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Effect of Nano-Selenium and Vitamin E on Growth Performanceand Blood Constituents of Broiler Chickens

Kout-Elkloub M. El. Moustafa[1], Wafai Z. A. Mikhail[2], Hany M. R. Elsherif[3] and Marwa A. El-tybe[1]

[1] Poultry Nutrition Department, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt
[2]Natural Resources Department, Faculty of African Postgraduate Studies, Cairo University, Giza, Egypt.
[3]Animal Production Department, Faculty of Agriculture, Cairo University, Giza,Egypt.
Corresponding author: wafai1947@gmail.com
ORCID ID: 0000-0003-4471-610X

ABSTRACT

This study was carried out to determine the effect of nano-selenium (SeNPS) and vitamin E (Vit. E) on the growth performance of broiler. A total number of 108 Arbor Acres broiler chicks at one week of age, having the nearest weight (about153g) were used and distributed into 4 groups of 27 chicks each. Each group was divided into 3 replicates of 9 chicks each. Experimental treatment diets were T1(Control), T2(Control without selenium+SeNPS 0.1mg/Kg), T3(Control+Vit.E100mg/Kg), T4(Control without selenium + SeNPS 0.1mg/Kg+Vit.E100mg/Kg). The supplementation of SeNPS (T2), Vit.E(T3) and a combination of them(T4) were improved body weight and body weight gain compared to the control group. At the end of the experimental period, T2 (SeNPS) and T4(SeNPS +Vit.E) recorded the lowest ($P \leq 0.05$) feed intake compared to T1 and T3. Regarding feed conversion ratio (FCR), all treatments recorded the better FCR compared to the control group at all periods studied. At the overall period, the better FCR ($P \leq 0.05$) was obtained by T2 and T4 compared to the control group. The viability of all birds during the experimental period was high where the mortality was normal-and less than the control-and absent in T4. Plasma calcium had significantly increased in all treatments compared to control. Also, phosphorous was numerical increase in all treatments compared to control group. The highest value of plasma calcium and phosphorous obtained by T2. There were significant differences between treatments in plasma total protein and the highest value obtained by T3. Albumin had significantly increased in T4 compared to all other treatments. All treatments were recorded lowest values of plasma cholesterol compared to control group. Chicks fed SeNPs+Vit.E(T4) and Vit.E(T3) were significantly ($p<0.05$) lower in plasma cholesterol compared to T1. While, T3 and T4 had significantly higher plasma triglycerides compared to T2 and control. Total antioxidant capacity had significant differences in all treatments and the best treatment ($P \leq 0.05$) was T4 compared to all treatments followed by T2. This result may be due to the ant oxidative effect of ether SeNPS or Vit.E which can improve the growth performance, immunity, and health in broiler chickens. It can be concluded that supplementation of SeNPS 0.1mg/Kg+Vit.E100mg/Kg or SeNPS 0.1mg/Kg of broiler chicks from 7 to 35 days of age improve the performance and blood constituents. More studies should be done in this new area of research in future.

Keywords: Broiler, Nano- elenium, Vitamin E, Performance, Blood.

Introduction

The poultry industry in the past 10-20 years has been witnessing a large number of feed additives that enhance broiler's productivity and survival. Moreover, they were recommended among preventive and biosecurity measures in broiler's farms for their known actions as immune-stimulants. These additives include probiotics (Yaqoop, 2017), synbiotics (Plaza-Diaz *et al.*, 2018), Nigella sativa Linn (Soliman *et al.*, 2017), organic acids (Yang *et al.*, 2018), and trace elements like selenium (Pan *et al.*, 2018). Selenium (Se) is also an essential micronutrient because of its unique antioxidant properties (Amoako *et al.,* 2009). Selenium is a trace mineral essential to maintain good health in animals and human beings. Selenium is incorporated into proteins to form selenoproteins, which are important as antioxidant enzymes. These antioxidant enzymes prevent oxidative damage to body tissues. Unfortunately, in many parts of the world, major food ingredients contain an inadequate level of selenium resulting in selenium deficiency in human and animal nutrition. In commercial poultry production, selenium needs to be supplemented to overcome various stressors (Chun *et al.*,2009). Selenium bioavailability is dependent on many factors such as intestinal absorption and biological activation (Rajashree *et al.,* 2014), this Se is mostly deposited in muscles, liver, and plasma (Mahima *et al*.,2012). The maximum amount for selenium in diets has been set at 0.5mg/kg based on the European Union (2004) recommendation to ensure feed safety. The bioavailability of selenium is largely correlated with its physical form.

