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EFFECT OF ADDING DIFFERENT LEVELS OF NANO-BORON PARTICLES TO THE DIET IN SOME OF THE PRODUCTIVE TRAITS FOR THE BROILER CHICKEN (ROSS 308)

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Abstract

This study was conducted in the poultry field belonging to the Department of Animal Production, College of Agriculture, Al-Qasim green University for the period from 9/9/2018 to 13/10/2018, in order to study the effect of adding different levels of nano-boron particles to the diet in some of the productive traits for the broiler chicken. In the experiment, 180 unsexed broiler chickens were used which randomly distributed at 12 pens, with 4 experimental treatments, each treatment contains 45 birds. Each treatment included three replicates, each replicate contains 15 birds. The treatments of the experiment were as follows: First treatment: control group free of any addition. The second treatment: a basic diet added to it 40 mg nano-boron / kg feed, the third treatment: a basic diet added to it 60 mg nano-boron / kg feed, and the fourth treatment: a basic diet added to it 80 mg nano-boron / kg feed. The results of the study showed a significant ($p<0.05$) excelling for all treatments of the experiment (including the addition of nano-boron particles) in the average weight of the live body (g) and the total weight gain, which recorded the lowest average for total feed consumption and the best cumulative feed conversion ratio compared to the control treatment. We conclude from this study that adding nanoparticles with a different percentage to the broiler chickens, led to improving the productivity traits, which may be a useful method to obtain healthy food.

Keywords : nano-boron particles, productive traits, broiler chickens.

Introduction

The modern inbreeds of commercial broiler chickens were characterized by high their growth rate and feed conversion efficiency to meat. This ability results in a growth rate as a result of continuous genetic selection. This has negatively affected the immunity of birds and modern breeds become more susceptible to diseases (Jatau *et al.*, 2014). The increase in production and the growth rate requires an increase in the birds need to the rare mineral elements, which are important nutrient elements for the growth and production of poultry and the lack of one or more of these elements leads to a significant deterioration in the birds health (Abbaspour *et al.*, 2014). One of these elements is the boron element, which has been discovered as an essential element for plants since 1923. By the early 1980s, the role of boron in human and animal nutrition had emerged through its effect on a large number of metabolic processes and bio-activities such as enzymes and Steroid hormones (I.R. SCOREI *et al.*, 2011). It also has a significant and effective role in the metabolism of calcium, phosphorus, and magnesium and in the development and growth of poultry birds (Hunt, 2012). The recommended boron concentration in nutrition according to the NRC (1994) is 2 mg, regardless of the type of poultry production. Boron is found in meat, plants, and many types of grains, vegetables, and nuts (Rainey *et al.*, 1999), Akbae *et al.*, (2015) showed that boron-containing compounds have anti-bacterial properties, it is often present in the form of boric acid or Borates (Dean, 1999). In recent years, the poultry industry has seen many technologies, including nanotechnology, a promising and emerging technology with enormous potential for revolution in the poultry sector worldwide. Nanoparticles generally have dimensions of approximately 1-100 nm. This technique is used in the field of poultry breeding on a scale. Thus, these nanoparticles can transcend the physiological methods for distribution the feeding materials and transfer it across tissues and cell membranes. Nanotechnology is developing new products and the possibility of re-shaping traditional materials to produce effective results (Troncarelli *et al.*, 2013), while the size of the material is very low, leading to the formation of new physical and chemical properties. These properties allow for nanomaterials to be used in a wide range of fields, such as health, pharmacy, industry and other Unlimited fields (Feynman, 1959). The nano-boron has been used as a new source for boron because of its highly efficient properties, a large surface area, and a high absorption capacity compared to boron element. The results obtained by (Thukra and Balqees, 2018) showed a significant improvement in body weight, weight gain, and feed conversion ratio compared to the control group when adding nano-boron particles to the drinking water of broilers chickens. Due to the lack of studies on the use of nano-boron particles in poultry diets, this study was conducted to determine the best concentrations of nano-boron particles added to poultry diets, which we might recommend, and to study the effect of these particles on the productive performance of broilers chickens.

