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Research Article

Growth performance, leg quality and viability of broiler chicken fed plant-based starter diet supplemented with zinc oxide (HiZox)

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ABSTRACT

The study was conducted to investigate the effect of HiZox on growth performance, leg health and liveability of broiler chicken from d1-21 days. Day-old male broiler chicks (*n*=1024; Cobb 500) were distributed randomly into four dietary treatments [D_1, D_2, D_3 and D_4], each treatment replicated eight times with thirty two chicks per replicate cage in a completely randomized design. Diet (D_1) was treated as control and supplemented with ZnSO4 (0.009%), whereas the D_2, D_3 and D_4 diets were supplemented with 0.006%, 0.009% and 0.12 % ZnO (HiZox) along with other feedstuffs, respectively. Similar housing, feeding, watering and environmental conditions were supplied the chicks entire the trial period. Birds were reared on the litter floor open-sided housing condition with *ad libitum* feed and water throughout the trail period. Data on feed intake (FI), body weight (BW), feed conversion ratio (FCR), viability, and the incidence of foot pad dermatitis (FPD) were measured. The result revealed that BW was increased significantly ($P<0.01$) by supplemented diets during 21d without affecting ($P>0.05$) FI at this period. From d1-14, the FI was increased ($P<0.01$) in the birds fed supplemented diet compared to control. The BW was unaffected ($P>0.05$) between treatment from d1-14 days. The FCR differed significantly ($P<0.01$) between treatment entire the trial period. The FCR was improved ($P<0.01$) in the broilers fed supplemented diet compared to control (D_1). Survivability of broiler was not affected ($P>0.05$) by treatment. Leg disorder such as FPD was influenced ($P<0.01$) by treatment. The incidence of FPD was increased ($P<0.01$) in D_2, D_3 and D_4 compared to control (D_1). It can be concluded that the HiZox showed beneficial effect on the growth responses of broiler, and it can be used as a potential nutrient source for poultry.

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1. INTRODUCTION

The trace mineral requirements for commercial poultry production in recent years can not be ignored by the poultry scientists in despite of the great progress in their performance. Zinc, is an essential trace element which acts as a co-factor in several metaloenzymes, and plays an important role in different metabolic pathways. The deficiency of trace minerals particularly Zinc in poultry diet could affect the protein and carbohydrate metabolism, which in turn, could have a negative impact on feed consumption, growth rate, feed conversion ratio, immunological, reproductive, skeletal and skin disorders of broilers (Underwood and Suttle, 1999). The commercial poultry producers often use a considerable safety margin for trace minerals including Zn in feed formulation, which would be resulted in trace mineral excretion into environment (Navidshad *et al.*, 2016). There are differences in the recommended dietary Zn requirement between two strains of broiler chickens, and it varies from NRC (1994) recommendation.

Broiler standard diets usually do not contain enough quantities of trace minerals naturally present in feed ingredients to satisfy the physiological needs of modern genetics of farm animals. So supplementation is practiced in routine in order to prevent any clinical sign or deficiency syndrome. Adding trace mineral sources in the diet could fulfill the basic animal requirements for their maintenance, growth and their specific needs for production of meat, egg and so on.

HiZox® is a free flowing dustless powder standardized zinc oxide of high purity. It is one kind of trace mineral of animal feed additive recently introduced in poultry diet. The use of this potentiated zinc oxide could show a positive effect on gut microbes and intestinal health parameters. Lina *et al.* (2009) reported that both protein-bound zinc and nano-ZnO improved antioxidant capacity in the body, increased the activities of the antioxidant enzymes and reduced the concentrations of free radicals in poultry.

Zinc requirement of poultry is defined according to specific criteria, related to growth, bone composition, or immune function, and could vary according to the criteria considered. Supplementation with inorganic salts or the chelated form aims to satisfy the animal's need on top of the zinc contained in feedstuffs. The severity of foot pad dermatitis in broilers reared under high litter moisture condition could be reduced by supplementation with a biotin and 150 ppm organic Zn-methionine (El-Wahab *et al.*, 2013).