Nanotechnology plays a major role in the areas of research in poultry science. The future challenges of the poultry science research include controlling the macro and micro-nutrient absorption, tackling the diseases, targeting drug delivery, safety growth promoter, reducing the energy and protein wastage in unproductive physiological purposes thereby, increasing the feed efficiency and reducing the price of the poultry meat(Kout-Elkloub *et al*., 2015). Nano-selenium(NS) has attracted wide spread attention nowadays since nanometer particulates exhibit novel characteristics such as large surface, smaller sized nanoparticle which plays the excellent role of its high bioavailability, high catalytic efficiency, strong adsorbing ability, and low toxicity compared with selenite in chickens(Wang *et al*., 2009; Wadhwani *et al.,* 2016; Skalickova *et al*.,2017). Essential elements, which include iron, zinc, chromium, manganese, Se, and molybdenum, are vital to the health of poultry and play important roles in the function of co-enzymes (Peters *et al*., 2016).

Some data exist that evaluate growth performance parameters of commercial broilers fed with NS supplemented diets by many authors (Mahmoud *et al*., 2016; Moghaddam *et al*.,2017). Saleh and Ebeid (2019) investigated that feeding broilers on sodium selenite (1mg/kg)and nano-Se (0.5mg/kg) improved body weight gain, muscle weight, and crude protein digestibility in nano group.

The success of broiler production depends on maximum weight gain within a minimum period which can be fulfilled by proper nutritional and management practices. Administration of certain vitamins, minerals, amino acids, and their different combinations to chicken in excess of their supposed requirements enhances their disease resistance. Vitamin E and selenium are one of them. Vitamin E plays an important role in the enzyme system in the animal body. Vitamin E added to levels beyond those needed to support optimal growth and improving the immune competence of growing broilers (Erf *et al*., 1998).

Vitamin E (Vit.E) is a lipid-soluble vitamin, which is well known as an efficient chain-breaking antioxidant preventing oxidative damages to body tissues (Voljc *et al.*,2011). In broiler chickens, biological damages induced by oxidative stress result in several pathologies affecting growth and health (Estevez, 2015; Akbarian *et al.*,2016). Thus, dietary supplementation of Vit. E is a common practice in the broiler industry to counteract the deterioratiite effects of oxidative stress. Moreover, it was demonstrated that the antioxidant properties of Vit. E can improve immunity in broiler chickens (Leshchinsky and Klasing 2001). The current recommendation for Vit. E concentrations in broiler diets ranges from10.0IU/kg (NRC,1994) to 80.0IU/kg (Aviagen, 2014) depending on the stage of growth. However, recommendation levels of Vit. E in diets are also affected by various factors including other antioxidants such as vitamin C and selenium, type and amount of lipids in diets, and environmental conditions (NRC,1994).

In poultry production, vitamin E supplementation is essential for a crucial role in the prevention of nutritional encephalopathy and myopathies in chickens and turkeys (Klasing and korver, 2020).The supplementation of layer hen feed with 30 IU/Kg of vitamin E resulted in a significant increase of serum superoxide dismutase and glutathione peroxidase, both of which are enzymes with antioxidant activities as reported by Liu *et al.*(2019).

Therefore, this study was conducted to investigate the effect of SeNPs and Vit. E and the combination of them on growth performance and blood constituents of broiler chickens.

Material and Methods:

The experimental study was conducted at El-Fayoum Poultry Farm, Animal Production Research Institute, Egypt during the summer season. The Vit. E was purchased from a local market(5%), while, nano-selenium was prepared in the laboratories of the Poultry Nutrition

Department, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture.

Preparation and characterization of Selenium nanoparticles

Preparation:

Selenium nanoparticles were prepared by the reduction of selenium with diluted aqueous solutions containing Na_2SO_3. Sodium selenosulphate solution was prepared by refluxing a mixture of selenium and Na_2SO_3 in double distilled water at 70-80°C for about7-8 hours (Gorer and Hodes,1994). An aqueous polyvinyl alcohol (PVA) stock solution, 1% by weight was prepared and used as a stabilizing agent. The formation of orange-red colored selenium nanoparticle solution was observed in less than one minute upon mixing the PVA with Sodium selenosulphate. It is important to use a stabilizer, during the preparation of metal nano-particle, to avoid nano-particle agglomeration (Bai *et al*.,2007).

