starter, grower and finisher) contained 2.5, 5.0, 7.5, and 10.0 ppm/kg of both silver (SNaPs) and graphene (GNaPs) nanoparticles, in addition to a control (basal diets) through the three stages. The results showed that:

1. Productive performance including LBW, BWG, FI, PI and EPEF differed significantly between treatments related to the different levels of nanoparticles but were not affected by the different types of nanoparticles overall period. Also FCR was not differed significantly, affected by either type or level of nanoparticles during the overall period.
2. All carcass traits and total digestive tract and ceca length were not significantly affected by the treatments except for liver percentage which increased significantly with higher nanoparticles levels in diets.

There weren't significant differences between the two types of nanoparticles (silver and graphene) as feed additives on productive performance and carcass characteristics. The different levels of nanoparticles decreased LBW and BWG and increased liver percentage compered to control.

Keywords: *Nanoparticles; silver, graphene, and broiler chicks.*

INTRODUCTION

Several applications of nanotechnology for food and agricultural production are being developed in research and development (R&D) settings. Key international challenges are associated with animal production, including environmental sustainability, health, disease control, and feed security. Nanotechnology holds promise for animal health, veterinary medicine, and other areas of animal production (Scott 2005).

Nanomaterials, used in animal and poultry production include, for example silicon dioxide, calcium, magnesium; and silver nanoparticles for water purification , antimicrobial packaging and feed storage, and zinc as a feed colorant. Titanium dioxide, a feed colorant used as a ultraviolet (UV) protection barrier in the feed packaging industry, is an approved inorganic nanoparticle because it becomes transparent and also loses its ability to act as a feed colorant in its nanoform (El Sabry *et al.,* 2018). Nanocomposite are also use as feed additives in feedstuffs contaminated with Fusarium mycotoxins such as magnetic graphene oxide nanocomposites due to their ability to bind with the mycotoxins (Zhu *et al.,* 2016).

Nanoparticles added to broilers feed not only positively affected breast and thigh muscle protein content while simultaneously lowering cholesterol but raised the average daily gain and feed efficiency of the broilers. The implications of these results are shorter production cycles for better quality meat with less feed required to have broilers reach market weight (Zha *et al.,* 2009). Anwar *et al.* (2019) studied the effect of SNaPs in broiler diets on growth performance and found that SNaPs at a dose rate of 9 ppm/kg improved the growth performance of poultry. Hassanabadi *et al.* (2012) investigated the effect of different levels of SNaPs as feed additives in starter (0.5, 1.0, 1.5 ppm) and grower diets (1, 2, 3 ppm). The results indicated that body weight gain was not significantly different between birds fed with nano-silver and control group.

On the other hand, Ahmadi (2012) investigated the effects of SNaPs supplementation in broiler diets on LBW through a period from1-42 day. Experimental diets included: 0 (Control), 20, 40, and 60 ppm SNaPs /kg diet, and found a negative effect of SNaPs on LBW, with the highest LBW was recorded in the control group (2284.45 g). Anwar *et al.* (2019) Hassanabadi *et al.* (2012), and Felehgari *et al*. (2013) found that SNaPs at a dose rate of 9 ppm/kg could improve feed intake and feed conversion ratio in poultry. Ahmadi (2012) also reported a significant increase in abdominal fat percentage with increasing Nano-silver (SNaPs) level in the diets. Felehgari *et al.* (2013) indicated that treatments significantly afreported aarcass characteristics as liver percentage increased significantly, while the percentages of heart, gizzard and abdominal fat hadn't affected significantly by treatments. Kout-Elkloub *et al.* (2015) showed significant differences in carcass, gizzard and abdominal fat percentage with silver nanoparticles supplementation, while liver, heart and spleen percentages were not significantly different. Saleh and El-Magd (2018) found that breast and thigh muscles weight (g/100 g BW) increased significantly in the group fed SNaPs compared with other groups. Graphene oxide has potential applications in removing heavy metal ions and ionic dyes from wastewater (Deng, 2013). Graphene exhibits a huge surface area (2630 m2/g) and strong chemical stability (Sun and Fugetsu, 2013).

