Investigation was carried out to elucidate the effects of dietary kaolin (clay) as feed additive on the growth parameters of broiler chickens. One hundred and twenty (120) day-old Hubbard broiler chickens with mean initial weight of 60g were used in a completely Randomized design (CRD) for 56 days. The birds were randomly assigned to 4 treatments consisting of 30 birds/treatment and 10 birds/replicate. The 4 Treatments were: basal diet only (control), basal diet + 10g kaolin/kg, basal diet + 20g kaolin/kg and basal diet + 30g/kg kaolin. Results obtained revealed that incorporating kaolin into broiler diets significantly (p<0.05) improved feed intake and feed efficiency. It was concluded that dietary kaolin in the diet of broiler birds had beneficial effects on the growth performance.
INTRODUCTION

Presently, general knowledge exists that feed constitutes the highest and most expensive input in any livestock farm, especially poultry (Owen, et al. 2010). Any major reduction or decrease in the cost of feed will extensively reduce the overall cost of production and increase the profit margin of the farm. In view of the high cost of the conventional protein ingredients like soya bean, groundnut cake meal and maize, the plunge of dietary research now tends towards feed manipulation (Owen, et al. 2009).

Kaolin (Chinese Kaoling ‘high ridge’) or china clay is one of such non-conventional feed additives. It is a fine, usually white clay formed by the weathering of aluminous minerals such as feldspar, a plastic clay mineral kaolinite. In systematic mineralogy it is classified as phyllosilicate clay. Due to its adsorption qualities and absence of primary toxicity (Anonymous 1998), the use of kaolin is considered to be a simple and effective preventive measure against effects exerted by a number of toxic substances in the living organism as well as the environment (Heimann, 1984; Kasi, et al. 1995; Knezevich, 1998; Gebesh et al., 1999). Dietary Kaolin (clay) is therefore a feed additive in animal production involving qualitative and/or quantitative manipulation of animal nutrition to affect growth performance without seriously upsetting nutritional requirements of values (Savory, 1984). This study was therefore designed to investigate the effect of different levels of Kaolin on the growth performance parameters of broiler chickens.

MATERIALS AND METHODS

The experiment was carried out in the poultry section of the Rivers State University of Science and Technology Teaching and Research Farm; Nkpolu – Oworukwo, Port Harcourt, South–South of Nigeria. Dietary Kaolin was added to commercial broiler starter and finisher diets at 0g Kaolin/kg for Treatment 1, which also served as the control. Treatments 2, 3 and 4 had 10g Kaolin/kg, 20g Kaolin/kg and 30g kaolin/kg respectively as diet inclusions. 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/kg and 2900ME/Kcal/kg respectively.

A total of one hundred and twenty (120) Hubbard strain broilers of mixed sexes with an initial mean body weight of 60g were used in the experiment 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 4 groups of 30 birds each. Each treatment group was further subdivided into 3 replicates of 10 birds in a completely randomized design (CRD). Feed and water were offered ad-libitum. Feed intake was measured on daily basis while body weight was observed weekly. At the expiration of the experiment, all the birds were weighed and 3 birds were selected from each treatment for histological assay.

All the data collected were subjected to Analysis of Variance (Steel and Torrie, 1980) and the differences in treatments, where it existed was separated using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (1990).

RESULTS

The performance of the birds fed the different levels of experimental diets is shown in Table 1.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatments</th>
<th>0g</th>
<th>10g</th>
<th>20g</th>
<th>30g</th>
<th>+ SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean initial weight (g)</td>
<td></td>
<td>60.00</td>
<td>60.00</td>
<td>60.00</td>
<td>60.00</td>
<td>0.04</td>
</tr>
<tr>
<td>Mean final weight (kg)</td>
<td></td>
<td>2.25</td>
<td>2.18</td>
<td>2.10</td>
<td>2.23</td>
<td>0.10</td>
</tr>
<tr>
<td>Mean total weight gain (kg)</td>
<td></td>
<td>2.20</td>
<td>2.12</td>
<td>2.04</td>
<td>2.23</td>
<td>0.08</td>
</tr>
<tr>
<td>Mean daily weight gain (g)</td>
<td></td>
<td>39.30</td>
<td>37.85</td>
<td>36.43</td>
<td>38.75</td>
<td>0.05</td>
</tr>
<tr>
<td>Mean total feed intake (kg)</td>
<td></td>
<td>5.10a</td>
<td>4.70b</td>
<td>4.90b</td>
<td>4.90b</td>
<td>0.15</td>
</tr>
<tr>
<td>Mean daily feed intake (g)</td>
<td></td>
<td>91.07a</td>
<td>83.93c</td>
<td>87.50b</td>
<td>85.71c</td>
<td>0.08</td>
</tr>
<tr>
<td>Feed conversion ratio (feed/gain)</td>
<td></td>
<td>2.32a</td>
<td>2.23b</td>
<td>2.40b</td>
<td>2.21a</td>
<td>0.18</td>
</tr>
</tbody>
</table>

abc means with + within the same rows with different superscript are significantly different (p<0.05)

