EFFECT OF GRADED LEVELS OF BENTONITE IN DIET ON LITTER CHEMICAL CHARACTERISTICS OF BROILER CHICKENS

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ABSTRACT
The study was conducted to evaluate the effect of graded levels of Bentonite in diet on litter chemical characteristics of broiler chickens. A total of 300 chicks (10 days old) were allotted to five treatments viz; 0%, 0.5%, 1%, 1.5% and 2% Bentonite and replicated thrice with 20 birds/replicate in a completely randomized design. During the eight weeks experimental period, the birds were given feed and water *ad libitum* and routine vaccinations/medications were administered appropriately. 2% bentonite inclusion in broiler chicken diet significantly ($P<0.05$) reduces litter moisture (6.33% - 20.12%) and litter total nitrogen concentration (2.80% - 33.51%). 0.5% Bentonite in broiler chicken diets significantly improved litter quality and hence general environment of broiler chickens.
Keywords

INTRODUCTION
Silicate covers about 90% of the earth's mineral (Katouli *et al.*, 2010). Bentonite is an absorbent aluminum phyllosilicate clays with strong colloidal properties that absorb water rapidly, which results in swelling and manifold increase in volume, giving rise to a thixotropic gelatinous substance (Pasha, *et al.*, 2008).

One of the benefits of using silicate minerals in the diet was improvement in the quality of broiler litter (Cabuk *et al.*, 2004). The ingredients of Bentonite are SiO_2, (66%); Al_2O_3, (16.3%); H_2O (Crystal), (60%); Fe_2O_3, (3.3%); Na_2O, (2.6%); CaO, (1.8%); MgO, (1.5%); K_2O, (0.48%) and TiO_2, (0.12%) (Salari *et al.*, 2006; Sallary *et al*., 2008). The special properties of bentonite such as hydration, swelling, water adsorption and viscosity make it a valuable material for a wide range of applications in industrial and livestock farming systems (Miazzo *et al*., 2005).

MATERIALS AND METHODS

Table 1: Ingredients Composition and Calculated Analysis of Starter Diets

	Bentonite Inclusion Level (%)				
Ingredient	0	0.5	1.0	1.5	2.0
Maize	54.95	53.80	52.85	51.05	51.10
Soya bean meal	36.00	36.25	36.40	36.50	36.70
Crude Vegetable Oil	1.00	1.40	1.70	1.90	2.15
Wheat Bran	3.00	3.00	3.00	3.00	3.00
Lime stone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Dicalcium Phosphate	0.50	0.50	0.50	0.50	0.50
Common Salt	0.25	0.25	0.25	0.25	0.25
Sodium Bicarbonate	0.05	0.05	0.05	0.05	0.05
Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Bentonite	-	0.50	1.00	1.50	2.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein (%)	22.38	22.39	22.37	22.33	22.33
Metabolisable energy (kcal/kg)	3,040	3,040	3,035	3,027	3,020
Ether extract (%)	4.79	5.13	5.37	5.53	5.73
Crude fibre (%)	3.40	3.36	3.33	3.30	3.27
Calcium (%)	1.43	1.43	1.43	1.43	1.43
Available Phosphorus (%)	0.68	0.69	0.69	0.69	0.69
Lysine (%)	1.51	1.52	1.52	1.52	1.52
Methionine + Cystine (%)	0.95	0.95	0.95	0.95	0.95

**Composition of premix supplies the following per 1kg diet: Vit. A = 10000IU; Vit. D_3 = 2000IU; Vit. E = 20IU; Vit. K = 2.500mg; Thiamin = 1.75mg; Ribolflavin = 5.0mg; Pyridoxine = 2.75mg; Niacin = 2.75mg; Panthotenic acid = 7.5mg; Folic acid = 7.5mg; Biotin = 0.05mg; Vit. B_{12} = 0.015mg; Choline chloride = 0.40g; Antioxidant = 0.125g; Mn = 0.08g; Zn = 0.05g; Fe = 0.02g; Cu = 0.005g; I = 0.0012g; Se = 0.2mg; Co = 0.02mg.*