Graphene oxide (GO) also has potential applications in removing ionic dyes and heavy metal ions from wastewater (Gao *et al.,* 2011 and Bradder *et al.,* 2011). Graphene nanoparticles are the latest nanomaterial used in the field of animal production. However, there is very little research on their use in poultry feed or drinking water. Saminathan *et al.* (2018) studied the effect of broiler diets supplemented with graphene nanoparticles and found that LBW, and BWG improved significantly with their inclusion.

This study aimed to investigate the effect of using different types and levels of nanoparticles (silver and graphene) in broiler diets on productive performance and carcass characteristics.

MATERIALS AND METHODS

The present study was carried out at the Poultry Nutrition Farm, Poultry Production Department, Faculty of Agriculture, Ain Shams University, Shalakan, Kaliobia, Egypt. Nanoparticles prepared in faculty of science, South Valley University, Qena, Egypt.

This experiment was conducted to evaluate the effect of using nanoparticles) silver or graphene nanoparticles) as a supplementation in broiler diets on productive performance, carcass traits, and total digestive tract and ceca length. A total of 360 unsexed one-day-old of IR (Indian river) broiler chicks were used in this study; obtained from a commercial hatchery and divided into nine treatments. Each treatment comprised of 40 chicks, divided into eight replicates of five chicks. The tested nanoparticles treatments were (0 nanoparticles) as a control treatment, 2.5, 5.0, 7.5 and 10.0 ppm/Kg feed of two types of nanoparticle) silver or graphene nanoparticles), of starter, grower and finisher diets, respectively.

Birds housing and management:

Birds were reared under similar managerial conditions and monitored daily for mortality rate Feed was presented in mash form using metallic feeders and automatic nipple drinkers supplied water. Feed and water were provided *ad-libitum*. The chicks were subjected to 24 hours of artificial light during the 1$^{st.}$ week then 23 h and 1 h dark untill the end of the experiment. They were vaccinated in drinking water against Newcastle and IB diseases using Hitchner IB vaccine at 7 days, Lasota vaccine at 18 and 28 day-old and Gumboro disease at 14 day-olds.

Experimental diets:

Three (diets in mash form were formulated in the experiment): starter from 1 to 14 days, grower from 15 to 28 days and finisher from 29 to 35 days. The nutrient requirements were supplied (according to strain catalog). Chicks were fed on the experimental corn – soybean diets in which the composition and calculated analysis which are shown in Table 1.

Measurements and procedure:

Live body weight (LBW) of each replicate was recorded, and average body weight gain (BWG) and Average feed intake (FI) were calculated. Feed conversion ratio (FCR) was calculated as the amount of feed intake required to produce one gram of weight gain. Performance index (PI) was determined according to North (1981) while European production efficiency factor (EPEF) was calculated according to Emmenrt (2000).

Table (1): Composition and calculated analysis of starter grower and finisher diets.

Ingredients	Diets		
	Starter	**Grower**	**Finisher**
	1-14 day	15-28 day	29-35 day
Yellow corn	55.76	59. 70	63.70
Soybean meal 48%	37.84	33.10	28.22
Soy 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	0.30	0.30	0.30
Premix**(Vit+Min)	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**
Calculated 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

***Each 3 kg contains: Vit A 12 000 000 IU, Vit D3 2 000 000 IU, Vit E 10g, Vit K3 2 g, Vit B1 1 g, Vit B2 10 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 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 according to NRC (1994)*

Slaughter procedure:

At the end of the experiment, four chicks from each treatment (with no visible abnormalities) were randomly selected and fasted for about 10 hours before slaughter. After complete bleeding ended, birds were scalded in water at 50° C. Feathers were removed by a de-feathering machine and birds were reweighed and eviscerated. Viscera were removed manually without disrupting abdominal fat. Total inedible parts (head, legs, and inedible viscera) were set aside and then, the remaining carcass (dressed weight), liver, gizzard, heart, and abdominal fat, were weighed. The data on carcass yield, abdominal fat, and relative weights of liver, gizzard, and heart were calculated as a percentage of live body weight.