Materials and Methods

This study was conducted in the poultry field belonging to the Department of Animal Production, College of Agriculture, Al-Qasim green University for the period from 9/9/2018 to 13/10/2018, in order to study the effect of adding different levels of nano-boron particles to the diet in some of the productive traits for the broiler chicken (Ross 308). In the experiment, 180 unsexed broiler chickens were used, with one day age and 38 g weight. The chicks were raised in halls with the dimension of (3 × 10 × 45 m) which supplied by air fan, divided into Pens by means of a metal mesh cutter, The area of each pen (1.5 × 1) m^2. The chicks were randomly distributed on the treatments, with 45 chicks per treatment into three replicates (15 chick/replicate). The treatments of the experiment were as follows: First treatment: control group free of any addition. The second treatment: a basic diet added to it 40 mg nano-boron / kg feed, the third treatment: a basic diet added to it 60 mg nano-boron / kg feed, and the fourth treatment: a basic diet added to it 80 mg nano-boron / kg feed. The study included the following traits: The average weight of the body, weight gain, the average feed consumption, feed conversion ratio, and the percentage of mortality. The averages of these traits were estimated for each week (five-week) using the Completely Randomized Design to study the effect of different treatments on the studied traits. The significant differences between the averages were measured using Duncan's Multiple Range Test (Duncan, 1955), the SAS statistical program was used for data analysis. The nano-boron powder was used in the form of white powder, which was supplied by Naqaa Foundation for Scientific Research, Technology, and Development. Transmission Electron Microscope (TEM) test as shown in Fig. 1 was conducted on the nano-boron sample in the central laboratory of the College of Education for Pure Science (Ibn al-Haitham).

Results and Discussion

The productive traits are the most important traits that depend on them to assess the health and immune status for the birds, the more healthy birds and the high immunity with the necessary conditions, The most important productive traits that are taken into account in measuring the productive state are weight, weight gain