However, the introduction of HiZox in poultry ration as feed additives is very recent. Very few research work has been conducted and there is a scare of data regarding the potentiality of this feedstuff in poultry industry. So the current study was undertaken to compare a new potentiated form of zinc oxide (ZnO), HiZox (Animine), at different nutritional level of regular $ZnSO_4$ in starter diets on the productive performance and leg quality of broiler chickens.

2. MATERIALS AND METHODS

A total of 1024 (Cobb 500) day-old male broiler chicks was procured from a local commercial hatchery to conduct this experiment from d1 to 21 days. The chicks were weighed on receipt, and then randomly assigned into four dietary treatment groups, *i.e* D_1, D_2, D_3 and D_4. Each treatment had eight replicates with 32 birds per replicate in a completely randomized design (CRD). All the chicks were allotted into 32 floor-pens within a mechanically –ventilated closed housing condition. Wood-shaving litter materials were used to cover the surface of floor-pen. Each pen was furnished with hanging feeder and automatic drinker to get an easy access of feed and water for the birds during the trial period. The chicks were brooded with electric bulb (100 watt) placed hanging at the middle of the each pen. For the first two days the birds were provided with a temperature of 33°C. The temperature was then gradually reduced by 1 or 2°C every 1 or 2 days until the chicks were 19 days old at which point the temperature was maintained at 24°C for the rest of the trial. Eighteen hours of lighting and six hours darkness per day were provided throughout the trial period except for first week only, and at this period continuous lighting (23h light:1h darkness) program was maintained for the chicks.

Diet formulation

Four experimental diets (D_1, D_2, D_3 and D_4) were formulated with maize and palm oil as the main energy sources, soybean meal as the main protein source along with other feedstuffs (Table 2). All the diets were formulated exclusively with the ingredients of plant origin. Diet (D_1) was supplemented with $ZnSO_4$ (0.009%), whereas the other diets (D_2, D_3 and D_4) were supplemented with 0.006%, 0.009% and 0.12% ZnO(HiZox) in a CRD design, respectively, as shown in Table 2. The chicks were fed a standard broiler starter diet from day1 to 21d. All the diets were iso-caloric and iso-nitrogenous, and fed the birds *ad libitum* throughout the trial period. Starter diet in mash form was formulated to meet the requirements as prescribed

by Cobb 500 manual for the broilers at this age. The diets were formulated based on the digestible amino acid contents.

Data collection

Prior to feeding, chicks were weighed at the first day of starting trial. Live weight, feed consumption and feed conversions ratio were calculated weekly. Mortality was recorded when it occurred. Footpad dermatitis (FPD) incidences of birds were also assessed on the last day of trial to assess the leg health status of broiler chicken.

Method of scoring the incidence of FPD of broilers

The severity and incidence of FPD of broilers are scored by visual ranking system on day 21. The FPD scoring test followed the 3-point scoring system developed by Nagaraj *et al.* (2007). Twenty birds were randomly selected from each replicate cage, and observed the foot-pad of each birds visually for any incidence of dermatitis or disorder, wound, lesions, and scored against a number of criteria accordingly (Table 1).

Table 1. 3-point scoring system of foot-pad dermatitis of broiler chicken

Scores	Degree of impairment	Criteria
1	Foot-paw with no lesion	Dermal ridges intact within central plantar footpad surface, with or without discoloration;
2	Footpads with mild lesions	Dermal ridges not intact within a central, round to oval ulcer on the central plantar footpad surface, roughened lesion surface with small tag of crust less than 1.5 cm in diameter;
3	Footpads with severe lesions	A brown crust more than 1.5 cm in diameter, adhered to the central plantar footpad, sometimes extending up to the hock joint

Table 2. Ingredient and nutrient composition of starter diet (d1-21 days)

