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Blood Chemistry and Haematological Indices of Broiler Chickens Administered Varying Levels of Kaolin (Clay) Diets.

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ABSTRACT

A total of 120 Hubbard strain broilers having mean weights of 60g were used in a study that lasted for 56 days. The birds were divided into four groups of 30 birds each. Each treatment group was further subdivided into three replicates of 10 birds each in a completely randomized design (CRD). The four bird groups were assigned to; 1) basal diet only (control), 2) basal diet + 10 g kaolin per kg body weight, 3) basal diet + 20 g kg-1, and basal diet + 30 g kg-1. At the end of the study, three birds per treatment were randomly selected and bled by severing the jugular vein; blood samples were collected for haematological and biochemical evaluation. The results obtained showed that significant ($p<0.05$) differences existed in all the measured hematological and blood chemistry indices vis-à-vis RBC, Hb, WBC, PCV, Ca and P with the treated groups having a better result when compared to the control. It is therefore concluded that dietary kaolin could be added to broiler chickens' diet without any detrimental effect to the physiological indices evaluated.

INTRODUCTION

Feed represents 70-85% of the total cost of production of meat and table eggs and as such is the most expensive input in animal production. The limited supply of raw materials for the feed industry has resulted in a continuous increase in the cost of production. It has thus become necessary to explore other feed ingredients and additives that are locally available and relatively cheap. Kaolin is a plastic material largely containing the clay mineral classified as phyllosilicate. Due to its adsorption qualities and the absence of primary toxicity (Anonymous, 1998), the use of kaolin is considered to be a simple and effective prevention of the effects exerted by a number of toxic materials. Kaolin based medicaments are commonly used for the treatment of digestive disorders in humans (Heimann, 1984; Kasi *et al*; 1995; Knezevich, 1998; Gebesh *et al*; 1999). When Kaolin is added to animal diets, it reduces resorption of harmful toxins present in the feed because it binds them firmly and selectively. A number of studies on kaolin to decontaminate entero-toxins which cause diarrhea (Doming, Daroust and Minekus, 2004), aflatoxins (Schell *et al.,* Abdel-Wahhab *et al.1999;* Phillips 1999), plant metabolites (alkaloids, tannins), pathogenic microorganisms, metals (Hassen *et al*. 2003; Katsumata *et al*., 2003), and poisons (Knezevich and Tadic, 1994) are documented. Kaolin added to farm animal diets was found to influence the efficiency and quality of meat (Savory,1984; Sakata, 1986; Kolacz *et al*.,2005). However, information on the effects of this feed additive on the blood chemistry and haematological profiles of animals is scarce. It has been noted that significant changes in the blood and serum parameters can be used to assess both the pathological and nutritional status of individual animals (Owen *et al.* 2008; Owen *et al.* 2009; Owen and Amakiri, 2011). It has also been established that certain haemotological factors can be associated with certain production traits. For example, it has been established that high packed cell volume (PCV) and high haemoglobin content (Hb) are associated with high feed conversion efficiency (Mitruka and Rawnsely,1997) while high percentage of white blood cells, especially lymphocytes, are associated with the ability of the chicken to perform well under stressful conditions. Consequently, the effects of any feed ingredient or additive on the blood profile and serum biochemistry of the chicken are of immense assistance in deciding whether or not such an additive should be used in poultry feed. It is envisaged that the outcome of this study will be used to make decision as to whether or not kaolin can be used in poultry feed with high margin of safety.