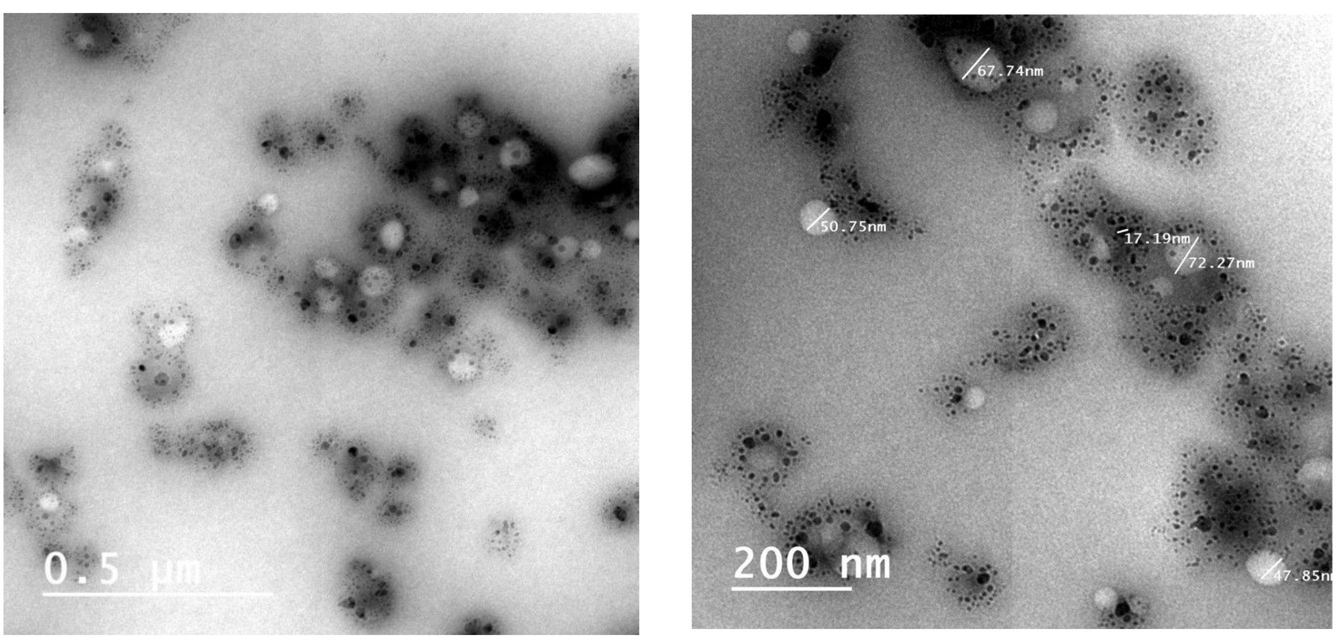

Fig. 1 : Transmission Electron Microscope (TEM) test.

Table 1: The percentage of feed materials used in the composition of the initiator diet and the final diet used in the experiment with the calculated chemical composition for both diets.

Feed materials	**Initiator diet 1-21 day**	**Growth diet 22-35 day**
Yellow corn	48.2	58.7
Wheat	8	7.5
Soybeans meal (44% protein)	28.5	20.5
Concentrated Proteins*	10	10
Sunflower oil	4	2.5
Limestone	1	0.5
Salt	0.3	0.3
Total	100%	100%
The calculated chemical composition**		
The metabolic energy (kcal / kg feed)	3079.85	3102.6
Crude protein (%)	21.56	18.87
Lysine (%)	1.04	0.85
Methionine + Cysteine (%)	0.455	0.42
Raw fiber%	3.54	3.2
Calcium (%)	1.28	1.07
Available phosphorus (%)	0.42	0.41

* Concentrated Protein (Belgian origin), Each one kilogram of which contains: 2200 kcal of metabolic energy, 40% crude protein, 8% fat, 3.5% fiber, 25% ash, 8% calcium, 3.1 phosphorus availability, 1.2% Methionine, 1.8% methionine + 70 mg, B 30 mg vitamin 1, 300 mg vitamin E, D 2500 IU 3, A Cysteine, 2% chlorine, 10.000 IU 12 mg folic acid, B 250 feed 12, B 120 mg Pantothenic acid, 400 mg Niacin, 50 mg 6, B vitamin 2 5000 mg colloid, 450 mg iron, 70 mg copper, 600 mg, C 600 microgram biotin, 1000 mg special vitamin 750 manganese, 5 mg iodine, 1 g cobalt and antioxidants.

** the chemical composition was calculated according to the analysis of feed materials in (NRC (1994).

and feed conversion ratio, which reflect the success of poultry projects (Al-Zubaidi, 1986). Table 2 shows the average weights of the live body ± standard error for the treatments of the experiment, where the results of the statistical analysis indicate to the effect of adding different levels of nano-boron particles to the diet in the weight of the live body (g) for the experiment week (5 weeks), It was noted that the second treatment was significantly excelled in the first week on the first treatment (control) by giving it the highest body weight amounted to (166.00 g/bird) while the first treatment (control) recorded the lowest body weight amounted to (155.33 g/bird). As for the birds of the third and fourth treatments, there were no significant differences between them and between the second and the first treatment. In the second week, there was no significant difference between all treatments. In the third, fourth and fifth week from the experiment age, the treatments of the nano-boron were significantly ($P<0.05$) excelled on the first treatment (control), which recorded the following weights (893.33, 896.66, 901.00 g/bird), (1465.67, 1503.00, 1505.33 g/bird) and (2102.33, 2123.33, 2125.00 g/bird), respectively, While the first treatment (control) recorded the following weights (865.00 g/bird), (1393.00 g/bird) and (1937.00 g/bird), respectively.

Table 3 shows the results of the statistical analysis to the effect of adding different levels of nano-boron particles to the diet in the average weight gain for the different weeks. where the results showed during the first week of the experiment that the birds of the second treatment were significantly ($P<0.05$) excelled, where the average weight gain for it amounted to (128.00 g/bird) on the birds the first treatment (control), where the average weight gain for it amounted to (117.33 g/bird). As for the birds

Table 2 : Effect of adding different levels of nano-boron to the diet in the average weights of the live body (g) for the broiler chickens (average ± standard error).