Scores	Dietary Treatment			
	D_1	D_2	D_3	D_4
Corn	50.32	50.32	50.32	50.32
Soybean meal	39.02	39.02	39.02	39.02
Palm oil	6.67	6.67	6.67	6.67
DCP	1.62	1.62	1.62	1.62
Limestone	1.22	1.22	1.22	1.22
Table salt	0.50	0.50	0.50	0.50
Vita-premix	0.05	0.05	0.05	0.05
Min-premix	0.25	0.25	0.25	0.25
L-lysine	0.13	0.13	0.13	0.13
DL-methionine	0.12	0.12	0.12	0.12
L-threonine	0.10	0.10	0.10	0.10
ZnSO4	0.009	0.00	0.00	0.00
HiZox (ZnO)	0.00	0.006	0.009	0.12
Calculated nutrient composition (%)				
ME-Kcal/kg	3130	3130	3130	3130
CP	22.20	22.20	22.20	22.20
Ca	0.91	0.91	0.91	0.91
Av. P	0.45	0.45	0.45	0.45
Meth + cyst	0.90	0.90	0.90	0.90
Lys	1.22	1.22	1.22	1.03

[D_1 refers to a control diet that was supplemented with $ZnSO_4$ 0.009%, and D_2, D_3 and D_4 diets were added 0.006%, 0.009%, and 0.12% HiZox, respectively]

Statistical analyses

All collected data were statistically analyzed using Minitab software (Minitab Version 16, 2000). The data were analyzed using one-way ANOVA with diet as factor. The significance of differences between means was determined by Fisher's least significant difference at $P \leq 0.05$

3. RESULTS

Gross responses of broiler chickens fed HiZox supplemented diet

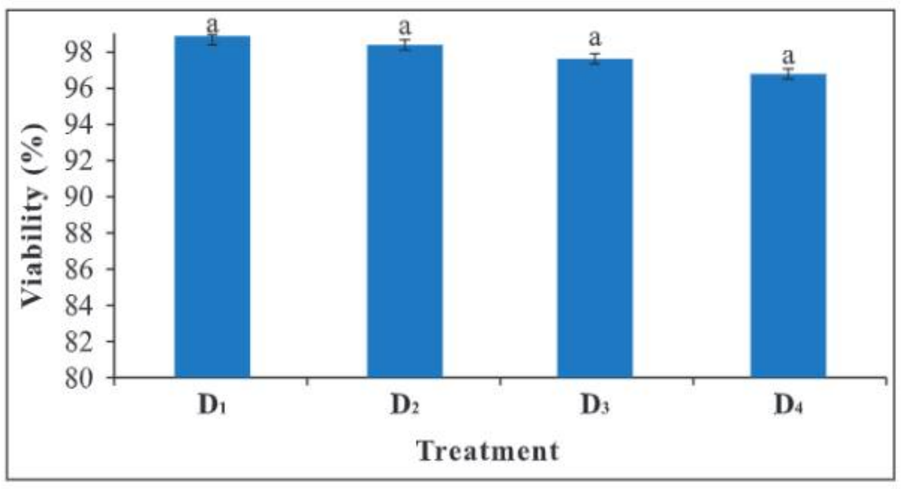
The growth responses of broilers in terms of body weight (BW), feed intake (FI), and feed conversion ratio (FCR) on the different dietary treatment group of broiler are shown in Table 3. The data revealed that the BW of broiler was increased significantly (P<0.01) fed supplemented diets during 21d without affecting (P>0.05) FI at this period. From d1-14, the FI was increased (P<0.01) in the birds fed supplemented diet compared to control. The BW was unaffected (P>0.05) between treatment from d1-14 days. The FCR of broiler fed different levels of supplemented diet differed significantly (P<0.01) between treatment entire the trial period. The FCR was improved (P<0.01) in the broilers fed supplemented diets compared to control group (Table 3).