Statistical analysis:

Statistical analysis was conducted using the general linear model (GLM) procedure of base SAS® (SAS instituted, 2004). Factors test using two ways ANOVA. Means were compared using Duncan´s multiple range test (Duncan, 1955) where the level of significance was set at minimum ($P \leq 0.05$). Treatments were assigned as the main factor, the statistical model performed as follow:

$$Y_{ijk} = \mu + T_i + L_j + (T*L)_{ij} + E_{ijk}$$

Where
Y_{ijk}= is the effect of observation
μ = overall mean.
T_i = the effect of i^{th} type of nanoparticles.
Lj= the effect of the j^{th}. levels of nanoparticles
$(T*L)_{ij}$= interaction between types and levels of nanoparticles.
E_{ijk} = random error.

RESULTS AND DISCUSSION

Live body weight (LBW) and body weight gain (BWG):

Table 2 shows the main effect of either type of nanoparticles (silver or graphene) and levels (0.0, 2.5, 5.0, 7.5 and 10.0 ppm/kg diets) on (LBW) and (BWG) of broilers, chicks fed different types of nanoparticles during the study period reflected insignificant values in both (LBW) and (BWG). On the other hand, chicks fed control diets reflected the highest significant (LBW) and (BWG) compared with those fed different levels of nanoparticles. Besides, the chicks fed the diet supplemented with 5 ppm/kg diets showed the lowest (LBW and BWG) compared with other treatments.

On the other hand, the obtained data are in disagreement with those reported by Ahmadi (2009), Kout-Elkloub *et al.* (2015), Saleh and A. El-Magd (2018) who showed significant improvement in LBW and BWG of broiler chicks with silver nanoparticles supplementation. Also, Odunsi *et al.* (2007), Abu Bakr (2008), and Majewska *et al* (2009) who found that inclusion of charcoal at different levels in broiler diets reflected significantly higher LBW and BWG compared with control groups.

Feed intake (FI) and Feed conversion ratio (FCR):

Data showed that no significant differences were observed for (FI and FCR) within different types of nanoparticles (silver or graphene) overall period of experiment. In the same order, the figures of (FI and FCR) indicated significant differences between chicks fed diets containing 5 ppm/kg diet compared with those fed other levels of nanoparticles or control diet.

On the other hand, the best FCR was detected in chicks fed control diets (1.52) and the worst FCR was found in chicks fed diets containing 7.5 ppm/kg, (1.58 and 2.5 ppm/kg, 1.57) during whole experiment period, without any significant differences.

These results were in agreement with those obtained by Ahmadi (2009), Shabani *et al.* (2010), Mohammadi *et al*. (2015) and Andi *et al*. (2011) who found that FI was affected at 42 days of age by type of feed, supplementation, and interaction. The FCR was affected at 42 days of age by type of feed, and interaction but supplementation hasn't affected FCR. This result disagrees with Ahmadi *et al.* (2010), Pineda *et al.* (2012) Felehgari *et al*. (2013) and Kout-Elkloub *et al*. (2015) who found that FCR was significantly affected with different levels of silver nanoparticles supplementation. The best FCR was recorded by the 4ppm/kg treatment.

In addition to Odunsi *et al.* (2007), Abu Bakr (2008), Majewska *et al.* (2011), khadem (2012), and Saminathan *et al.* (2018) showed that using active charcoal or graphene nanoparticles in broiler diets led to significant improvement in FI and FCR.

Performance index (PI) and European production efficiency factor (EPEF):

The effect of adding different types and levels of nanoparticles in broiler diets on (PI and EPEF) of broilers is shown in Table 3. Data showed that PI or EPEF were not significantly affected by nanoparticle types. On the other hand, there were significant decreases in PI or EPEF with increasing nanoparticles levels until 5 ppm/kg diet then increased again. The birds fed a diet with 5 ppm/kg diet recorded the lowest PI or EPEF values (106.45 and 300.44 respectively) and the control group recorded the highest PI value (117.94) and EPEF value (336.98). This result may be related to the effect of nanoparticles on BWG where the same trend achieved with both BWG and PI or EPEF. This result agrees with Kout-Elkloub *et al*. (2015) who found significant differences between silver nanoparticles levels in EPEF where the highest EPEF value recorded by birds fed diet with 4 ppm SNaPs (374) and the lowest EPEF value recorded by birds fed control group.