Characterization:

Characterization of nanoparticles is important to understand and control nanoparticle synthesis and applications. SeNPs were assessed by UV-V spectroscopy (Fig. 1). The determination of SeNPs concentration of the present study was 1645 ppm/liter using Flam Atomic absorption spectrometry (Agilent Technologies 200 Series AA).

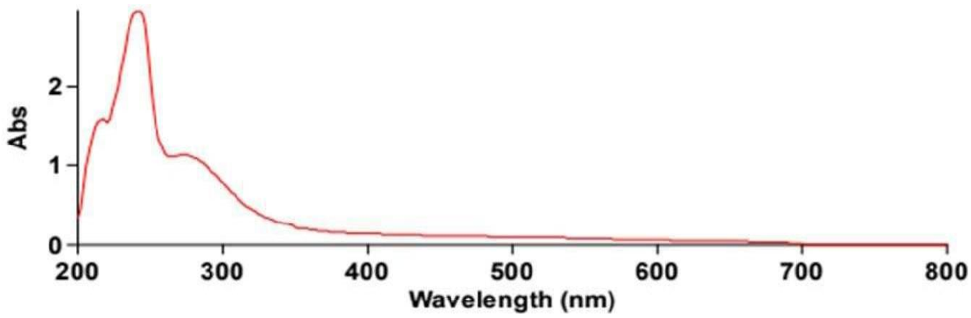

Fig. (1):UV-V spectroscopy of nano selenium

Birds, housing, and growth measurements:

A total number of 108 days old Arbor Acres broiler chicks at one week of age, having the nearest weight (about 153g) were used and distributed into 4 groups of 27 chicks each. Each group was divided into 3 replicates of 9 chicks each. Feed and water were provided *ad-lib*. The light was provided for 24 hours in a form of natural during the day and artificial light during the night. Feed intake (FI) and live body weight were recorded also body weight gain (BWG) and Feed conversion ratio (FCR) were calculated for each growth period. The experimental diet was formulated according to the nutrients requirements of the broiler chicks (Arbor Acres) to the strain catalog recommendation.

Treatment Experimental diets:-

T1-Control.

T2-Control (without selenium) +Selenium nanoparticles 0.1mg/Kg diet.

T3-Control+Vitamin E 100mg/Kg diet.

T4-Control (without selenium) +Selenium nanoparticles 0.1mg/Kg diet +Vitamin E 100mg/Kg diet.

Basal corn-soy diets were formulated (Table 1) to meet the nutrients requirements of the broiler chicks (Arbor Acres) according to the strain catalog recommendation.

Mortality rate

The mortality rate was calculated according to the following equation:

The mortality rate= (Number of live birds at the beginning - Number of live birds at the end/total Number at the beginning)*100

Blood sampling:

At the end of the experiment blood samples were taken by slaughtering 3 chickens within each treatment. The blood samples were collected into sterile tubes with some drops of heparin and centrifuged at 3000 rpm for 15 minutes to separate plasma. The plasma was collected and kept in a deep freezer subsequent chemical analysis. Commercial kits were used to determine calorimetrically plasma content f Calcium (mg/dl), Phosphor(mg/dl)**,** Total Protein (g/dl), Albumin(g/dl), Globulin (g/dl), Cholesterol (mg/dl), Triglycerides (mg/dl), Alkaline phosphatase (mg/dl) and Total antioxidant capacity (Mm/L).

Table (1) Ingredients and nutrient composition of broiler starter, grower and finisher diet.

