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Effect of dietary nano zinc oxide on growth performance and carcass characterstics of broiler chicken

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The dynamic growth is based on many factors in which feed and feed additives play a vital role in improving the growth performance of birds (Panda and Samal 2016). Various feed and feed additives are required for commercial broilers, of this zinc plays an essential role in array of processes. Zinc element participates in growth, metabolism pathways, physiological and biosynthetic processes within the body of poultry and animals (Cesur *et al.* 2005). The poor availability of zinc from plant feed ingredients is due to the binding of zinc with phytate which makes Zn unavailable to birds. The National Research Council (1994) suggests 40 mg/kg as required level for Zn. In recent years, additives from nanotechnology in broiler nutrition are tried to achieve positive effects in poultry production (Ahmadi and Fariba 2010) and also nano-particles can be used as a supplemental source of trace minerals in diets (Mohapatra *et al*. 2014). The use of nano Zn has shown to produce better results as compared with conventional Zn sources (Sahoo *et al.* 2014). The present research was conducted to find the optimum levels of nano zinc in ration that can provide better growth performance and carcass parameters. Due to their small size, zinc oxide nano-particles are readily absorbed and easily cross biological barriers, which makes them promising candidates as feed additives.

A total of 240 Commercial broiler chicks were randomly allotted to 48 battery brooder cell with an average floor space of 82 square inches per bird. Nano ZnO was supplied by Biofac Inputs Private Limited, IDA Bollaram, Telangana. Nano ZnO having a particle size of 80 nm was added in drinking water at 0, 0.1, 0.2, 0.4, 0.6 and 0.8 ppm/litre graded levels to broiler chicken in the dietary treatments and control groups which was offered basal feed (BIS 2007) without nano zinc and conventional zinc. Each diet was fed *ad lib.* to six treatment groups which were subdivided into eight replicates containing five chicks in each. The chicks were reared under uniform conditions up to 6 weeks of age and individual body weight of chicks and replicate-wise feed intake were recorded at weekly intervals throughout the experimental period and weekly feed conversion ratio was calculated. The carcass parameters (Ready to cook yield, heart, liver, gizzard, abdominal fat and breast yield) were studied at the end of the experiment on five birds from each treatment. The weekly mortality was recorded.

Data were analyzed using General Linear Model procedure of Statistical Package for Social Sciences (SPSS) 20th version and comparison of means was done using Duncan's multiple range test (Duncan 1955) and significance was considered at $P<0.05$.

Growth performance: The body weight gain was significantly ($P<0.05$) higher in birds fed with nano ZnO @ 0.2 ppm/litre (2017 g) followed by 0.1, 0.4, 0.6 and 0.8 ppm/litre compared to control (1,805 g) at 42 d of age (Table 1). The increase in body weight gain might be due to positive effects of nano ZnO on digestion and absorption of nutrients in the gastrointestinal tract and higher bioavailability of Zn in nano form. Because of small particle size (80 nm) of nano ZnO, a faster diffusion through GIT membrane took place to reach the cells of the intestinal lining, followed by uptake through the GIT barrier to reach the blood. Similar observations of higher weight gain were reported by feeding of nano ZnO supplementation at 0.06 ppm and organic Zinc (Zinc methionine) at 7.5 ppm in broilers by Sahoo *et al.* (2016). Zhao *et al.* (2014) reported that nano ZnO at 20 and 60 mg/kg could promote body weight gain compared with control. However, the higher concentration of nano ZnO at100 ppm inhibited body weight gain. These findings are in line with the reports of Ahmadi *et al.* (2013) at 30 to 90 mg/kg and Lina *et al.* (2009) at 40 mg/kg who reported that nano ZnO significantly affected body weight gain of broilers.

The findings in the present study are in contrast to results of Stenclova *et al.* (2016) who reported that additive Zinc at 120, 40 and 20 mg/kg had no significant effect on live body weight of broiler chickens. One possible explanation for this difference may be related to differences in physicochemical properties of the Zn sources used. The contrast to results of Yogesh *et al.* (2013) and Vieira *et al.* (2013) revealed that Zn sources (additive Zinc, organic Zinc and inorganic source) at higher levels had no significant

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Table 1. Effect of supplementation of nano ZnO in water at various graded levels on performance of broiler chicken at 42 days of age

Trt	Diet	Levels (ppm/litre)	Body weight gain (g)	Feed Intake (g)	FCR (FI/BWG)	Mortality (%)
T1	Control	0	1805[c]	3085	1.709	2.5
T2	nano ZnO	0.1	2001[a]	3336	1.667	0.0
T3	nano ZnO	0.2	2017[a]	3383	1.677	0.0
T4	nano ZnO	0.4	1934[b]	3280	1.696	2.5
T5	nano ZnO	0.6	1915[b]	3223	1.683	0.0
T6	nano ZnO	0.8	1898[b]	3221	1.697	0.0
	N		8	8	8	
	SEM		20.241	29.025	0.012	
	P Value		0.026	1.025	0.939	

Mean bearing at least one common superscript in a column do not differ significantly (P>0.05). Trt, Treatment.

effect on live body weight of broiler chickens.

