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Effect of zinc oxide nanoparticles on carcass parameters, relative weight of digestive and lymphoid organs of broiler fed wet diet during the starter period

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Abstract

The aim of the trial was to investigate the effects of zinc oxide nanoparticles (ZnO-NPs) on the carcass yield, digestive and lymphoid organs weighted index of broilers fed wet diet during the starter period. A total of 300 one-day old male broilers (Ross- 308) were randomly allotted to 5 treatments and 4 replicates and a total of 20 experimental units and 15 broilers in each replicate in a completely randomized design. The study was performed during the starter period (1-21d). The results showed that the addition of ZnO-NPs in fed wet diet at the age of 21 days had significantly affected on the percentage carcass of broilers than dry rations and control ($P<0.05$). The highest and lowest percentage of carcass in T_3 (dry ration+200mg of NPs-ZnO) and T_2 (dry ration+100mg of ZnO-NPs) was observed ($P<0.05$). Wet diet containing 200 mg of ZnO-NPs had significantly increased the relative weight of the proventriculus when compared to other treatments ($P<0.05$). In addition, dry diet is treated with 100 mg of ZnO-NPs significantly increased the relative weight of the pancreas compared to the other treatments ($P<0.05$). Although, no significant relative weight of lymphoid organs, but the maximum weight percent related to treatments containing zinc oxide nanoparticles observed. According to the data of the present study could be concluded that adding ZnO-NPs to dry diets compared to wet diet probability improve carcasses yield and increase relative weight of digestive and lymphoid organs of broilers during the starter period.

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Introduction

Zn is necessary for growth improves appetite, metabolism of carbohydrates, proteins, lipids, etc and development of the skeleton, skin health, wound healing and many essential biochemical processes (Bartllet and Smith, 2003). Researchers have shown that the use of feeding wet diet in broiler nutrition had increased appetite and improved poultry performance, thereby increasing the final weight of chicks (Forbes, 2003). In addition, the use of wet diet for broiler had reported to have favorable effects on feed consumption and increasing feed utilization efficiency due to improving of nutrient retention (Yalda and Forbes, 1996).

Wet diet increases the usability of grain at a high level without plates, reduce dust in the hall, raising, lowering the cost of processing and formulation of the optimal diet (Forbes, 2003). Wet diet feeding (with 80% wheat) increased feed intake and weight gain up to 17 days of age by almost 20%. In addition, wet feeding is a promising feeding strategy, especially in the early age of broilers and the condition could develop the gastrointestinal poultry and animal farm (Scott, 2002). Zinc is one of the essential trace elements in the function of the immune system in animals and its deficiency can reduce cellular immune (Fletcher *et al.*, 1988). The patients who are unable to use of zinc, fully lymphoid tissue, including the thymus, tans land lymph nodes lose indicating the important role of the mineral life of the system.

Ahmadi *et al.* (2013) reported that zinc oxide nanoparticles improved on broiler growth performance, especially at levels 30 to 90 mg per kg diet. Therefore, the present research was carried out that whether inclusion of zinc oxide nanoparticles to wet diet could affect on the carcass yield, digestive and lymphoid organs index of broilers fed a wet diet during the starter period. In the case of achieving the desired results can be an appropriate level of zinc oxide nanoparticles added to broiler diets.

Materials and methods

Experimental diets, broilers and Management

In this research, a total of 300 one-day old male broilers (Ross-308) were randomly divided in a completely randomized design that consisted of 5 treatment and 4 replicates and 15 broilers in each replicate. The diets consisted of: T1) control (basal diet without nano- ZnO, and contain 28.5 mg/kg Zn from ZnO), and T2, T3, T4 and T5 were dry and wet experimental diets that any of those supplementation with 100 or 200 mg/kg level of zinc from zinc oxide nanoparticles. The wet diet contained 1.3 unit (Wt) diet /1 unit water (Wt).