MATERIALS AND METHODS

The research was conducted at the poultry section of the Rivers State University of Science and Technology; Teaching and Research Farm in Port Harcourt, Southern Nigeria. A total of 120 Hubbard strain boilers having mean weight of 60g were used in a study that lasted for 56 days. The birds were housed in a deep litter with wood shavings as bedding material. Before the arrival of the birds, the pens were cleaned, washed, and disinfected. The birds were divided into four groups of 30 birds each. Each treatment group was further subdivided into three replicates of 10 birds each in a completely randomized design (CRD). The four bird groups were assigned to 1) basal diet only (control), 2) basal diet + 10g kaolin per kg bodyweight, 3) basal diet + 20 g kg^{-1}, and 4) basal diet + 30 g kg^{-1}. The proprietary feed used in this study at both the starter and finisher phases were of Top feed with protein contents of 22% for starter and 18% for finisher. They contained 2800 ME $kcal^{-1}$ kg^{-1} and 2900ME/kcal/kg respectively.

Feed and water were offered *ad libitum*. Routine management practice and vaccinations were maintained while the study lasted. At the end of the study, 3 birds per treatment were randomly selected and bled by severing the jugular vein. The first set of blood samples were collected into bottles containing EDTA for haematological evaluation, while another set of blood samples were collected without anticoagulant, for blood chemistry evaluation. Haematological parameters and blood chemistry were determined as described by Dacie and Lewis (1991)

The blood parameters determined includes haemoglobin (Hb), red blood cell (RBC), packed cell volume (PCV), white blood cell (WBC), and WBC differentials. From these parameters, the mean corpuscular volume (MCV), mean corpuscular Haemoglobin (MCH) and mean corpuscular Haemoglobin concentration (MCHC) were calculated from the method of Schalm, Jain and Carrol (1975). All the data obtained were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980) and means were partitioned where necessary using Duncans New Multiple Range Test (DNMRT) as outlined by Obi (1990).

RESULTS AND DISCUSSION

The effect of feeding Kaolin on the various haematological parameters is presented in **Table 1**.

Table 1: Haematological responses of broiler chickens to graded levels of kaolin

Parameters	Treatments				
	1 0 g kg^{-1}	2 10 g kg^{-1}	3 20 g kg^{-1}	4 30 g kg^{-1}	Mean ±SEM
Hb (g L^{-1})	7.50^{c}	8.40^{b}	9.40^{a}	8.40^{b}	0.30
RBC ($X10^{12}$ L^{-1})	2.60^{b}	2.65^{b}	2.78^{a}	2.67^{b}	0.15
PCV (%)	22.00^{c}	25.00^{b}	28.00^{a}	25.00^{b}	1.00
WBC ($X10^{9}$ L^{-1})	5.60^{a}	4.80^{b}	4.90^{b}	5.00^{a}	0.08
MCV (fL)	84.46	94.34	100.72	93.36	
MCH (pg)	28.84	31.17	33.81	31.46	
MCHC (%)	34.10	33.60	33.57	33.60	
Neutrophil (%)	46.00^{b}	50.00^{a}	44.00^{b}	50.00^{a}	0.10
lymphocyte (%)	52.00^{a}	44.00^{b}	56.00^{a}	47.00^{b}	0.18
Eosin (%)	2.00	2.00	0.00	0.10	0.20
Basophil (%)	0.00	0.20	0.00	0.20	0.36
Monocyte (%)	0.00	0.00	0.00	0.00	0.00

^{abc}Means within rows with different superscript differs significantly (<0105).

Data obtained shows that significant ($p<0.05$) differences existed in all the measured haematological indices vis-à-vis RBC, Hb, WBC and PCV. The results on WBC showed that the 0 g kg^{-1} (control) and the 30 g kg^{-1} groups had comparable values of 5.60x 10^{9} L^{-1} and 5.00x 10^{9} L^{-1} respectively which was observed to be higher than 10 g kg^{-1} and 20 g kg^{-1} groups.

Results on RBC did not follow any definite trend and it showed that the highest value was recorded in the group receiving 20 g kg^{-1} ($2.8x10^{12}$ L^{-1}). Although the groups receiving 0 g kg^{-1}, 10 g kg^{-1}, and 30 g kg^{-1} recorded comparable values, those on 0 g kg^{-1} had the lowest numerical RBC values.