Ingredients %	Starter (1-14day)	Grower (15-28day)	Finisher (29-35day)
Yellow corn	52.02	55.74	60.86
Soya Bean Meal 44%	35.21	31.16	25.73
Corn gluten meal 60%	5.00	5.00	5.00
Soya bean oil	3.20	4.06	4.59
Limestone	1.73	1.49	1.40
Mono calcium phosphate	1.43	1.26	1.12
Vit. & minerals premix*	0.30	0.30	0.30
DL-Methionine	0.28	0.23	0.20
L–lysine HCL Sodium	0.31	0.24	0.27
chloride(salt) Sodium	0.32	0.32	0.33
bicarbonate Choline	0.10	0.10	0.10
chloride 60%	0.10	0.10	0.10
Total	100	100	100
Calculated Analysis**			
Crude Protein %	23.00	21.50	19.00
Metabolizable Energy (kcal/kg)	3,000	3,100	3,200
Crude fiber %	3.85	3.65	3.37
Crude fat %	5.81	6.75	7.39
Lysine %	1.45	1.29	1.16
Methionine	0.69	0.51	0.56
Methionine+ Cysteine %	1.06	0.99	0.91
Calcium %	0.98	0.87	0.89
Available Phosphorus %	0.45	0.44	0.41
Sodium %	0.17	0.17	0.17

*Each 3 kg of premix contains:
Vitamin A 12000000 IU, Vitamin D_3 2200000 IU, Vitamin E 10000 mg, Vitamin K_3 2000 mg, Vitamin B_1 1000 mg, Vitamin B_2 5000 mg, Vitamin B_6 1500 mg, Vitamin B_{12} 10 mg, Biotin 50 mg, Niacin 30,000 mg, Calcium pantothenate 10,000 mg, Folic acid 1000 mg, Manganese 60,000 mg, Iron 30000 mg, Copper 4000 mg, Iodine 1000 mg, Zinc 50000 mg, Choline chloride 300000 mg, Cobalt 100 mg, Selenium100 mg and carrier $CaCO_3$ up to 3000g.

**According to Feed Composition Tables for animal and poultry feed stuffs used in Egypt(2001).

Statistical analysis:

Data obtained were statistically analyzed for the effect of treatments using the General Linear Model for analysis of variance described in the SAS program (SAS Institute, 2004). Means of significant differences were compared using Duncan‘s multiple range test(Duncan‘s1955).

The model used in the experiment:

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

Where:

Y_{ij}=an observation

μ =the overall mean

T_i =Effect of i^{th} treatments (i=1,2,3,4)

e_{ij}=Experimental error

Results and Discussion

Body weight and body weight gain:

Effect of feeding nano selenium particles (SeNP$_S$**)**,Vitamin E (Vit.E) and combination of them (SeNPS+Vit.E) on body weigh t(BW), body weight gain (BWG), and mortality rate (%) of broiler chicken from 7 to 35 days of age were shown in Table 2.

There were no significant differences between all treatments in initial body weight (BW1), BW2, BW4, and BW5. While BW3 had significant differences and the highest significant body weight was found at T4 (SeNPS+Vit.E) compared with T2 (SeNPS). At the end of the experiment (35days), all treatments were higher body weight than the control group, and T4 (SeNPS+Vit.E) was recorded the best body weight followed by T3 and T2. The same trend was obtained for body weight gain (BWG) where there were no significant differences observed between all periods except BWG2 (15-21days) for T4 which significantly increased compared to the control (T1) and T2 groups. At overall period all treatments numerically increased in body weight gain compared to the control groups. Generally, supplementation of SeNPS (T2), Vit.E (T3) and a combination of them (T4) were improved body weight and body weight gain compared to the control group. In this regard, Ahmadi *et al.*(2018) found that dietary nano-selenium supplementation in broiler diet significantly improved weight gain and feed conversion ratio. Also, Saleh and Ebeid (2019) found enhancement in body weight gain in the nano-Se group, but was not influenced by sodium selenite supplementation when he used 0.0 Se, 1mg SS, 0.5mg nano Se/kg diet from 15 to 27 days old in broiler. Senthil *et al*. (2015) concluded that the selenium nanoparticles supplementation with a level of 0.3 mg/kg diet improved productivity, physiology and immunology. Also, Jayanthi *et al.* (2018) reported that improvement of growth performance of broilers with a reduction in production cost was achieved when broilers were fed on a diet containing 0.11mg/kg of Nano-Se (75% of inorganic Se). The supplemented diet with nano selenium at the doses of 0.2-0.5mg/kg improved daily weight gain and feed conversion ratio in avian broilers(Wang and Xu,2008).

These findings may be due to supplemented Se in the nano-particle form is more effective than in the metallic form which produces higher chemo preventive influence and appears to be less toxic and more biocompatible compared to sodium selenite (control) in addition to possessing a powerful property including catalytic efficiency, adsorbing ability, surface activity and chemical stability resulting in increasing immune competence and thus ability to resist adverse effects of sub-clinical diseases.

