GROWTH PERFORMANCE CHARACTERISITICS OF EGG-TYPE CHICKENS FED DIET SUPPLEMENTED WITH CHELATED ORGANIC TRACE MINERAL BLENDS AT THE CHICK AND GROWER PHASES

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Target Audience: Animal Nutritionists, Poultry farmers and Researchers

ABSTRACT

Trace minerals commonly used in poultry are supplied by inorganic salts, and they have low bioavailability because they can form complexes with other nutrients in the gut. A 18 weeks experiment was conducted to evaluate the effects of diet supplemented with chelated organic trace mineral blends on the performance characteristics of egg-type chickens at both chick and grower phases. The experiment involved a total of five hundred (500) one- day old pullet chicks randomly allotted to five (5) dietary treatments consisting of positive control, recommended level of inorganic trace minerals in the premix 16, 64, 64 mg/kg of Cu, Zn and Mn (T1), negative control, basal diet with 0.0, 0.0,0.0 mg/kg of Cu, Zn and Mn i.e. premix free of Cu, Zn and Mn (T2), diets with 16, 64, 64 mg/kg of chelated Cu, Zn and Mn, 100% higher than the manufacturer's recommendation (T3), diets with 8, 32, 32 mg/kg of chelated Cu, Zn and Mn, at the manufacturer's recommendation (T4) and diets with 4, 16, 16 mg/kg of chelated Cu, Zn and Mn at 100% lower than the manufacturer's recommendation (T5) respectively. Each treatments was replicated ten times with 10 birds per replicate. Growth performance characteristics were evaluated as response criteria in the experiment. All data obtained were subjected to One-way Analysis of Variance in a Completely Randomized Design. At the chick and grower phases, the FCR was greatly improved even at the least feed intake. A significant ($P<0.05$) increase in weight gain was also recorded at the grower phase. The study concluded that supplementation of chelated trace mineral blends at 100% higher than manufacturer's recommended level in the diets of egg-type chickens resulted in an improved FCR at the least feed intake.

Keywords: Pullets, Chelated Trace mineral Blends, Copper, Zinc, Manganese, Growth Performance

DESCRIPTION OF PROBLEM

Trace minerals, such as Zn, Mn and Cu, are involved in a wide variety of physiological processes, making them essential for optimal bird growth and health (8). They act as catalysts in many enzyme and hormone systems (7) and, as a result, influence growth, bone development, feathering, enzyme structure and function, and appetite (6). These elements are involved in myriad of metabolic and physiological processes which are critical to the general well-being of man and animals. However, subclinical inadequacies, severe deficiency or imbalance of these vital micronutrients results in metabolic disorders which are often expressed as poor growth rate, low feed efficiency, loss of appetite, reproductive disorders, impaired immune response and deficiency diseases in many avian species (1). Organic Trace Minerals (OTM) have been hypothesized to have a higher bioavailability than inorganic salts (2) though their effects on the long term use for pullets has not been documented, its use in premix formulation has been suggested as a potential solution to mitigating mineral pollution. This implies that OTM may be added at a much lower concentration in the diet than ITM, without causing any negative effect on production performance and potentially reducing mineral excretion (4). The study aim at evaluating the growth performance characteristics of egg-type

chicken fed diet supplemented with chelated organic trace mineral blends.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit, Directorate of University Farms (DUFARMS), and Animal Nutrition Laboratory, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

Test Ingredients

The chelated organic Zn/Cu/Mn used were obtained from Novus Intl., USA and trace mineral (Cu, Zn and Mn) free premix was formulated at Rotinol, Gbonogun, Odo Eran, Abeokuta, Ogun State.

Diets and feeding management

The egg-type chicken diet that was used in this study was formulated to meet the nutrient requirements of the birds at all phases (5). The treatments included supplementation of trace minerals at recommended level of inorganic supplementation according to (10) (16, 64 and 64 mg/kg of Cu, Zn and Mn, respectively) "Positive Control"; supplementation at zero (0.00mg/kg Cu, Zn and Mn, respectively)"Negative Control"; chelated supplementation at 100% higher than manufacturer's recommended level (16, 64 and 64mg/kg of Cu, Zn and Mn, respectively); chelated supplementation at manufacturer's recommended level (8, 32 and 32 mg/kg of Cu, Zn and Mn, respectively); and chelated supplementation at 100% lower than recommended level (4, 16 and 16 mg/kg of Cu, Zn and Mn, respectively). Premix was formulated based on breed specification (without Cu, Zn and Mn dietary supplementation in the control diet) and supplemental levels was defined based on the manufacturer's (Novus Inc.) recommended level of inclusion in diet.