Table 3. Body weight (BW), feed intake (FI) and feed conversion ratio (FCR) of broiler chickens fed Hizox diet from d1-21

Parameter	Age (day)	Dietary Treatment				SEM	P-value
		D_1	D_2	D_3	D_4		
BW(g/b)	1-14	437.00	440.04	447.83	464.54	4.600	0.171
	1-21	907.00b	965.00a	975.10a	991.60a	7.332	0.01
FI(g/b)	1-14	480.82b	474.60b	482.31b	519.62a	4.226	0.01
	1-21	1280.50	1259.00	1269.60	1288.40	8.092	0.682
FCR	1-14	1.34a	1.21b	1.20b	1.20b	0.009	0.01
	1-21	1.49a	1.37b	1.37b	1.36b	0.006	0.01

Viability (%) or livability of broiler chickens fed HiZox supplemented diet

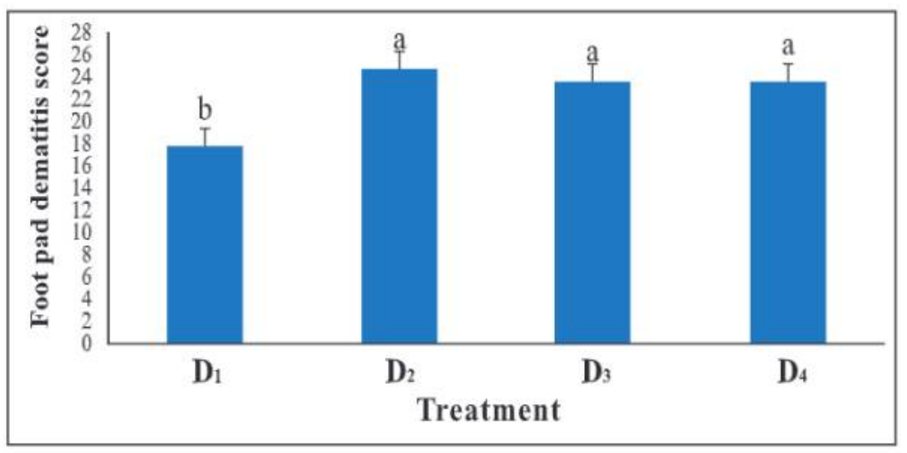
The livability (%) of broilers fed HiZox diet on days 21 was not significant (P>0.05) between treatment as shown below in Figure 1. The result denotes that supplemental diets had no detrimental effect on the viability of chicks.



[**Figure 1.** Viability (%) of broilers of different treatments on day 21; Bars with similar superscripts are not significantly different (P>0.05) between treatment.]

Foot-pad dermatitis (FPD) of broiler fed HiZox diet

The foot pad dermatitis score (FPD) of broilers are shown graphically below in Figure 2. It demonstrates that the FPD scores were significantly (P<0.01) affected by dietary treatment (Figure 2). Higher incidences (P<0.01) of FPD were observed in the broiler chickens reared on supplemental diet than those reared on control group. The higher scores of FPD was found in D_2 treatment, followed by D_3, D_4 and D1treatments, respectively.



[**Figure 2.** Foot pad dermatitis scores of broilers of different treatments on day 21; Bars with different superscripts are significantly different at **P<0.01]

4. DISCUSSION

Gross responses of broiler chicken fed HiZox supplemented diet

Introducing the organic Zn supplements, allowed the modern broilers to intake their required dietary levels with a lower dietary Zn supplementation. The nanoparticles of Zn are a more recent generations of supplements which are under investigations. The source of Zn influences the dietary requirement of it in poultry. However, it is obvious from the current study that birds fed HiZox supplemented diet grew better than those of control diet. The reason behind this improved body weight of broiler chicken might be a result of better FCR of the birds as is seen from our study.

The improved growth performance of broilers fed on HiZox diet indicates that the broilers of this diet groups are assumed to be more efficient to convert the feed into meat more rapidly than the birds fed on control diet. From the result it could be assumed that, the bioavailability of Zn from HiZox might be more than the bioavailability of Zn in $ZnSO_4$, and it could stimulate higher metabolism or synthesis of protein and carbohydrate for the improved growth and performance of broiler chickens. Initially significantly improved feed intake was observed in the birds fed HiZox diet, though later no variation was observed in the feed intake of broilers between treatments. It does imply that HiZox might have very little or nominal effect on the palatability of the diet. Our results might be correlated with the findings of previous researcher (El-Samee *et al.*, 2012), who reported that laying quails fed diets supplemented up to 40 ppm of organic Zn, and observed an improvement in weight, fertility and hatch-ability of eggs. Survivability of broiler was not influenced by dietary treatments. It implies that HiZox had no detrimental effect on the viability of broiler chicken.