Table 2: Ingredients Composition and Calculated Analysis of Finisher Diets

	Bentonite Inclusion Level (%)				
Ingredient	0	0.5	1.0	1.5	2.0
Maize	56.50	55.80	54.80	53.00	52.20
Soya bean meal	31.00	31.10	31.20	31.35	31.50
Wheat Bran	5.00	5.00	5.00	5.00	5.00
Crude Vegetable Oil	2.50	2.60	3.00	3.15	3.30
Lime stone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Dicalcium Phosphate	0.50	0.50	0.50	0.50	0.50
Common Salt	0.25	0.25	0.25	0.25	0.25
Sodium Bicarbonate	0.05	0.05	0.05	0.05	0.05
Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Bentonite	-	0.50	1.00	1.50	2.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Crude protein (%)	20.45	20.42	20.38	20.37	20.36
Metabolisable energy (kcal/kg)	3,141	3,130	3,131	3,120	3,109
Ether extract (%)	6.38	6.45	6.79	6.90	7.00
Crude fibre (%)	3.39	3.37	3.33	3.30	3.27
Calcium (%)	1.42	1.42	1.42	1.42	1.42
Available Phosphorus (%)	0.65	0.65	0.65	0.65	0.65
Lysine (%)	1.32	1.32	1.32	1.33	1.33
Methionine + Cystine (%)	0.89	0.89	0.88	0.88	0.88

**Composition of premix supplies the following per 1kg diet: Vit. A = 8000IU; Vit. D_3 = 1600IU; Vit. E = 5.0IU; Vit. K = 2.0mg; Thiamin = 1.50mg; Riboflavin = 4.0mg; Pyridoxine = 1.50mg; Niacin = 15.0mg; Panthotenic Acid = 5.0mg; Folic acid = 0.50mg; Biotin = 0.02mg; Vit. B_{12} = 0.01mg; Choline chloride = 0.20g; Antioxidant = 0.125g; Mn = 0.08g; Zn = 0.05g; Fe = 0.02g; Cu = 0.005g; I = 0.0012g; Se = 0.20mg; Co = 0.20mg.*

Experimental site and Location

The experiment was conducted at the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria. Zaria is located in Northern Guinea Savannah Zone of Nigeria, Latitude 11^0 14' 44'' N and Longitude 7^0 38' 65'' E at an altitude of 610 mm above sea level between the months of December to February.

Experimental treatments and diets

Three hundred (300) broiler chicks were brooded for 10 days before being used for the study. The study design was a Completely Randomized Design with 5 treatments and 3 replicates of 20 birds each. Broiler starter and finisher diets were formulated to meet the nutrient requirement of broilers and used in feeding the experimental birds throughout the 56 days period of the study. Bentonite was included in the diets at graded levels as follows: 0% (control), 0.5%, 1%, 1.5% and 2% bentonite. The basal diets for the starter and finisher phases are shown in Tables 1 and 2.

DATA COLLECTION AND ANALYSES

Blood sample collection and haematological analysis

At the termination of the experiment (day 56), two birds from each pen having representative weights for the group (6 birds per Treatment) were selected and 1.5ml of blood was taken via the wing vein. Experiment one and two haematological parameters were analyzed by an auto haemo-analyzer (BC2800 vet auto hemo analyser) at the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria.

Litter sample collection

Five sets of litter samples were obtained fortnightly from each pen from different locations i.e. the four corners and centre from which the moisture, pH and total nitrogen (N) were measured. Litter samples were taken by removing the first 10mm of the exposed surface from each location set. The samples from each pen were mixed and homogenized to make one sample and was refrigerated before being taken to the laboratory for analyses.

Chemical analysis of litter

The litter samples were analyzed for moisture, pH and ammonium ion (NH_4^+) concentration at the Department of Agronomy, Ahmadu Bello University, Zaria. A subsample of the litter was collected and put in a hot air oven at a temperature of 105ºC for 3h to dry and weighed to constant weight. The difference between the original and final weight was determined as described by A. O. A. C. (2005).

A 20-g subsample of the litter sample was extracted with 200 ml of deionized water for 2 hours on a mechanical shaker, then centrifuged at 3,687 × *g* for 15 minutes (DeLaune *et al*., 2004). Aliquots were taken for pH, and total nitrogen. Unfiltered samples were used for pH using a pH meter and were analyzed immediately. Samples for total nitrogen were filtered through a 0.45-µm membrane filter and were determined using Kjeldahl method as described by A. O. A. C. (2005).

Statistical analysis

All the data collected from the experiment were subjected to analysis of variance (ANOVA) using the general linear model of SAS software package and the mean separation was done using Duncan Multiple Range Test in the SAS (2001) package.

RESULTS AND DISCUSSION

Litter Moisture of Broiler Chickens Fed Graded Levels of Bentonite

The fortnightly litter moisture level of broiler chickens fed graded levels of bentonite is presented in Figure 1. The result showed significantly ($P<0.05$) lower litter moisture levels in all the treatment group fed bentonite compared to the control.