Regarding Vit. E and selenium, Singh and Sodhi (2009) reported that chicks receiving 200 mg vitamin E and 0.2 mg selenium per kg had significantly higher body weight, body weight gain, and feed conversion efficiency. On the contrary, Habibian *et al*.(2014) found that there was a significant reduction in body weight and feed intake and a significant increase in feed conversion ratio when the birds fed vitamin E (0,125, and 250 mg/kg) and selenium (0,0.5 and 1mg/kg). Similarly, Canoğullari *et al*.(2010) found no significant differences in final body weight, in Japanese quail supplemented with selenium at 0.2 and 0.1mg/kg of ration.

Mahmoud *et al.* (2016) found that dietary supplementation with Nano-Se at 0.3 mg/kg diet might enhance growth performance by improving anti oxidative or immune properties in broilers reared under high ambient temperature.

Mortality rate:

The viability of all birds during the experimental period was high. The overall mean of mortality during the whole experimental period did not exceed 7.41% (the control), which nearly matched with the normal mortality in the broiler (5%). Table 2 showed that the mortality percentage for control (T1) recorded 7.41% and selenium nanoparticles (T2) and vitamin E (T3) was 3.70%. While no mortality was recorded at SeNPS+Vit.E (T4). The high viability through the experimental treatments was shown may be due to the antioxidative effect of ether SeNPS or Vit.E which can improve the growth performance, immunity, and health in broiler chickens.

Table (2): Effect of feeding selenium Nano particles (SeNPS) and Vitamin E(Vit.E) on live body weight (BW), Body weight gain(BWG), and mortality rate (%) for broiler chicken at 7-35 days.

Items	Treatment			
	T1 (control)	T2 (SeNPS)	T3 (Vit.E)	T4 (SeNPS+Vit.E)
	Body weight /g			
7days (BW1)	153	153	153	153
14 days(BW2)	426	430	437	449
21days (BW3)	734^{ab}	722^{b}	766^{ab}	790^{a}
27days (BW4)	1204	1209	1266	1291
35days (BW5)	1652	1718	1725	1735
	Body weight gain (g/bird)			
7-14 days(BWG1)	273	277	284	296
15-21 days(BWG2)	308^{bc}	291^{c}	329^{ab}	340^{a}
22-27 days(BWG3)	470	487	500	501
28-35 days(BWG4)	448	508	459	444
Overall BWG(7-35days)	1499	1565	1572	1582
	Mortality rate (%)			
7-14 days	3.70	0	0	0
15-21days	0	0	0	0
22-27days	3.70	3.70	0	0
28-35days	0	0	3.70	0
Overall Mortality rate(7-35days)	7.41	3.71	3.70	0

a,b,c Means in the same row with different superscripts are significantly different($P \leq 0.05$).

Feed intake and feed conversion ratio:

The effect of SeNPS and Vit.E supplementation on feed intake (FI) and feed conversion ratio (FCR) are showed in Table 3. At the first period 7-14 days (FI1), all treatments were significantly increased FI compared to the control group. While at second period 15-21 days (FI2) all treatments were recorded significantly deceased in FI compared to control. Whereas, T2 (SeNPS) and T3 (Vit.E) recorded the lowest ($P \leq 0.05$) FI compared to T1 and T4. At the end of the experimental period 28-35 days (FI4) and the overall period T2 (SeNPS) and T4 recorded the lowest ($P \leq 0.05$) FI compared to T1 and T3. Regarding FCR all treatments recorded the better FCR compared to the control group at all periods studied. At the overall period, the better FCR ($P \leq 0.05$) was obtained by T2 (SeNPS) and T4 (SeNPS+ Vit.E) compared to the control group.

Table (3) Effect of feeding selenium Nano particles and Vitamin E on feed intake (FI) and feed conversion ratio (FCR) for broiler chicken at 7-35 days.