Carcass characteristics:

As shown in Table 4 there weren't significant differences observed in percentages of carcass, giblets and total edible parts between different dietary treatments. The corresponding values for carcass percentage ranged between (67.12 and 69.56 %), also TEP % ranged between (71.58 and 74.24 %). The differences failed to be significant compared to different dietary treatments. Numerically, chickens fed GNaPs had the highest percentage for carcass and total edible parts compared with chickens fed SNaPs (68.88 vs. 67.44 and 73.32 vs. 72.07 % respectively). These results agree with Majewska *et al.* (2011), Jiya *et al.* (2014) Ognik *et al.* (2016), and Saminathan *et al.* (2018) who found that dressing in broiler chicks was not significantly affected by different levels of SNaPs , activated charcoal or GNaPs.

However, these findings disagree with Kout-Elkloub *et al.* (2015) who reported significant differences in carcass percentage with silver nanoparticles supplementation. Moreover, Odunsi *et al.* (2007), showed that inclusion of different levels of charcoal in broiler diets had a negative effect on carcass percentages and abdominal fat.

However, liver % differed significantly between chicks fed different levels of nanoparticles and those fed the control diet. The corresponding figures were 2.80, 2.60, 2.77 and 2.73 vs. 2.19 % for the control, respectively. This result agrees with Ahmedi *et al.* (2013), and Felehgari *et al.* (2013), who found that treatments significantly affected some carcass characteristics with liver percentage increasing significantly at certain levels. These results may be related to the function of the liver as a blood filter for minerals where the silver or graphene can depose.

On the other hand, these findings are in contrast with the results obtained by Vadalasetty *et al.* (2018), Ognik *et al.* (2016), Kout-Elkloub *et al.* (2015), and Saminathan *et al.* (2018) who found that the percentage of liver wasn't significantly affected with a different type of nanoparticles. These discrepancies may be attributed to differences in nanoparticle properties, doses or experimental conditions, despite some similarities between silver and graphene nanoparticles.

Abdominal fat percentage also showed no significant effect on nanoparticle type or level. This result agrees with Felehgari *et al*. (2013), who found that nanosilver and selenium haven't significant effect on the percentages of abdominal fat. This result disagrees with Ahmedi *et al*. (2012) and Kout-Elkloub *et al.* (2015), who reported significant difference in abdominal fat percentage with silver nanoparticles supplementation.

CONCLUSION

Using different levels of nanoparticles (silver or graphene) as feed additives in broiler diets has negative effects on live body weight, body weight gain and increased liver%

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Table (2): Effect of nanoparticles (silver and graphene) in broiler diets on live body weight (LBW) and body weight gain (BWG)