Data collection

Growth Parameters

Weighing of Birds

Birds in each replicate group were weighed at the beginning of the experiment and subsequent weighing for pullets were done forthnightly. All weighing were done on a Five Star weighing scale in the morning before feeding. Weight gain was determined by the difference in the body weights of the two consecutive weighing for each replicate group.

Feed Intake

Known quantities of feed were supplied to each replicate group at the beginning of each week and the left-over at the end of 7day period were subtracted from the amount supplied to obtain the feed consumed by the replicate group. Cumulative feed intake was the summation of the feed consumed within a particular time.

$$\text{Feed intake/bird(g)} = \frac{\text{Feed supplied(g)} - \text{left over feed(g)}}{\text{No of birds}}$$

Feed Conversion Ratio

Feed conversion ratio of the chicks and growing birds was determined by following the formula:

$$\text{Feed Conversion Ratio} = \frac{\text{Amount of feed consumed}}{\text{Weight gain}}$$

RESULTS AND DISCUSSION

The result of the performance characteristics of pullet chicks and the grower chicks fed diets supplemented with chelated organic trace mineral blends is presented in Tables 1 and 2. At the chick phase, the result shows that the daily feed intake and FCR were significantly ($p<0.05$) influenced by dietary treatments. Daily feed intake was higher in birds fed T4 compared to other treatment groups, the least daily feed intake was recorded in birds fed T3. The least and better FCR (2.12) was recorded in birds fed T3 while the highest FCR (2.37) was recorded in birds fed T1. All parameters measured for growth performance at the grower phase were not significantly ($P>0.05$) influenced by the dietary treatments.

The reduced feed intake and better FCR observed in birds on diet supplemented with chelated trace minerals at the end of the chick phase may be due to a more balanced amino acid profile as a result of the organic ligands to which the trace minerals were chelated. This implies that the diet was able to meet up with the nutrient requirements of the birds faster than the control group and that with zero level of Cu, Zn and Mn which might have

elicited the better FCR. This is in consonance with (11) who reported an improved FCR in turkeys fed diets supplemented with chelated trace mineral blends even with reduced feed intake. Similar findings were reported by (12); a better FCR occured in broiler chickens fed starter diets containing supplemented organic trace minerals compared to those fed diets supplemented with the inorganic form. This improved FCR also concurred with the findings of (6) who reported an increased body weight gain, improved FCR and production efficiency factor as a result of feeding diets supplemented with organic Cu, Zn and Mn in broiler chickens. The improvement in FCR following increasing supplemental level of organic trace mineral observed in this study however contradicted the reports of (5) who stated that with the inclusion of additional dosage of trace mineral into diets, improvement of performance would not be expected at the starter phase.

Table 1: Performance characteristics of pullet chicks fed diets supplemented with chelated organic trace mineral blends (0-10 weeks)

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Initial weight (g/bird)	130.50	129.40	130.50	130.48	130.50	1.98	0.442
Final weight (g/bird)	600.50	578.50	597.15	601.50	599.60	6.08	0.176
Daily weight gain (g/bird)	8.42	8.01	8.36	8.45	8.39	0.10	0.108
Daily feed intake (g/bird)	36.00^{b}	35.75^{ab}	34.45^{b}	37.92^{a}	37.53^{a}	0.20	0.051
FCR	2.37^{a}	2.27^{ab}	2.12^{b}	2.17^{b}	2.31^{a}	0.05	0.101

^{abc} means on the same row having different superscripts are significantly different ($p<0.05$)

T_1 - Recommended levels for inorganic trace minerals supplementation
T_2 - Supplementation at zero level for Cu, Zn and Mn, respectively
T_3 - Chelated supplementation at 100 % higher than manufacturer's recommendation
T_4 - Chelated supplementation at manufacturer's recommendation
T_5 - Chelated supplementation at 100 % lower than manufacturer's recommendation

Table 2: **Performance characteristics of pullet chicks fed diets supplemented with chelated organic trace mineral blends (10-20 weeks)**

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Initial weight	780.00	685.00	785.35	779.50	729.00	18.26	0.654
Final weight	1356.90	1298.00	1388.00	1397.78	1358.02	17.78	0.824
Daily weight gain	11.92	9.72	12.89	12.76	11.10	0.38	0.184
Daily feed intake	88.58	88.54	89.13	89.36	89.00	0.62	0.173
FCR	7.18	7.32	7.09	7.02	7.12	0.25	0.397

^{abc} means on the same row having different superscripts are significantly different ($p<0.05$)

T_1 - Recommended levels for inorganic trace minerals supplementation
T_2 - Supplementation at zero level for Cu, Zn and Mn, respectively
T_3 - Chelated supplementation at 100 % higher than manufacturer's recommendation
T_4 - Chelated supplementation at manufacturer's recommendation
T_5 - Chelated supplementation at 100 % lower than manufacturer's recommendation

CONCLUSIONS AND APPLICATION

From the study and the result, it can be concluded that;

- At the starter chick phase, chelated supplementation led to a better FCR with the least feed intake.
- At the grower phase, birds fed chelated supplementation at 100% higher that the manufacturer's recommendation had the highest weight gain, least feed intake, good FCR and least cost of production compared to other groups.
- More eggs were produced by birds fed 100% higher than manufacturer's recommendation at the three laying phases.

