EFFECTS OF CALCIUM BENTONITE CLAY ON GROWTH PERFORMANCE OF PULLET CHICKENS

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ABSTRACT
The 8-week study was aimed to evaluate the effects of calcium bentonite clay on the growth performance of pullets. A total a total of 150-day old, pullet chicks were randomly allocated to five dietary treatments designated T1 (0% bentonite clay), T2 (1% bentonite clay), T3 (2% bentonite clay), T4 (3% bentonite clay) and T5 (4% bentonite clay). Each treatment was replicated 3 times with 10 birds per replicate, making a total of 30 birds per treatment in a completely randomized design. The result showed that significant (P<0.05) difference existed for feed intake across the treatment means, which was significantly higher (P<0.05) in T1 (27.42g) and T2 (27.00g), while T3 (25.80g) and T4 (25.25g) had the least feed intake. The birds fed T3 and T4 recorded the highest final body weight, average weight gain and average daily weight gain when compared with other treatments. The feed conversion ratio (FCR) of the broiler starter chickens fed T3 and T4 were significantly superior (P<0.05) to others. Bentonite clay inclusion levels of 3% and 4% of the diets of pullet chicks significantly (p<0.05) improved the weight gain of the birds.
Keywords: Calcium bentonite clay, pullets, growth performance, diets

INTRODUCTION

The poultry industry in Nigeria is gaining rapid recognition and attention due to the high demand of animal protein. Bentonite is an aluminum phyllosilicate generated frequently from the alteration of volcanic ash, consisting predominantly of smectite minerals, mostly montmorillonite (80-90 % by weight). Due to its special properties, bentonite is a versatile material for geotechnical engineering and as well as their demand for different industrial applications (James *et al.*, 2008; Ahmed *et al.*, 2014). Mineralogical and chemical composition affects the properties of bentonite. Ali *et al.*2020). On the other hand, the measured physical characteristics are frequently used to interprete the mineralogical composition of bentonite. Two types of bentonite exist: swelling bentonite which is also called sodium bentonite and non-swelling bentonite or calcium bentonite. Majority of bentonites occurring worldwide are of the calcium type (; Ahmed *et al., 2012*; Tijen, 2010; Trauger, 1994). Investigations by the Nigerian Mining Corporation established the existence of bentonite clay reserves of over 700 million tonnes in different parts of the country. Bentonite as a clay has strong colloidal properties and the ability to rapidly absorb many times its volume of water. Clays are often incorporated in animal diets as a stabilizer, lubricant or agglomerant to enhance feed manufacture (Liu *et al*., 2010; Theng, 2012). Nutrient digestibility and enzymatic activity of gastrointestinal secretions has been improved by addition of clay to broilers and pig feedstuffs (Tijen, 2010). There were several reports on the negative effects of antibiotics on consumers' health especially the astmatics. Hence, the ban on their use as feed additives in animal feeds. The aim of the study was to evaluate the effects of calcium bentonite clay on the growth performance of pullet chickens.

MATERIALS AND METHOD

Location of the study and experimental design

The research work which was a completely randomized design experiment was conducted at the poultry unit of the Teaching and Research farm of the College of Animal Science and Animal Production of Michael Okpara University of Agriculture, Umudike. 150-day old, pullet chicks were brooded for 7 days and then randomly allocated to five dietary treatments designated T1 (0% bentonite clay), T2 (1% bentonite clay), T3 (2% bentonite clay), T4 (3% bentonite clay) and T5 (4% bentonite clay). Each treatment was replicated 3 times with 10 birds per replicate. The gross composition of the chick mash is shown in Table 2. Feed and water were provided *ad-libitum* for the chicks. The experimental diets were isocaloric and isonitrogenous and were formulated according to the recommendation of Fetuga, (1997) for nutrient requirement of pullet chicks.

Statistical model

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where,

Y_{ij} = Single observation
μ = Overall mean
T_i = Treatment effect (i=1..5)

e_{ij} = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance.

Table 1. Gross composition of experimental diets containing calcium bentonite clay

Ingredients	T1	T2	T3	T4	T5
Maize	50.00	50.00	50.00	50.00	50.00
Soybean meal	30.00	30.00	30.00	30.00	30.00
Wheat offal	10.50	10.50	10.50	10.50	10.50
Bone meal	2.00	1.50	1.00	0.50	0.25
Oyster	2.00	1.50	1.00	0.50	0.25
Lysine	0.40	0.40	0.40	0.40	0.40
Sodium bentonite clay	0.00	1.00	2.00	3.00	4.00
Methionine	0.40	0.40	0.40	0.40	0.40
Vit./Min/premix	0.40	0.40	0.40	0.40	0.40
Salt (Nacl)	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100
Crude protein	22.77	21.45	22.33	22.01	21.66
M.E (Kcal/kg)	3226	3226	3226	3226	3226

Vit/min premix supplying the following per kg diet; vit A(1,500 i.u; vit D(1,600 i.u); riboflavin(9.0mg); vit B_6(0.3mg); vit B12(8.0mg); nicotinic acid (8.0mg); iron (5.0mg); selenium(0.01mg); magnesium (10.0mg); zinc (4.5mg); cobalt (0.02mg_

Data Collection and analysis

Data were collected on the following parameters during the study.

a. Growth performance parameters

The initial live weight of the pullet chicks at day old was recorded. The birds were weighed weekly to determine the live weight and weight gain. The quantity of feed offered to the birds daily and the left over the next morning were measured to ascertain feed intake. The data obtained was used to obtain the following parameters.