Item	Type	Control	Level				Overall	Sig.			
			2.5 PPM	5 PPM	7.5 PPM	10 PPM		MSE	T	L	T*L
Initial LBW	SNaPs	43.30	44.00	43.62	44.10	43.77	**43.76**	**0.39**	**NS**	**NS**	**NS**
	GNaPs	43.30	43.72	43.92	43.80	43.80	**43.71**				
	Overall	**43.30**	**43.86**	**43.77**	**43.95**	**43.78**					
LBW (14 day)	SNaPs	436.62	431.82	454.71	475.68	426.42	**445.05**	**38.49**	**NS**	**NS**	**NS**
	GNaPs	436.62	450.48	450.48	439.98	386.40	**432.79**				
	Overall	**436.62**	**441.15**	**452.60**	**457.83**	**406.41**					
LBW (28 day)	SNaPs	1195.21	1117.10	1110.05	1212.26	1111.61	**1149.25**	**34.45**	**NS**	**	**
	GNaPs	1195.21	1134.05	1107.27	1113.27	1146.97	**1139.36**				
	Overall	**1195.22a**	**1125.58c**	**1108.66c**	**1162.77ab**	**1129.29b**					
LBWG (35 day)	SNaPs	1787.62	1702.52	1626.93	1781.42	1735.37	**1726.77**	**36.68**	**NS**	**	**
	GNaPs	1787.62	1718.61	1686.21	1664.94	1742.80	**1720.04**				
	Overall	**1787.63a**	**1710.57b**	**1656.57c**	**1723.18b**	**1739.09b**					
BWG (1-14 day)	SNaPs	393.72	388.82	411.11	431.73	382.97	**401.67**	**38.08**	**NS**	**NS**	**NS**
	GNaPs	393.72	407.03	406.88	396.13	342.75	**389.30**				
	Overall	**393.72**	**397.93**	**409.00**	**413.93**	**362.86**					
BWG (15-28 day)	SNaPs	758.60	685.28	655.34	736.58	685.19	**704.20**	**45.60**	**NS**	**	**NS**
	GNaPs	758.60	683.57	656.79	673.29	760.57	**706.57**				
	Overall	**758.60a**	**684.43bc**	**656.07c**	**704.94bc**	**722.88ab**					
BWG (29-35 day)	SNaPs	592.41	585.42	516.88	569.15	623.76	**577.53**	**38.16**	**NS**	*	**NS**
	GNaPs	592.41	584.55	578.94	551.66	595.82	**580.68**				
	Overall	**592.41ab**	**584.99ab**	**547.91c**	**560.41b**	**609.79a**					
BWG (1-35 day)	SNaPs	1744.73	1659.52	1583.33	1737.47	1691.92	**1683.40**	**36.67**	**NS**	**	**
	GNaPs	1744.73	1675.16	1642.61	1621.09	1699.15	**1676.55**				
	Overall	**1744.73a**	**1667.34b**	**1612.97c**	**1679.28b**	**1695.54b**					

*a,b: Means in the same row or column with the same letters are not significantly different. MSE: Mean standard error NS: Non-significant *: (P≤ 0.05) SNaPs = silver nanoparticles, GNaPs = graphene nanoparticles, T*L= the interaction between type and level of nanoparticles.*

Table (3): Effect of nanoparticles (silver and graphene) in broiler diets on feed intake (FI) and feed conversion ratio (FCR).

Item	Type	Control	Level				Overall	Sig.			
			2.5 PPM	5 PPM	7.5 PPM	10 PPM		MSE	T	L	T*L
FI 1-14 day	SNaPs	489.24	492.85	502.27	513.68	496.59	**498.92**	**20.16**	**NS**	**NS**	**NS**
	GNaPs	489.24	507.62	504.72	510.15	488.49	**500.05**				
	Overall	**489.24**	**500.24**	**503.50**	**511.92**	**492.54**					
FI 15-28 day	SNaPs	1126.53	1083.13	1137.36	1218.54	1067.63	**1126.64**	**88.43**	**NS**	**NS**	**NS**
	GNaPs	1126.53	1156.29	1053.45	1080.48	1149.13	**1113.18**				
	Overall	**1126.53**	**1119.72**	**1095.41**	**1149.51**	**1108.38**					
FI 29- 35 day	SNaPs	1049.53	936.84	842.04	1042.44	1009.90	**976.15**	**58.30**	**NS**	**	**
	GNaPs	1049.53	1058.94	943.58	973.57	971.09	**999.35**				
	Overall	**1049.53a**	**997.89a**	**892.81b**	**1008.01a**	**990.50a**					
FI 1- 35 day	SNaPs	2665.30	2512.83	2481.67	2774.67	2574.12	**2601.72**	**114.60**	**NS**	*	*
	GNaPs	2665.30	2722.86	2501.76	2564.21	2608.72	**2612.57**				
	Overall	**2665.31a**	**2617.85a**	**2491.72b**	**2669.45a**	**2591.42ab**					
FCR 1-14 day	SNaPs	1.25	1.27	1.22	1.19	1.30	**1.24**	**0.10**	**NS**	**NS**	**NS**
	GNaPs	1.25	1.26	1.24	1.29	1.42	**1.29**				
	Overall	**1.25**	**1.26**	**1.23**	**1.24**	**1.36**					
FCR 15-28 day	SNaPs	1.48	1.58	1.73	1.65	1.56	**1.60**	**0.09**	**NS**	**	**NS**
	GNaPs	1.48	1.69	1.60	1.60	1.51	**1.58**				
	Overall	**1.48c**	**1.63ab**	**1.66a**	**1.63ab**	**1.53b**					
FCR 29- 35 day	SNaPs	1.77	1.60	1.62	1.83	1.62	**1.69**	**0.04**	**NS**	**	**
	GNaPs	1.77	1.81	1.62	1.76	1.62	**1.72**				
	Overall	**1.77a**	**1.70b**	**1.62c**	**1.79a**	**1.62c**					
FCR 1- 35 day	SNaPs	1.52	1.51	1.56	1.59	1.52	**1.54**	**0.05**	**NS**	**NS**	**NS**
	GNaPs	1.52	1.62	1.52	1.58	1.53	**1.55**				
	Overall	**1.52**	**1.57**	**1.54**	**1.58**	**1.53**					