The results on haemoglobin and PCV showed similar trends. Those on 20 g kg had the highest values while the control group (0 g kg^{-1}) and the group on 10 g kg^{-1} had the lowest values. The values for Hb ranged from 7.5 g L^{-1} to 9.4 g L^{-1} while 22% - 28% values were recorded for PCV.

Table 2 shows the effect of dietary kaolin on serum calcium(Ca) and phosphorus (P). Data obtained in the blood chemistry evaluated showed significant ($p<0.05$) differences in the levels of Ca and P. The serum levels of Ca and P increased with concomitant increase in dietary kaolin.

Table 2: Serum biochemistry of broiler birds administered different levels of dietary kaolin.

Parameters	Treatments				
	1	2	3	4	Mean ±SEM
	0g/kg	10g/kg	20g/kg	30g/kg	
Ca (mg L^{-1})	56^{c}	82^{b}	94^{a}	100^{a}	0.15
P (mg L^{-1})	32.5^{c}	50.0^{b}	52.5^{a}	56.0^{a}	0.10

^{abc}Means within rows with different superscript are significantly different (P <0.05)

The values for Ca were 56mg/L^{-1}, 82mg/L^{-1}, 94mg/L^{-1} and 100mg/L^{-1} for 0g/kg, 10g/kg, 20g/kg and 30g/kg levels of inclusion respectively. Similar trend was observed in the phosphorus (P) levels where highest value of 56mg/L^{-1} was recorded in the 30g/leg level of kaolin inclusion with the least value (32.5mg/L^{-1}) observed in the control group.

On haematology, the results obtained in all the parameters did not show any definite trend. The Hb and PCV value in the 20g/kg consistently had the highest value. The function of Hb is in the transportation of 0_2 and $C0_2$. A decrease therefore in the level of Hb in the blood is indicative of poor nutrition including dietary deficiency of Cu, Fe, amino acids and vitamins (Frandson,1981). Also Maxwell *et al*., (1990) showed that haemoglobin level tends to decrease with low protein intake, parasitic infection and liver damage.

Leucocytes (WBC) differ from other blood cells in that they perform important functions outside the vascular compactment. Their primary function appears to be to defend the body against foreign bodies, achieved by phagocytosis and antibody production (Robbins and Angel, 1976). Considering the fact that the animals depend on leucocytes for protection against foreign bodies, like virus, bacteria and foreign tissues, attempt to characterize these blood cells become

necessary. Haematological values were within the ranges reported in literature (Nwonu *et al*. 1996). This result is also consistent with the report of Coates *et al*., (1963) that feed additive supplementation could improve the response of birds to several stressors and disease condition. Although most of the data obtained on haematology in this study were significantly different ($p<0.05$), the values were still within the normal ranges (Cambell, 1975). This finding is further supported by the work Mmerole (2008). This implies that any of the test diets could be selected as far as haematological parameters are concerned

Calcium (Ca) is required by the chicken in greater amount than any of the other minerals (Tion and Njoku, 2009). Cromwell (1982) suggested that approximately 99% of Ca is located in the skeleton where it complexes with phosphates to give rigidity to bones. The remaining <1% is widely distributed throughout the organs and tissues with relatively large amounts found in blood. Simkis (1967) reported that the blood cells are almost devoid of Ca but the serum and plasma contain 9-12 mg/dl in most species when not in reproductive activity. The findings of the present report agrees with the assertion.

There were significant difference between the Ca levels of the treated groups and the control. It was observed that as the level of dietary Kaolin inclusion in the diet increases, the Ca level also increased with a concomitant increase in P level. The serum Ca and P levels are vital to the life of the animal and the effect of their deficiency or imbalance may first be shown as skeletal aberrations

CONCLUSION

There is indication from this study that Kaolin as feed additive in broiler production did not distort any of the haematological parameters measured rather it improved the serum Ca and P of the birds. It is therefore concluded that dietary kaolin could be added to broiler chickens' diet without any detrimental effect to the physiological indices evaluated.

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