Treatments	**First week**	**Second week**	**Third week**	**Fourth week**	**Fifth week**
T_1 control group	±155.33 b 2.60	±434.00 a 3.78	±865.00 b 3.60	±1393.00 b 30.98	±1937.00 b 55.66
T_2 adding 40 mg nano-boron / kg feed	±166.00 a 2.30	±444.6 a 0.88	±893.33 a 7.31	±1503.00 a 11.37	±2102.33 a 10.80
T_3 adding 60 mg nano-boron / kg feed	±160.66 ab 3.17	±443.66 a 6.35	±901.00 a 5.03	±1465.67 a 24.77	±2123.33 a 13.64
T_4 adding 80 mg nano-boron / kg feed	±158.00 ab 0.57	±439.66 a 1.85	±896.66 a 6.69	±1505.33 a 41.57	±2125.00 a 12.52
LSD	*	**NS**	*	*	*

The averages with different letters within the same column vary significantly between them.

* ($P<0.05$): NS: Non-significant.

of the third and fourth treatments, there were no significant differences between them and between the second and the first treatment which recorded (120.00, 122.66 g/bird), respectively. While the results of the statistical analysis for the weeks (2, 3, 4 and 5) did not show significant differences between all treatments, although the mathematical superiority, but did not rise to the significant level. As for the total weight gain, the control treatment recorded the lowest total weight gain amounted to (1899.00 g/bird) compared to the second, third and fourth treatments of the nano-boron, which recorded a total weight gain amounted to (2064.33, 2085.33, 2087.00 g/bird), respectively.

Table 4 shows the averages feed consumption for birds of all the used treatments in the experiment. The results of the statistical analysis showed no significant differences between all the treatments during the first week of the experiment. In the second week, the birds of the first treatment recorded the highest average of feed consumption amounted to (452.33 g /bird), compared to the birds of the fourth treatment which recorded the lowest average of feed consumption amounted to (416.33 g/bird). As for the birds of the second and third treatments, there were no significant differences between them and between the birds of the first treatment (control) on the one hand and the birds of the fourth treatment on the other hand, During the third and fourth weeks of the experiment, the birds of the first treatment (control) continued to record the highest average of feed consumption amounted to (660.00 g/bird, 913.67 g/bird) compared to the nano-boron treatments, which recorded an average of feed consumption amounted to (636.66, 628.66 g/bird) and (870.67, 855.67, 868.33 g/birds), respectively. In the fifth week, the results of the statistical analysis showed no significant differences between all treatments. As for the average of total feed consumption, the results indicate that the first treatment recorded the highest average of total feed consumption amounted to (3105.67 g/bird), While nano-boron recorded the lowest average of feed consumption amounted to (3008.33, 3006.67, 3003.67 g/birds), respectively.

Table 5 indicates the effect of adding different levels of nano-boron particles to the diet in the feed conversion ratio for the five-weeks of the experiment, where the

Table 3: Effect of adding different levels of nano-boron to the diet in the average weight gain (g) for the broiler chickens (average ± standard error).

Treatments	First week	Second week	Third week	Fourth week	Fifth week	Total weight gain
T1 control group	±117.33 2.60 b	±278.66 3.52 a	±431.00 7.02 a	±528.00 33.97 a	±544.00 86.00 a	±1899.00 55.66 b
T2 adding 40 mg nano-boron / kg feed	±128.00 2.30 a	±278.66 1.85 a	±448.67 8.00 a	±609.67 9.20 a	±599.33 1.20 a	±2064.33 10.80 a
T3 adding 60 mg nano-boron / kg feed	± 122.66 3.17 ab	±283.00 4.04 a	±457.33 9.82 a	±564.67 22.57 a	±657.67 36.03 a	±2085.33 13.64 a
T4 adding 80 mg nano-boron / kg feed	±120.00 0.57 ab	±281.66 2.40 a	±457.00 5.56 a	±608.67 34.92 a	±619.67 54.03 a	±2087.00 12.52 a
LSD	*	NS	NS	NS	NS	*

The averages with different letters within the same column vary significantly between them. * (P<0.05): NS: Non-significant.