*MSE: Mean standard error NS: Non-significant) SNaP = silver nanoparticles, GNaP = graphene nanoparticles, T*L= the interaction between type and level of nanoparticles.*

Table (4): Effect of nanoparticles (silver and graphene) in broiler diets on Performance index (PI) and European production efficiency factor (EPEF).

Item	Type	Control	Level				Overall	Sig.			
			2.5 PPM	5 PPM	7.5 PPM	10 PPM		MSE	T	L	T*L
Performance index	SNaPs	117.94	111.85	104.01	112.38	115.42	**112.32**				
	GNaPs	117.94	106.31	108.89	107.19	116.25	**111.31**	**6.70**	**NS**	**	**NS**
	Overall	**117.94a**	**109.08bc**	**106.45c**	**109.78bc**	**115.83ab**					
European production efficiency factor	SNaPs	336.98	319.59	289.76	313.06	321.54	**316.18**				
	GNaPs	336.98	303.74	311.13	298.61	323.83	**314.86**	**18.84**	**NS**	**	**NS**
	Overall	**336.98a**	**311.66b**	**300.44c**	**305.83bc**	**322.69ab**					

*MSE: Mean standard error NS: Non-significant; SNaPs = silver nanoparticles, GNaPs = graphene nanoparticles, T*L= the interaction between type and level of nanoparticles.*

Table (5): Effect of nanoparticles (silver and graphene) in broiler diets on carcass characteristics %.