The study was performed during the starter period (1-21 d). The birds had access to feed and water *ad libitum* throughout the study. The birds received light system as one hour darkness and 23 hours light (one hour D=23 L) till the end of the research. Other rearing conditions during the research were identical to the statistical community. The ingredients and composition of the basal diet presented in Table 1. The basal diet was formulated to meet or excess of requirement of broiler based on NRC (1994).

Data Collection

At the end of study to determine the carcass quality traits and relative weight of different bird organs, on d 21, four birds (one bird per replicate) were randomly selected for treatment based on the average weight per each replication and after weighing, slaughtered. After slaughtering of the sample birds, immediately open body cavity, weighted carcass and then removed breast, thighs, wings, abdominal fat, and different organs such as proventriculus, gizzard, heart, small intestine, pancreas, liver, spleen, bursa Fabricius, and then by means of a digital scale with a precision 0.01g calculated the relative weight of the organs by dividing the weight of the organs to live body weight.

Statistical analysis

The data obtained from the experiment were analyzed (ANOVA) by using SAS (2007) software statistical programs with the ANOVA. Significant differences among treatment means were separated using

Duncan's multiple range tests (1955) with a 5% probability.

Results and discussion

Carcass traits

Results related to effects of zinc oxide nanoparticles on quantitative traits carcass, digestive and lymphoid organs weighted index of broiler fed a wet diet during the starter period presented in tables 2, 3 and 4. According to the results, the effects of experimental diets on quantitative carcass traits on d 21 showed no significance difference compared to the control (P>0.05). However, in relation to the relative weight carcasses of bird that fed with dry diet plus 200 mg per/kg of zinc oxide nanoparticles on a significant increase compared to other treatments (P>0.05). The results of the present study were agreed to the previous reports. The researchers had reported that adding zinc excess to the basal diet no significant any effect on the carcass yield of broilers (Yalda and Forbes, 1995; Yasar and Forbes, 2000).

Table 1. Ingredients and composition of the basal diet during starter period (1-21 d).

Ingredients (%)	**%**
Corn	60.7
Soybean meal	31.0
Soybean oil	2.8
Corn Gluten Meal	1.5
Di-calcium phosphate	1.7
Limestone	1.2
Mineral and vitamin supplements[1]	0.5
Sodium chloride	0.3
L - lysine	0.16
D L- met	0.15
Nutrients composition	
Energy (kcal/kg)	3055
CP (%)	21.92
Crude Fat (%)	5.48
Dry Matter (%)	89.74
Met + Cys (%)	0.82
Available phosphorus (%)	0.43

The maximal relative weight of carcass (P=0.029) and breast (P=0.424) observed in the birds that fed dry diet inclusion of 200 mg Nano-ZnO when compared to other treatment. Also, the highest relative weight of the wings, thigh and abdominal fat belong to the birds that fed with the wet diet inclusion of 100 and 200 mg Nano-ZnO per kg, respectively (P>0.05), although, this data were statistically no significant. The results agree with the parts of the reports of Yalda and Forbes (1995) and Yalda and Forbes (1996). They had reported that feeding broilers with wet diet had not significantly on performance and carcass parameters which non-significant effects were observed for the relative weight of abdominal fat.

Relative weight of digestive organs

The effect of the experimental diet on the relative weight of digestive organs of the birds was presented in table 3. Experimental diets had significantly effected on the proventriculus (P=0.042) and pancreas (P=0.025) in comparison with control. The wet diet inclusion of 200mg/kg of zinc oxide

nanoparticles had significantly increased the relative weight of the proventriculus than dry diet and control. Also dry diet treatment with 100mg/kg of zinc oxide nanoparticles had significantly increased relative weight of the pancreas compared with the dry diet with 200mg/kg of zinc oxide nanoparticles.

Tables 2. Effect of experimental diets on carcass traits of broilers on d 21 age (LBW, %).