The lower moisture observed in treatment groups with bentonite in the diet compared to the control may be due to the high capacity for swelling and absorbing moisture as reported by Ramos *et al.* (1996). The result of this study was in agreement with previous studies in which silicate mineral (sodium bentonite and zeolite) decreased litter moisture in broiler house (Safaeikatouli *et al*., 2011).

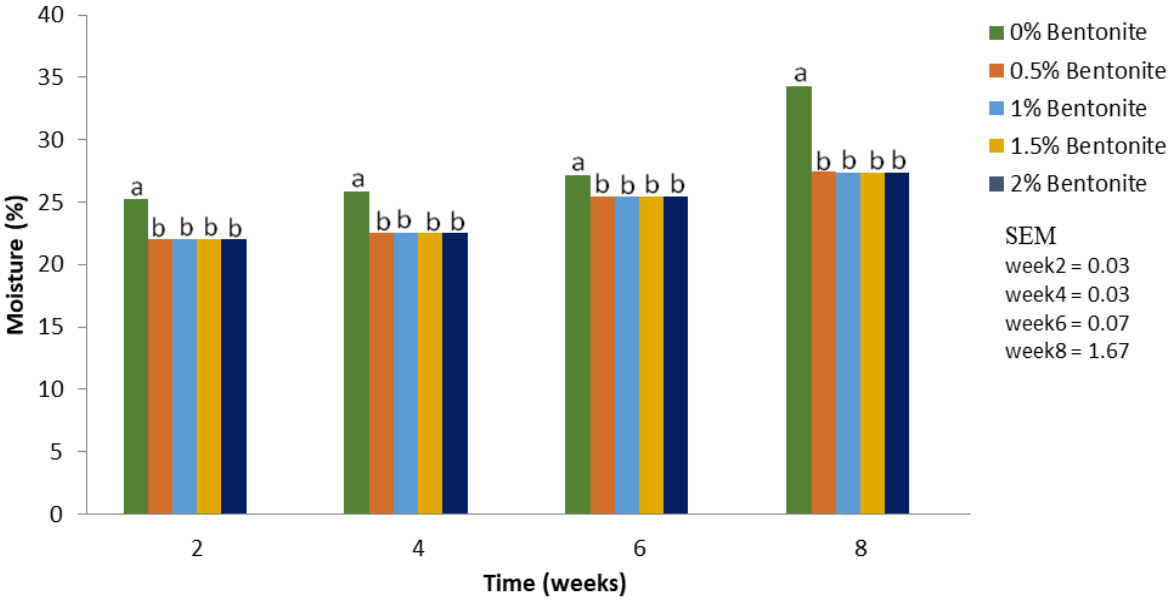

Figure 1: Litter Moisture of Broiler Chickens Fed Graded Levels of Bentonite

Litter pH of Broiler Chicken Fed Graded Levels of Bentonite

Figure 2 shows the fortnightly litter pH of broiler chickens fed graded levels of bentonite. The result shows no significant (P>0.05) differences among all the treatments groups in litter pH. This result agrees with the findings of Safaeikatouli *et al*. (2011) who reported non-significant deference between broiler fed bentonite and the control during a 42 day trial.