Table 4: Effect of adding different levels of nano-boron to the diet in the average of total feed consumption (g/bird) for the broiler chickens (average ± standard error).

Treatments	First week	Second week	Third week	Fourth week	Fifth week	Total feed consumption
T1 control group	149.67± 10.20 a	452.33± a 8.00	660.00± 4.61 a	913.67± 7.21 a	930.00± 17.57 a	3105.67± 20.16 a
T2 adding 40 mg nano-boron / kg feed	158.67± 1.66 a	434.67± 4.33 ab	636.67± 2.60 b	870.67± 8.83 b	907.67± 13.64 a	3008.33± 7.44 b
T3 adding 60 mg nano-boron / kg feed	151.67± 2.60 a	435.67± 6.64 ab	±614.00 7.76 c	855.67± 10.89 b	949.67± 42.00 a	3006.67± 25.62 b
T4 adding 80 mg nano-boron / kg feed	150.33± 1.45 a	416.33± 4.63 b	628.67± 3.71 bc	868.33± 6.83 b	940.00± 30.66 a	3003.67± 30.14 b
LSD	NS	*	*	*	NS	*

The averages with different letters within the same column vary significantly between them. * (P <0.05): NS: Non-significant.

Table 5 : Effect of adding different levels of nano-boron to the diet in the cumulative feed conversion ratio (g feed/ weight gain/bird) for the broiler chickens (average ± standard error).

Treatments	First week	Second week	Third week	Fourth week	Fifth week	The Cumulative feed conversion ratio
T1 control group	1.27 ± 0.06 a	1.62 ± 0.03 a	1.43 ± 0.09 a	1.74 ± 0.10 a	1.82 ± 0.37 a	1.64 ± 0.05 a
T2 adding 40 mg nano-boron / kg feed	1.23 ± 0.01 a	1.55 ± 0.02 ab	1.41 ± 0.02 a	1.42 ± 0.02 b	1.51 ± 0.02 a	1.45 ± 0.01 b
T3 adding 60 mg nano-boron / kg feed	1.23 ± 0.01 a	1.53 ± 0.02 bc	1.34 ± 0.03 a	1.51 ± 0.04 b	1.44 ± 0.03 a	1.44 ± 0.01 b
T4 adding 80 mg nano-boron / kg feed	1.25 ± 0.00 a	1.47 ± 0.00 c	1.37 ± 0.01 a	1.43 ± 0.06 b	1.53 ± 0.14 a	1.44 ± 0.02 b
LSD	NS	*	NS	*	NS	*

The averages with different letters within the same column vary significantly between them. * ($P < 0.05$): NS: Non-significant.

results of the first week showed no significant differences between all the treatments of the experiment. In the second week, the birds of the third and fourth nano-boron treatments recorded the best average for a feed conversion ratio, with a significant difference ($P<0.05$) compared to the control treatment, here recorded the following values (1.53 g feed / weight gain/bird) and (1.47 g feed / weight gain/bird), While the first treatment (control) recorded the average of feed conversion ratio amounted to (1.62 g feed/ weight gain/bird). In the third week, there were no significant differences between all the birds of the experiment treatments. In the fourth week, the first treatment (control) recorded an average of the feed conversion ratio amounted to (1.74 g feed / weight gain/bird), with a significant level ($P < 0.05$), while the birds of the second, third and fourth treatments recorded the best average of feed conversion ratio amounted to (1.42, 1.51, 1.43 g feed / weight gain/bird), respectively. In the fifth week, the results showed no significant differences between all the birds of the treatments. As for the cumulative feed conversion ratio, the first treatment (control) recorded the highest average of cumulative feed conversion ratio amounted to (1.64 g feed / weight gain/ bird) compared to the birds of the nano-boron treatments, where recorded the best feed conversion ratio amounted to (1.45, 1.44.1.44 g feed / weight gain/bird), respectively.