The data for daily feed intake indicated that the birds in treatment I (control), showed significant difference (p<0.05) among the experimental diets. The mean daily feed consumption was highest in treatment 1 (91.07g), and ranged between 83.93g - 87.50g in the treated group of birds. Significant differences (p<0.05) also existed in the total feed intake. Treatment I (control) recorded the highest total feed intake of 5.10kg. The
data showed that birds on 10g, 20g and 30g dietary levels of kaolin had 4.70kg, 4.90kg and 4.80kg of total feed intake respectively. Although there was no significant (p> 0.05) differences in the mean weight gain, the birds on 0g recorded the highest numerical body weight gain than the other groups.

There was significant difference (p<0.5) in feed conversion ratio among the birds in the different dietary treatments. Birds fed 10g kaolin and 30g kaolin recorded the best feed: gain ratio of 2.23 and 2.21 respectively, which was significantly better than the control (0g) and those fed 20g kaolin (p<0.05).

The results on organ weight measurements i.e. kidney, liver, Gizzard, heart, spleen and gall bladder of slaughtered broiler birds fed different levels of kaolin are shown in Table 2.

### Table 2: The effects of graded levels of kaolin on organ weights of broiler chickens

<table>
<thead>
<tr>
<th>Organs</th>
<th>Treatments</th>
<th></th>
<th></th>
<th></th>
<th>± SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>4g</td>
<td>10g</td>
<td>20g</td>
<td>30g</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>67.55a</td>
<td>60.15b</td>
<td>58.00c</td>
<td>63.90b</td>
<td>0.15</td>
</tr>
<tr>
<td>Gizzard</td>
<td>70.05a</td>
<td>57.75c</td>
<td>63.70b</td>
<td>56.65c</td>
<td>0.18</td>
</tr>
<tr>
<td>Heart</td>
<td>9.60</td>
<td>8.00</td>
<td>8.55</td>
<td>9.50</td>
<td>0.22</td>
</tr>
<tr>
<td>Spleen</td>
<td>0.40</td>
<td>0.35</td>
<td>0.30</td>
<td>0.35</td>
<td>0.03</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>1.95</td>
<td>2.00</td>
<td>1.95</td>
<td>1.85</td>
<td>0.15</td>
</tr>
</tbody>
</table>

abc means with ± SEM within the same rows with different superscript are significantly different (p<0.05).

The results indicated, there were significant differences (p<0.05) among the birds in the liver and gizzard. The 0g (control) group recorded the highest values in these parameters. However, the result also indicated that significant (p>0.05) differences did not exist in the remaining organs examined vis-à-vis kidney, heart, spleen and gall bladder among the groups.

**DISCUSSION**

Traditionally, clays have been incorporated into animal diets (10-20g/kg) as a technological additive (a lubricant/agglomerate) to improve feed manufacture (Angulo et al., 1995). It has been reported that dietary supplementation with clay improves the nutrient digestibility and enzymatic activity of gastrointestinal secretion (Ouhida et al.; 2000; Alzueta et al; 2002).

Growth performance potential represents an important index in animal studies. Addition of kaolin to poultry diets up to 30g had no significant detrimental effect on growth. The findings of this research showed that similar weight gains were observed in the treated groups when compared to the control. Results of previous experiments on the effects of clays on animal performance were generally inconsistent (Poulsen and Oksbjerg, 1995; Ouhida et al, 2000). The feeding value of clays is known to be affected by the kind of clays, producing area, grade and their physio-chemical and structural characteristics. This present study agrees with the findings of Taqir and Nawaz (2001) and Xia et al; (2004); that rations supplemented with 10-30g/kg of clay promote feed efficiency in chickens.

It was also observed that birds fed with 10 - 30g/kg kaolin consumed less feed when compared to the control group. This was reflected in the feed efficiency ratio although similar weight gain was reported in the treated groups and the control group.

It has been reported that animal feed containing clay minerals such as kaolin promote weight gain and feed efficiency (Mumpton, 1999), reduce bacterial contamination of the guts and reduce the detrimental effects of mycotoxin contaminated diets (Taugir and Nawaz, 2001). Kaolin also protects the intestinal mucosa, by adhering to pathogen and selectively promotes their excretion (Droy-lefain et al., 1985). This may have been responsible for the observed significantly low feed intake and improved feed conversion ratio in the treated groups, due to expulsion from the gut of the pathogens that should have competed with the birds for nutrients.

**CONCLUSION**

The compelling need to harness the potentials of feed additives in feed formulation, have been seriously expressed. The need arose mainly from the increasing cost of feed, especially poultry feed. The net effect of increased unit cost of feed is an increase in the cost of meat and animal products. There is indication from this study, that kaolin as feed additive in broiler production improved feed efficiency at all levels of inclusion, when compared to the control. It is therefore concluded that dietary kaolin had beneficial effects on the growth performance of broiler chickens.

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