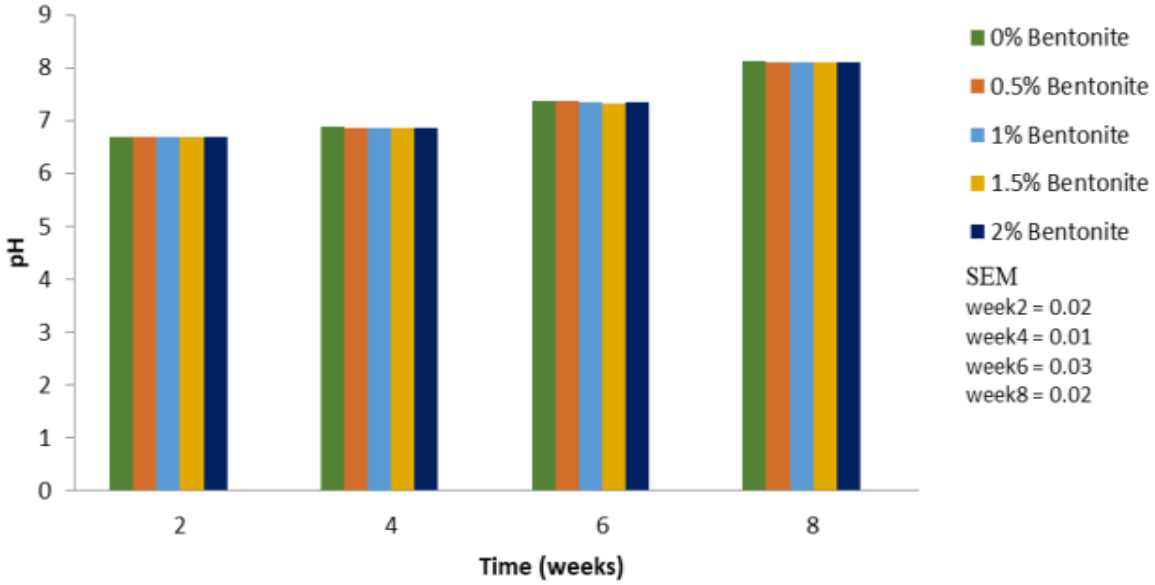

Figure 2: Litter pH of Broiler Chickens Fed Graded Levels of Bentonite

Litter Total Nitrogen of Broiler Chicken Fed Graded Levels of Bentonite

The litter total nitrogen of broiler chickens fed graded levels of bentonite fortnightly is presented in Figure 3. There were significantly (P<0.05) lower litter total nitrogen concentration in treatment groups fed bentonite compared to the control at weeks 4, 6 and 8.

The lower litter total nitrogen recorded in treatment groups with bentonite in diet compared to the control was similar to the results of Karamanlis *et al*. (2008) who reported significantly lower litter nitrogen among broiler chicken fed bentonite compared to the control. Some studies showed that the use of aluminosilicates in broiler diet would reduce ammonia concentration in poultry houses (Li *et al*., 2008).

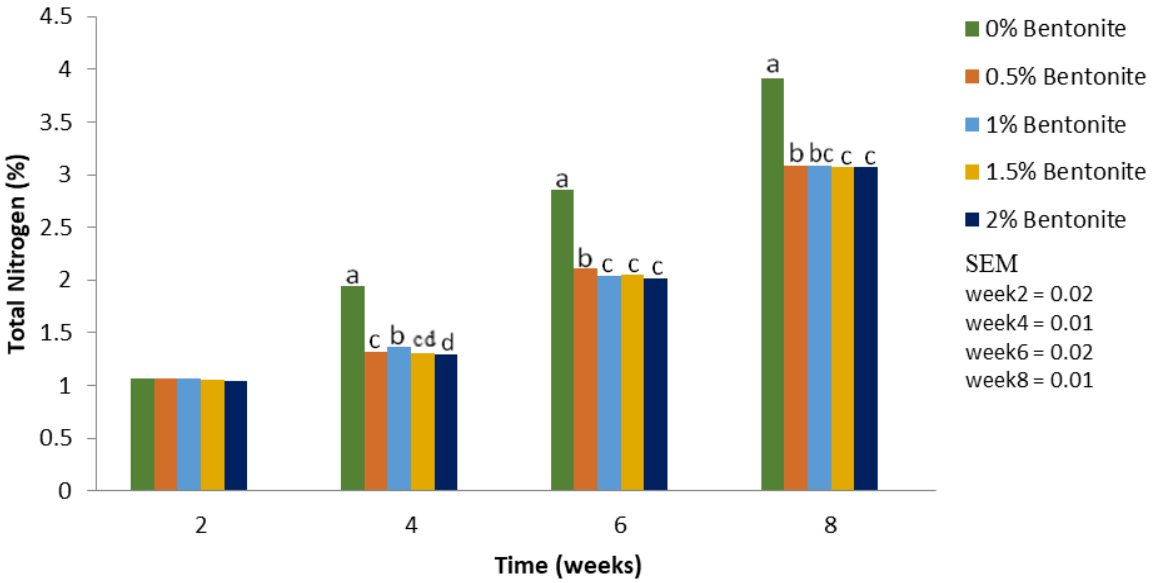

Figure 3: Litter Total Nitrogen of Broiler Chickens Fed Graded Levels of Bentonite

CONCLUSION AND RECOMMENDATIONS

In conclusion, the inclusion of Bentonite in broiler chicken diets improved litter quality and hence general environment of broiler chickens. 0.5% bentonite inclusion in the diet should be used to improve litter quality of broiler chickens.

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