Experimental diets	Carcass	Breast	Thigh	Wings	Abdominal fat
T1. Control	58.5[ab]	20.0	17.3	6.1	0.55
T2. Dry diet- 100mg Nano-Zno	55.5[b]	18.7	17.4	6.2	0.66
T3. Wet diet- 100mg Nano-Zno	57.4[ab]	19.9	16.9	6.5	0.68
T4. Dry diet- 200mg Nano-Zno	60.7[a]	21.3	16.1	6.4	0.65
T5. Wet diet- 200mg Nano-Zno	57.8[ab]	18.5	18.6	6.3	0.77
SEM	1.45	1.15	1.26	0.39	0.139
P-Value	0.029	0.424	0.682	0.938	0.852

[a-b] Mean in each column dissimilar letters means significant differences (P<0.05).

Dry diet treatments with 200mg/ kg of zinc oxide nanoparticles for the heart, wet diet with 200 mg per kg of zinc oxide nanoparticles for liver and gizzard and dry diet treatment with 100 mg per kg of zinc oxide nanoparticles for small intestine relative weight increase more than the other treatments showed. But these data are statistically no significant (P>0.05).

This result was consistence with the results of Yasar and Forbes (2000). They had demonstrated that feeding broilers with wet diet no significant effect on the relative weight of the digestive organs such as proventriculus and gizzard when compared to control or dried ration. However, the result of the previous research with regards to the relative weight of the small intestine, pancreas, and liver of broilers which significant effects were observed in compatible (Yasar and Forbes, 1996; Yasar and Forbes, 2000). Of course, one of the reasons that could explain the difference between the mention results may be related to the unique zinc oxide nanoparticles property such as particle size, bioavailability, *ect*.

Tables 3. Effect of experimental diets on the relative weight of digestive organs of broilers on d 21 (LBW, %).

Experimental diets	Proventriculus	Gizzard	Heart	Pancreas	Liver	Small intestine
T1. Control	0.75[ab]	3.35	0.80	0.41[ab]	3.08	5.72
T2. Dry diet- 100mg Nano-Zno	0.75[ab]	3.53	0.76	0.47[a]	3.13	7.13
T3. Wet diet- 100mg Nano-Zno	0.67[b]	3.33	0.73	0.41[ab]	3.11	6.77
T4. Dry diet- 200mg Nano-Zno	0.61[b]	3.05	0.81	0.36[b]	2.85	6.07
T5. Wet diet- 200mg Nano-Zno	0.85[a]	3.92	0.771	0.43[ab]	3.16	6.57
SEM	0.057	0.373	0.059	0.035	0.144	0.473
P-value	0.042	0.578	0.854	0.025	0.601	0.278

[a-b] Mean in each column dissimilar letters means significant differences (P<0.05).

Relative weighted of immune organs

The results of the experimental treatment effect on weighted index, immune organs of broilers at 21 days of age presented in Table 4. The results showed that among the experimental treatments in terms of weighted index organs spleen and bursa of Fabricius at 21 days of age showed a no significant difference compared with control (P>0.05). The relative weight of the spleen in the birds that fed dry diet inclusion of 100mg/kg of zinc oxide nanoparticles was the highest when compared to control and other treatments. Also, the control treatment has a greater relative weight of

bursa of Fabricius compared with other treatments, but this increase was statistically no significant.

The mention results were not agreed with the previous study (Ahmadi *et al.*, 2013). They had reported that the inclusion of zinc oxide nanoparticles to basal diet with different levels as significantly increased relative weight of immune system organs. This researcher reported that the growth index of bursa Fabricius and thymus had significantly increased in the birds that fed 90 mg ZnO-NPs/kg ($P<0.05$) in comparison with control and other treatments.

Tables 4. Effect of experimental diets on the relative weight of immune organs on d 21 age.