Items	Treatment			
	T1 (control)	T2 (SeNPS)	T3 (Vit.E)	T4 **(SeNPS+vit.E)**
Feed intake(g/bird)				
7-14 days(FI1)	252^{b}	287^{a}	284^{a}	282^{a}
15-21days(FI2)	622^{a}	489^{c}	504^{c}	540^{b}
22-27days(FI3)	927^{b}	910^{b}	1019^{a}	805^{c}
28-35days(FI4)	798^{a}	641^{b}	805^{a}	663^{b}
Overall FI (7-35days)	2600^{a}	2329^{b}	2612^{a}	2291^{b}
Feed conversion ratio (g feed/g gain)				
7-14 days(FCR1)	0.93	1.04	1.00	0.95
15-21days (FCR2)	2.02^{a}	1.68^{b}	1.53^{b}	1.58^{b}
22-27days (FCR3)	1.99	1.88	2.05	1.83
28-35days (FCR4)	1.78	1.57	1.76	1.69
Overall FCR(7-35days)	1.74^{a}	1.59^{b}	1.66^{ab}	1.55^{b}

a,b,c Means in the same row with different superscripts are significantly different ($P \leq 0.05$).

Cai *et al*. (2012) recommended 0.3 to 0.5 mg/kg was to be the optimum supplementation level of nano-Se, and the maximum supplementation of nano-Se could not be more than 1.0 mg/kg in broilers when they used nano-se levels 0.0, 0.3, 0.5, 1.0, or 2.0 mg/kg. Dalia *et al*.(2019) found that dietary supplemented of sodium selenite (0.15ppm) and Nano-selenium at concentration of 0.15 ppm, 0.075 ppm and 0.0375 ppm significantly improved FCR in group supplemented with 0.15ppm Nano selenium at weekly interval compared to control and other dietary treated groups.

Aravind *et al*.(2001) also observed improvement in feed efficiency in broiler birds supplemented with 0.15ppm of selenium and 75ppm of vitamin E /kg in diet. Habibian (2014) when he feed vitamin E with the level of 0, 125 and 250 mg/kg, a n d selenium with the level of 0, 0.5 and 1 mg/kg found that feed conversion was improved significantly by 125 mg/kg vitamin E ($P<0.05$). Bobade *et al.,* (2009) concluded that the supplementation of vitamin E and selenium in the diet has beneficial effect on body weight and feed efficiency of broilers.

Moreover, it was observed that adding SeNPs and SeNPs + Vit.E to diet improved feed conversion of poultry which could be a result of lower feed intake while maintaining the same weight gain. Since Se is a part of iodothyronine deiodinases, which are involved in the metabolism of thyroid hormones necessary for normal growth and development(Arthur *et al.*,1992),better activation of thyroid hormones by increased selenium content may explain the improved feed efficiency (Choct *et al*.,2004). Also, the supplementation of Vit.E alone or in combination with $SeNP_S$ could enhance growth performance due to the complementary effect between them where Vit.E and Selenium have the deteriorative effects of oxidative stress and can improve the immunity and health in broiler chickens.

Blood constituents:

Plasma biochemical parameters could be used as indicators for the nutritional and physiological status of experimental broiler chicks. The results of the estimated blood plasma parameters of broilers at 35 days old for the effect of SeNPs and Vit.E treatments are presented in Table 4.

These results had significantly increased in plasma calcium in all treatments compared to control. While, there were no significant differences in plasma phosphorous among all the treatment groups but there were numerical increase in all treatments compared to control group. The highest value of plasma calcium and phosphorous obtained at T2.

There were significant differences between treatments in plasma total protein and the highest value obtained by T3. Albumin had significantly increased in T4 compared to all other treatments. While globulin had no significant differences between all treatments. On the contrary, Imran *et al*., (2019) who used mixture of Nano-selenium with 0.1 mg/kg feed+50 mg/kg feed vitamin E and found a decrease in total protein and cholesterol.

Singh and Sodhi(2009) reported that chicks receiving 200 mg/kg vitamin E and 0.2 mg/kg Selenium resulted in increase of total protein. However, there was no significant change in albumin.