The dietary supplementation of nano ZnO did not influence (P>0.05) feed intake and feed conversion ratio (FCR) of broilers at 42 days of age. However, numerically better FCR was recorded in nano ZnO supplemented groups compared to the control at 0–42 days of age (Table 1). Among the nano ZnO fed groups, better FCR was observed in 0.1 ppm/litre which implied better utilization of nano ZnO by the birds of this group but higher graded levels could not improve feed conversion ratio. This indicates that appropriate concentrations of nano ZnO were better than higher concentrations of nano ZnO for improving the efficiency of feed utilization.

Concomitant to the findings of the present study, Sahoo *et al.* (2016) discerned that supplementation of organic Zinc (Zinc methionine @ 7.5 ppm) and nano ZnO @ 0.06, 0.03, 0.3 ppm significantly improved FCR in broilers. Similarly, Yogesh *et al.* (2013), Vieira *et al.* (2013) and Stenclova *et al.* (2016) revealed that Zn sources (additive Zinc, organic Zinc and inorganic source) at higher levels had no significant effect on feed efficiency. However, Smith (2003) reported that the feed efficiency was significantly (P<0.05) decreased in broiler chicken at higher levels due to overdosing and toxicity of zinc.

Carcass yields: Supplementation of various graded levels of ZnO did not exert any significant (P>0.05) effect on various carcass parameters, viz. ready to cook yield, per cent weight of heart, gizzard, giblet and abdominal fat, except liver and breast yield at 42 days of age (Table 2). The liver weight was increased significantly (P<0.05) with increased level of nano ZnO but the breast yield was higher (P<0.05) in nano ZnO at 0.6 ppm/litre followed by nano ZnO 0.2 and 0.4 ppm/litre at the age of 42 days of age. Similar results were reported by Sarvari *et al.* (2015) and Stenclova *et al.* (2016) at various levels of supplemental Zinc in broiler chicken. In contrast, Khah *et al.* (2015) observed that addition of nano ZnO (60 and 90 mg/kg) significantly (P<0.05) improved dressing percentage, giblet weights and breast weight than control.

Finally, it could be concluded that supplementation of nano ZnO @ 0.1 and 0.2 ppm in drinking water helped achieve a better performance in terms of body weight gain, FCR and breast weight as compared with 0.4, 0.6 and 0.8 ppm/litre in broilers.

SUMMARY

This study was conducted to evaluate the effect of dietary supplementation of nano zinc oxide (nano ZnO) on the performance and slaughter variables of commercial broiler chicken from 0 to 42 days of age. Straight run '*Cobb* 400' day-old broiler chicks (240) were randomly distributed into six treatment groups which were sub-divided into eight replicates containing five chicks in each and fed with T1 (control), T2 (nano ZnO @ 0.1 ppm/litre) and T3 (nano ZnO @ 0.2 ppm/litre), T4 (nano ZnO @ 0.4 ppm/litre) T5 (nano ZnO @ 0.6 ppm/litre) and T6 (nano ZnO @0.8 ppm/litre) diets. The results revealed that body weight gains were significantly influenced by the graded levels of nano ZnO at 42 days of age and the weight gain increased with decrease in level of nano ZnO 0.1 and 0.2 ppm/litre compared with 0.4, 0.6 and 0.8 ppm/litre. However, the feed intake and FCR was not influenced by nano ZnO supplementation. All the dietary supplements did not exert any significant effect on various carcass parameters, except liver and breast yield. The liver weight was increased with increased level of nano ZnO but the breast yield was higher in nano ZnO at 0.6

Table 2. Effect of supplementation of nano ZnO in water at various graded levels on carcass variables and organ weights (% live weight) at 42nd days of age

Trt	Diet	RCY*	Heart	Liver	Gizzard	Giblet	Abdominal fat	Breast yield
T1	Control	65.82	0.660	2.562[ab]	1.996	5.218	1.289	17.558[c]
T2	nano ZnO (0.1)	68.52	0.598	2.371[b]	1.942	4.912	1.068	19.294[ab]
T3	nano ZnO (0.2)	67.80	0.586	2.310[b]	1.735	4.630	1.325	19.428[ab]
T4	nano ZnO (0.4)	69.40	0.590	2.406[b]	1.839	4.836	1.013	19.316[ab]
T5	nano ZnO (0.6)	68.22	0.652	3.266[a]	1.860	5.778	0.915	20.036[a]
T6	nano ZnO (0.8)	66.45	0.568	3.280[a]	1.911	5.760	1.324	18.414[bc]
	N	8	8	8	8	8	8	8
	P Value	0.063	0.238	0.031	0.537	0.060	0.155	0.001
	SEM	0.388	0.013	0.123	0.040	0.140	0.058	0.198

*Ready to cook yield. Mean bearing at least one common superscript in a column do not differ significantly (P>0.05). Trt, Treatment.

ppm/litre followed by nano ZnO 0.2 and 0.4 ppm/litre at the age of 42 days. The mortality rate was within the limits. It can be concluded that supplementation of nano ZnO @ 0.1 and 0.2 ppm (in drinking water) can be used for improving performance and breast yield of broiler chicken.

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