Experimental diets	Spleen	Bursa of Fabricius
T1. Control	0.10	0.20
T2. Dry diet- 100mg Nano-Zno	0.11	0.19
T3. Wet diet- 100mg Nano-Zno	0.09	0.14
T4. Dry diet- 200mg Nano-Zno	0.08	0.18
T5. Wet diet- 200mg Nano-Zno	0.079	0.17
SEM	0.016	0.021
P-Value	0.476	0.349

The reasons that properly explain the differences between of the mention results and previous reports may be due to some of the new characteristics of zinc oxide nanoparticles, such as, high reactivity high particle kinetic, bioavailability, the contact surface and also form of the diet (wet) which causes facilitate the digestion and this condition had caused increasing of digestive enzymes, absorption of nutrients from alimentary tract of birds (Ahmadi *et al.*, 2013; Coscun and Zadn, 1997).

In conclusion, the result of current study showed that the inclusion of 100 mg to the dry diet could improve carcass parameters in comparison to the control group. As well, zinc oxide nanoparticles plus wet diet could not improve the mention parameters when compared to control treatment.

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References

Ahmadi F, EbrahimnezhadY, Maheri Sis N, Ghiasi Ghaleh-kandi J. 2013. The effects of zinc oxide nanoparticles on performance, digestive organs and serum lipid concentrations in broiler chickens during starter period. International Journal of Biosciences **3(7),** 23-29. http://dx.doi.org/10.12692/ijb/3.7.23-29

Bartlett JR, Smith MO. 2003. Effects of different levels of zinc on the performance and immunocompetence of broilers under heat stress. Poultry Science journal **82,** 1580-1588.

Coscun HR, Zadn K. 1997. Effect of wet feeding and die-tary supplementation of ascorbic acid on the performance of heat stressed broiler chicks. British Poult Science Journal **38,** 35-36.

Duncan DB. 1955. Multiple ranges and multiple F test. Biometrics, **11,** 1-42.

Fletcher MP, Gershwin ME, Keen CL, Hurley LS. 1988. Trace element deficiencies and immune responsiveness in human and animal models. In: Nutrition and Immunology (Ed. R. K, Chandra). Alan, R. Liss Inc. New York, NY, 215-239.

Forbes MJ. 2003. Wet foods for poultry. Avian and Poultry Biology Reviews **14,** 175-193. http://dx.doi.org/10.3184/147020603783637481

NRC. 1994. Nutrient requirements of poultry. 9th Rev.Edn., Natl. Acad. Press, Washington, DC.

SAS. Inc. 2007. SAS OnlineDoc® 9.1.3. Cary, NC, USA.

Scott TA. 2002. Impact of wet feeding wheat-based diets with or without enzyme on broiler chick performance. Canadian Journal of Animal Science **82,** 409-417.
http://dx.doi.org/10.1080/00071668.2010.540230

Sunder GSH, Panda AK, Gopinath NCS, Rama Rao SV, Raju MVLN, Reddy MR, Vijay Kumar CH. 2008. Effects of Higher Levels of Zinc Supplementation on Performance, Mineral Availability, and Immune Competence in Broiler Chickens. Applied Poultry Research Journal **17,** 79–86.

Yalda AY, Forbes JM. 1995. Food intake and growth in chickens given food in the wet form with and without access to drinking water. British Poultry Science Journal **36,** 357-369.
http://dx.doi.org/10.1080/00071669508417783

Yalda AY, Forbes JM. 1996. Effects of food intake, soaking time, enzyme and corn flour addition on the digestibility of the diet and performance of broilers given wet food. British Poultry Science Journal **37,** 797-807.
http://dx.doi.org/10.1080/00071669608417909

Yasar S, Forbes JM. 1999. Performance and gastro-intestinal response of broiler chickens fed on cereal grain-based foods soaked in water. British Poultry Science Journal **40,** 65-76.
http://dx.doi.org/10.1080/00071669987854

Yasser S, Forbes JM. 2000. Enzyme supplement ration of dry and wet a heat-based feeds for broiler chickens: Performance and gut responeses. British Journal of Nutrition **84,** 297-307.