Item	Type	Control	Level				Overall		Sig.		
			2.5 PPM	5 PPM	7.5 PPM	10 PPM		MSE	T	L	T*L
Carcass	SNaPs	67.30	68.90	66.99	64.73	69.30	**67.44**				
	GNaPs	67.30	67.81	69.94	69.51	69.83	**68.88**	**2.71**	**NS**	**NS**	**NS**
	Overall	**67.30**	**68.36**	**68.47**	**67.12**	**69.56**					
Liver	SNaPs	2.19	2.76	2.57	3.07	2.96	**2.71**				
	GNaPs	2.19	2.84	2.63	2.47	2.51	**2.53**	**0.32**	**NS**	**	**NS**
	Overall	**2.19[b]**	**2.80[a]**	**2.60[a]**	**2.77[a]**	**2.73[a]**					
Gizzard	SNaPs	1.56	1.30	1.39	1.35	1.41	**1.40**				
	GNaPs	1.56	1.24	1.46	1.26	1.42	**1.39**	**0.22**	**NS**	**NS**	**NS**
	Overall	**1.56**	**1.27**	**1.43**	**1.31**	**1.42**					
Heart	SNaPs	0.51	0.48	0.45	0.50	0.51	**0.49**				
	GNaPs	0.51	0.57	0.49	0.48	0.52	**0.51**	**0.07**	**NS**	**NS**	**NS**
	Overall	**0.51**	**0.53**	**0.47**	**0.49**	**0.51**					
Total giblets	SNaPs	4.28	4.56	4.43	4.93	4.89	**4.62**				
	GNaPs	4.28	4.66	4.59	4.22	4.46	**4.44**	**0.43**	**NS**	**NS**	**NS**
	Overall	**4.28**	**4.61**	**4.51**	**4.58**	**4.67**					
Total Edible parts	SNaPs	71.58	73.47	71.42	69.67	74.20	**72.07**				
	GNaPs	71.58	72.48	74.54	73.74	74.29	**73.32**	**2.53**	**NS**	**NS**	**NS**
	Overall	**71.58**	**72.97**	**72.98**	**71.71**	**74.24**					
Abdominal fat	SNaPs	0.97	0.86	0.90	0.76	1.43	**0.98**				
	GNaPs	0.97	1.06	1.19	1.06	0.85	**1.03**	**0.29**	**NS**	**NS**	**NS**
	Overall	**0.97**	**0.96**	**1.04**	**0.91**	**1.14**					

*a,b: Means in the same row or column with the same letters are not significantly different. MSE: Mean standard error NS: Non-significant *:(P≤ 0.05)**: (P≤ 0.01)*
*SNaPs = silver nanoparticles, GNaPs = graphene nanoparticles, T*L= the interaction between type and level of nanoparticles*

تاثيرات اضافة جزيئات النانو فضة والنانو جرافين في علائق دجاج اللحم على معدلات النمو وصفات الذبيحة

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تم استخدام ثلاثمائة وستين كتكوت تسمين من هجين IR عمر يومًا غير مجنسة لدراسة تأثير استخدام أنواع ومستويات مختلفة من الجسيمات النانوية (الفضة والجرافين) في علائق دجاج التسمين على الأداء الانتاجي، وصفات الذبيحة وطول الجهاز الهضمي في كتاكيت التسمين. تضمنت هذه التجربة 9 معاملات و 40 كتكوت تسمين لكل معاملة. استمرت التجربة من يوم إلى 35 يومًا واحتوت على 3 علائق (بادئ ونامي وناهي) تحتوي على 2.5 و 5.0 و 7.5 و 10.0 جزء في المليون / كجم من كلا النوعين من الجسيمات النانوية (الفضة والجرافين) بالاضافة عليقة الكنترول. تنقسم الفترة التجريبية إلى 3 مراحل مختلفة. فترة البادئ، تبدأ من 1 إلى 14 يومًا ، النامي من 15 الي 28 يومًا وفترة الناهي تبدأ من 29 الي 35 يومًا.

أظهرت نتائج هذه التجربة ما يلى:

- الاداء الانتاجي: اختلف أداء الطيورالانتاجي بما في ذلك وزن الجسم الحي و وزن الجسم المكتسب و العلف الماكول و دليل الإنتاجية والمعامل الأوربى للكفاءة الإنتاجية بشكل كبير بين المعاملات بمستويات مختلفة من الجسيمات النانوية ولكن لم تتأثر باختلاف أنواع جسيمات النانو خلال الفترة الإجمالية ، كما لم يختلف معامل التحويل الغذائى بشكل كبير حسب الأنواع المختلفة أو مستويات لجسيمات النانو في الفترة الإجمالية.
- صفات الذبيحة: لم تتأثر جميع صفات الذبيحة بشكل كبير بالمعاملات المختلفة باستثناء نسبة الكبد إذا زادت بشكل كبير مع زيادة مستوى جسيمات النانو في العلائق.

الخلاصة:

استخدام مصادر مختلفة من جزيئات النانو (فضة والجرافين) كاضافات علفية لم تؤثر على الاداء الانتاجى وصفات الذبيحة بينما المستويات المختلفة اثرت بصورة واضحة على وزن الجسم والوزن المكتسب و% للكبد.