All treatments were recorded lowest values of plasma cholesterol compared to control group. Chicks fed SeNPs+Vit.E(T4) and Vit.E(T3) were significantly ($p<0.05$) lower in plasma cholesterol compared toT1.While, T3 and T4 had significantly higher plasma triglycerides compared toT2 and control. Saleh and Ebeid (2019) found that plasma concentrations of total cholesterol and triglycerides were significantly lower, while plasma HDL-cholesterol were not influenced significantly by dietary Nano-Se (0.5 mg/kg) in broiler diets. Habibian *et al*.(2014) found that when he feed vitamin E (0, 125 and 250 mg/kg), selenium (Se, 0, 0.5 and 1 mg/kg),the serum concentrations of glucose, triglycerides, total cholesterol, and LDL-cholesterol were increased but serum HDL-cholesterol decreased in HS Broilers($P<0.05$). Mohapatra *et al*.(2014) reported that Nano-selenium in diets of layer chicks could significantly decrease ($P<0.05$) the levels of total cholesterol and triglyceride. The reduction of cholesterol level is due to the vitamin dissolves fatty content or because of the ability of vitamin E to break down the chains leading to fat oxidation. The Nano-Selenium particles work to lower cholesterol in the blood through influencing the mechanisms of cholesterol receptor production and the activity of the HMG-Coenzyme, which is responsible for controlling blood lipid levels. Thus, Nano-selenium is an effective antioxidant that improves the health indicators in the serum (Huang *et al.*, 2004).

There were no significant differences among all treatments in plasma alkaline phosphatase. Same result was obtained by Imran *et al*.,(2019) who found that there was no significant differences in the alkaline phosphatase.

Total antioxidant capacity had significant differences in all treatments and the best treatment (P≤0.05) was T4 compared to all treatments followed b yT2.

EL-Deep *et al*.(2016) declared that particularly in chicken, previous studies confirmed that dietary Nano-selenium supplementation could have a positive improvement in the ant oxidative status of broilers. The up-regulation process of Se- containing antioxidant enzymes and glutathione pool in the body were greatly affected by selenium supplementation in animal diets (Jiang *et al*.,2009). Some literatures referred to the role of seleniumin activating GSH-Px was reflected positively on the improvement of the antioxidant status (Ebeid *et al.*,2013). Nabi, *et al.*(2020) found that feeding Se-NPs could improve antioxidant status and glutathione peroxidase activities in both broilers and layers. Use of Se-NPs at 0.9 mg/kg diet in broilers improved the intestinal health via increasing the population of beneficial bacteria and producing short- chain fatty acids.

Supplementing poultry feed with vitamin E (or other antioxidants) is essential, especially when oxidizable fats are included in the feed, because upon oxidation, these fats release metabolically harmful free radicals that affect poultry health and production (Engberg *et al*., 1996; Lu *et al.,* 2014). Vitamin E supplementation of chicken feed also prevents the oxidation of lipids in unsaturated fatty acids (Rama *et al.*,2011) because of this, the amount of active vitamin E that reaches the intestine for absorption can be reduced in poultry diets high in unsaturated fat (Villaverde *et al.,* 2008). Under these circumstances, the antioxidant status in poultry can be decreased as a result of an increase in lipid peroxidation (Rama *et al*., 2011).

Table4: Effect of selenium Nano particles (SeNPS) and VitaminE (Vit. E) on some blood constituents of Arbor Acres broiler chicks at 35 days.

Items	Treatment			
	T1 (control)	T2 ($SeNP_S$)	T3 (Vit.E)	T4 ($SeNP_S$+Vit.E)
Calcium (mg/dl)	8.38^b	8.94^a	8.81^a	8.91^a
Phosphorus(mg/dl)	3.19	3.90	3.75	3.33
Total protein(mg/dl)	3.17^{ab}	3.09^{ab}	3.34^a	2.71^b
Albumin(mg/dl)	0.97^b	0.89^b	1.31^b	1.08^a
Globulin(mg/dl)	2.19	2.15	1.92	1.89
Cholesterol(mg/dl)	104.33^a	96.00^{ab}	75.88^b	65.03^b
Triglycerides(mg/dl)	49.65^b	49.54^b	89.28^a	90.80^a
Alkaline phosphatase(mg/dl)	178.92	154.17	170.74	170.13
Total antioxidant capacity(mM/l)	0.95^b	1.06^b	0.96^b	1.28^a

a,b,c Means in the same row with different superscripts are significantly different(P≤0.05).

Conclusion

It can be concluded that supplementation of SeNPS 0.1 mg/Kg + Vit.E 100 mg/Kg or SeNPS 0.1 mg/Kg of broiler chicks from 7 to 35 days of age improve the performance. More studies should be done to investigate more benefits of using nanotechnology in poultry feed.

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