Foot pad dermatitis (FPD) of broiler chicken

Footpad dermatitis is a type of contact dermatitis affecting the plantar region of the feet in poultry and other birds. At an early stage, discoloration of the skin is seen. Hyperkeratosis and necrosis of the epidermis can develop, and in severe cases, these changes are followed by ulcerations with inflammatory reactions of the subcutaneous tissue (Ekstrand *et al.*, 1997).

The result of FPD indicated higher incidence of dermatitis in the broiler chickens fed on supplemental diet than those reared on control group. The increased incidence of FPD might reduce the quality of leg and this in turn, could deteriorate the leg health status as well as downgrade the carcass quality. It could be assumed that the higher incidence of FPD might result from the heavier body weight of broilers, as the broiler grew well fed on supplemented diets in this study. The result of the current study contradicts with the findings of previous researchers (El-Wahab *et al.*, 2013) who reported that, a blend supplement of biotin and 150 ppm organic Zn-methionine, reduced the severity of FPD in broilers reared under high litter moisture condition. The reason of different results of the two experiments could be due to various factors such as different environment, different doses, variation in supplements etc. Apart from these, higher stocking density, low moisture litter, heavier body weight of the birds etc., might be another reasons for the increased incidence of FPD in broiler chicken.

5. CONCLUSIONS

An overview of the results obtained in this study revealed that, the better growth performance and liveability of the broiler (Cobb 500) might bring a great benefit from rearing this bird fed on supplement (HiZox) during starter period. Though the leg quality of broiler was not improved in supplemental feed, HiZox showed a significant effect on the improvement of average body weight of broiler chicken without affecting mortality. After all, HiZox showed a positive effect on the growth performance of broiler, and it can be a potential source to be used as a good feed additive for rearing broiler chicken successfully under commercial condition.

6. ACKNOWLEDGEMENT

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7. REFERENCES

El-Samee, L. D. A., El-Wardany, I., Ali, N. G. and Abo-El-Azab, O. M. 2012. Egg quality, fertility and hatchability of laying quails fed diets supplemented with organic zinc, chromium yeast or mannan oligosaccharides. International Journal of Poultry Science, 11: 221-224.

Ekstrand, C, Algers. B. Svedberg, J. 1997. Rearing conditions and foot-pad dermatitis in Swedish broiler chickens. Preventive Veterinary Medicine, 31: 167-174

El-Wahab A.A., Radko D. and Kamphues J. 2013. High dietary levels of biotin and zinc to improve health of foot pads in broilers exposed

experimentally to litter with critical moisture content. Poultry Science, 92: 1774-1782.

Lina T., Zhu F., Ren H., Jiang J.Y. and Li W. 2009. Effects of nano-zinc oxide on antioxidant function in broilers. Chinese Journal of Animal Nutrition, 21: 534-539.

Minitab .2000. Minitab Statistical software User Guide 2: Data Analysis & Quality Tools. Minitab Inc., State College, P.A. USA.

NRC.1994. Nutrient Requirements of Poultry, 9th Rev. ed. National Academy Press, Washington DC., USA.

Navidshad, B.; Jabbari, S., Mirzaei AghjehGheshlagh, F. 2016. The New Progresses in Zn Requirements of Poultry. Iranian Journal of Applied Animal Science, 6(4): 763-767.

Nagaraj, M., Wilson, C. A. P., Hess, J. B., Bilgili, S. F.2007. Effect of high-protein and all-vegetable diets on the incidence and severity of pododermatitis in broiler chickens. Journal of Applied Poultry Research 16: 304-312.

Underwood E.J. and Suttle, N.F.1999. The Mineral Nutrition of Livestock. CABI Publishing, New York.