$$\text{Average Daily Feed Intake (g/bird/day)} = \frac{\text{quantity of feed given minus quantity left over}}{\text{Number of birds x number of days}}$$

$$\text{Average Daily Weight Gain (g/bird/day)} = \frac{\text{Final live weight –initial live weight}}{\text{Number of birds x number of days}}$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Average daily feed intake per bird}}{\text{Average daily weight gain per bird}}$$

$$\text{Mortality rate (\%)} = \frac{\text{Number of dead birds}}{\text{Initial stock x Number of weeks}} \times \frac{100}{1}$$

Statistical analysis

All data generated were subjected to analysis of variance (ANOVA) and treatment means that were significantly different were separated using Duncan's Multiple Range Test (Duncan, 1955) using computer software IBM SPSS Statistic version 25 (SPSS, 2017).

RESULTS AND DISCUSSION

Growth performance of pullets fed diets containing bentonite clay

The growth performance of pullets chickens fed **diets containing bentonite clay is** presented in Table 3. There were significant ($P<0.05$) difference existed for feed intake and weight gain across the treatment means. Feed intake and weight gain improved with increase in quantity of calcium bentonite clay added to the diet. Pullet chicks fed the control diet (0% calcium bentonite clay) were observed to have the highest ($p<0.05$) feed intake (1536.66g/b). There was significant reduction in feed intake as the level of inclusion of calcium bentonite clay increased in the chick mash. This trend suggests that calcium bentonite clay may have reduced the palatability of the experimental diets. T5 (4% calcium bentonite clay) recorded the least feed intake (1414.01g/b). However, weight gain by pullet chicks fed diets containing calcium bentonite clay were indirectly proportional to level of inclusion of the additive. Calcium bentonite clay was observed to enhance weight gain in pullet chicks.

Pullets fed diets with no calcium bentonite clay (control) had the least (P<0.05) weight gain (328.67g/b) while the highest weight gain (1229.99g/b) were observed in pullet chickens fed diet containing 4%calcium bentonite clay. Feed conversion ratio (FCR) is a performance index which directly indicates how best feed consumed by birds are utilized for meat production. The FCR of the broiler starter chickens fed T_4 and T_5 were significantly superior (P<0.05) when compared with other groups. This could be as a result of superior growth performance of those treatment groups, showing better efficiency of the chicks to convert feed to meat thus, resulting in the most efficient value of the feed. This result is in line with the report of Asad *et al.* (2013) and El-Gogary *et a*l. (2017). The poor FCR observed in birds fed T1 suggests suppressed growth in those birds.

Feed conversion rate was lower birds supplemented with 1% sodium bentonite clay (1.66) than control group (2.12). The results of weight gain and feed consumption are in agreement with the findings of Degu *et* al., (2021). Aduku and Nuhu (1996), Trauger, 1994 reported that Sodium Bentonite supplementation at 1% level significantly improved (p<0.05) weight gain in the broiler chicks. The same level also improved (p<0.05) feed consumption and efficiency. Although there was an improvement (p<0.05) in weight gain at 2 and 3% levels, but with an increase in the level of inclusion of calcium bentonite clay, there was proportional depression in weight gain. The enhanced weight gain by addition of calcium bentonite may be attributed to decreased flow rate of digesta and ultimately greater absorption.

Table 2. Growth Performance of Pullets Fed Diets containing calcium bentonite clay

Parameters	T_1 (0)%	T_2 (1%)	T3 2%)	T4 (3%)	T5 (4)%	SEM
Initial body weight (g/b)	38.35	39.01	39.33	39.22	39.11	0.05
Average feed intake (g/b)	1536.66^{a}	1520.67^{a}	1477.77^{b}	1445.87^{bc}	1414.01^{c}	15;07
ADFI (g/b/d)	27.42^{a}	27.00^{a}	26.37^{b}	25.80^{c}	25.25^{c}	0.33
Final body weight (g/b)	966.67^{c}	1101.66^{b}	1110.33^{b}	1245.67^{a}	1268.44^{a}	16.45
Average weight gain (g/b)	928.67^{c}	1062.00^{b}	1070.67^{b}	1205.78^{a}	1229.99^{a}	10.21
ADWG (g/b/d)	16.57^{c}	18.16^{b}	17.71^{b}	21.52^{a}	21.95^{a}	1.48
FCR	1.69^{a}	1.50^{b}	1.53^{b}	1.19^{c}	1.19^{c}	0.00

$^{a-b-c}$Means with different superscripts in the same row are significantly different (p<0.05), S.E.M: Standard Error of mean. Weight, AWG=Average Weight Gain, ADWG=Average Daily Weight Gain, FCR=Feed Conversion Ratio.

CONCLUSION

Calcium bentonite clay was included into pullet chicken mash at 0%, 1%, 2%, 3% and 4% inclusion levels. Feed intake by the pullets was reduced indicating probable reduction in the palatability of the diets. Calcium bentonite significantly (p<0.05) improved the weight gain of the pullets used for the study. Birds on supplemented diets especially 4% supplementation had the least intake of feed but give the highest body weight and best FCR. It could be concluded that calcium bentonite clay could enhance feed utilization by pullets.

RECOMMENDATION

The use of calcium bentonite in the pullet chicken diet at up to 4% is recommended to improve feed utilization by the chicks.

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