As for mortality, there was no mortality during the experiment period (5 weeks). The significant improvement in the live body weight may be due to increase growth hormone concentration in the serum. The results suggest that the addition of different concentrations of boron to the diet leads to increase concentration of growth hormone in the serum of broiler chicken, and that the growth hormone is responsible for 50% of the body's growth, where it works to build the body and stimulate the secretion of thyroid hormones and hormone IGF-1 of the liver (Scanes, 2014). It is also important in metabolizing amino acids, building proteins and increasing growth rate, by increasing the concentration of amino acids within cells and by increasing the synthesis of proteins (Sturkie, 2000). The reason for the improvement in the average weight of the live body may be due to the role of boron in influencing the activity of the thyroid gland, thus increasing the secretion of Thyroxine and Triiodothyronine hormones (Cinar *et al.*, 2015). where T3 Hormone stimulates Gluconeogenesis process (Comte *et al.*, 1990), where T3 also increases the glucose-carrying units, such as insulin-like growth factor IGF-1 (Jannini *et al.*, 1995), which is important in building muscle mass in the body (Jader, 1996). Thyroid hormones are important hormones in increasing metabolism of energy and protein (Johannsen *et al.*, 2012; Mullur *et al.*, 2014). Several studies have shown that boron increases the concentration of Testosterone and Estrogens hormones in the body by increasing their processes of manufacture (Devirian and Volpe, 2003). The Testosterone hormone is the male sexual hormone that stimulates the synthesis of muscle proteins and stimulates the secretion of insulin-like growth factor IGF-1, thus increases muscle build-up (Bhasin *et al.*, 2001). The significant improvement in the weight of the live body when adding boron to the diet may be due to the role of boron as an antioxidant (Gregory and Kelly, 1997) showed that increasing the concentration of boron increases the activity of the Superoxide Dismutase (SOD) and increases its concentration. This enzyme is considered one of the antioxidant enzymes, where this enzyme acts to stop oxidation by removing free radicals (Shahidi, 2008). Protecting the body from the damage caused by these radicals to the cell membrane and amino acids and then blocking the process of building proteins in the body (Vive and Penn, 2003). The Antioxidants factor, especially enzymes, help maintain the body's oxidative balance. The most important of these enzymes is SOD, which converts free radical O_2 (the strongest free radicals) to the less dangerous hydrogen peroxide (Ahl, 2010). As mentioned above, the significant improvement in the weight of the live body may be due to the addition of boron at a concentration of (40 mg/kg) to the diet as shown in table 2 and according to the close relationship between the average weight of the live body and the weight gain. The improvement in the average weight gain as shown in table 3 is due to the improvement in the weight of the live body due to the effect of boron. The significant improvement in the average weight gain is due to the role of boron in increasing the activity of the thyroid, concentration of growth hormone and testosterone hormone and its effectiveness of antioxidant. With regard to the significant improvement in the feed conversion ratio as shown in table 5, it may be due to the significant improvement in the average weight gain as shown in table 3. This due to the close relationship between them, where the improvement in the feed conversion ratio is due to the improvement in the average weight gain due to the role of boron affected in the trait, or perhaps the significant improvement in the feed conversion ratio to the role of boron in the increasing concentration of copper element in the serum (Kurtoglu *et al.*, 2005) where Boron prevents the loss of copper from the body, Copper contributes to increased absorption of sugars and amino acids from the intestine and stimulates some digestive enzymes to increase the benefit of nutrients and increase the supplying of nutrients to the liver (Luo *et al.*, 2005). Based on the close relationship between the average weight of the live body, the average weight gain and the feed conversion ratio, the significant improvement in the feed conversion ratio is assumed to be due to the role of boron in increasing the activity of thyroid hormones, testosterone, insulin-like growth factor, and growth hormone.

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