- Hence, trace minerals (Cu, Zn and Mn) can be supplemented to the diet of egg-type chickens up to 16, 64, 64 mg/kg of chelated Cu, Zn and Mn respectively so as to achieve a better growth performance at both chick and grower phases.

REFERENCES

1. Abdallah, A. G., Ei-Husseiny, O. M. and Abdel-Latif, K. O. 2009. Influence of some dietary organic mineral supplementations on broiler performance. *International Journal of Poultry Science 8: 291-298.*
2. Aggett, P. J. 2010. Population reference intakes and micronutrient bioavailabiity: a European perspective. *American Journal of Clinical Nutrition 91: 1433S - 1437S.*
3. Aksu, D. S., Aksu, T. and Önel, S. E. 2012. Does inclusion at low levels of organically complexed minerals versus inorganic forms create a weakness in performance or antioxidant defense system in broiler diets? *International Journal of Poultry Science 11: 666 - 672.*
4. Close, W. H. 1999. "Biotechnology in the feed industry*." Proceedings of Alltech's 15th Annual Symposium, 51-55.* England: Nattingham University Press.
5. El-Husseiny, O. M., Hashish, A. S. M., Arafa, R. A., Abd El- Samee, S. A. and. Olemy, A. A.2012. Effects of feeding organic zinc, manganese and copper on broiler growth, carcass characteristics, bone quality and mineral content in bone, liver and excreta. *Poultry Science 11(6): 368377.*
6. Jegede A.V., Oso, A. O., Fafiolu, A. O., Sobayo, R. A., Idowu, O. M. O. and Oduguwa, O. O. 2015. Effect of Dietary Copper on Performance, Serum and Egg Yolk Cholesterol and Copper Residues in Yolk of Laying Chickens. *Slovakia Journal of Animal Science 48, 2015 (1): 29-36.*
7. Jegede, A. V., Oduguwa, O. O., Bamgbose, A. M., Fanimo, A. O. and Nollet, L. 2011. Growth response, blood characteristics and copper accumulation in organs of broilers fed on diets supplemented with organic and inorganic dietary copper sources. *British Poultry Science 52 (1): 133—139*
8. Jegede, A. V., Oduguwa, O. O., Oso, A. O., Bamgbose, A. M., Fafiolu, A. O., Idowu, O. M. O. and Nollet, L. 2012. Growth performance, blood characteristics and plasma lipids of growing pullet fed dietary concentrations of organic and inorganic copper sources. *Livestock Science 145: 298-302*.
9. National Research Council. 1994. Nutrient requirements of Poultry, 9th ed., National Academy Press, Washington D.C.
10. Nollet, L., J.D. van der Klis, M. Lensing and P. Spring, 2007. The effect of replacing inorganic with organic trace minerals in broiler diets on productive performance and mineral excretion. *Journal of Applied Poultry Research,* 16: 592-597.
11. Salami S. A., Oluwatosin, O. O., Oso, A. O., Fafiolu, A. O., Jegede, A. V., Adeleye, O. O. and Sogunle, O. M. 2016. Growth, mineral bioavailability and bone quality of turkeys fed inorganic blends or mineral chelates of Cu, Zn and Mn. *Tropical Agriculture (Trinidad) 93(4): 258-270.*
12. Scatolini, A. M. 2007. Mn, Zn and Se associated to organic molecules in feeding of laying hens in the second production cycle [dissertation]. Jaboticabal (SP): Universidade Estadual Paulista.
13. Suttle, N. F. 2010. Zinc. In: Suttle, N. F., *Mineral Nutrition of Livestock. 4th edition. Oxfordshire, UK: CAB International pp426-458.*
14. Van Der Klis, J. D., and A. D. Kemme. 2002. An appraisal of trace elements: Inorganic and organic. *Pages 99-108 in Poultry Feedstuffs*: Supply, Composition and Nutritive Value. J. M. McNab and K. N. Boorman, ed. CAB Int., Wallingford, UK.